An Experimental Investigation of Effect of Variation of Curing Time on Compressive Strength of Concrete

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Abstract - Today in this fast growing world where time is the most important thing, builders and constructors cannot invest their precious 28 days in curing of each and every element of the structure. Curing for 28 days become a problem in high rise structure. It resists speedy construction. Lack of scaffolding can also create a problem. This work is concerned with finding of an experimental research of variation of curing time on concrete compressive strength. For this cubes for mix design M-25 were cast using PPC, OPC 53 grade cement and were cured for 7, 14, 21 and 28 days and were be tested for characteristic compressive strength. The concrete cubes gain about 85%, 94%, 108%, and 124% of target characteristic compressive strength for PPC if cured for first 7, 14, 21 and 28 days respectively.

Keywords – Compressive strength, Curing, OPC 53 grade, PPC, variation.

I. INTRODUCTION

Concrete is an artificial construction structural material made from the mixture of aggregates (course and fine), water, Portland cement and small amount of air bubbles, incorporated and stabilized into cement mix. Concrete is formed when Portland cement is hydrated and forms cement paste, which when mixed with aggregates hardens and binds into solid mass. Concrete is currently the most widely used construction material as it can be cast to any form and shape at site very easily.

Curing can be achieved by keeping the concrete element completely saturated or as much saturated as possible until the water-filled spaces are substantially reduced by hydration products. If the concrete is not cured and is allowed to dry in air, it will gain only 50% of the strength of continuously cured concrete. Improper curing would entail insufficient moisture and this has been found to produce cracks, compromise strength, and reduce long-term durability. The scope of discussion in this study is to investigate the effect of variation of curing time on characteristic compressive strength of concrete.

In the present study, concrete with Pollozona Portland cement (PPC) and Ordinary Portland Cement (OPC) 53 grade, is adopted.

Concrete grade of M-25 design mix with a slump in between 75 to 100 mm were considered in the study. We cure the concrete cubes for 7, 14, 21, 28 days and test for characteristic compressive strength.

II. NECESSITY OF PROJECT

It is well known fact that as curing time increases strength of concrete increases however in practice this curing time varies due to multiple reasons, shortage of water, inadequate knowledge, other construction constraints, etc. Hence, optimum curing period for type of cement grade is not available in practice.

Now, considering these several reasons, variation in curing time on compressive strength of concrete needs to be investigated as time and condition may not allow 28 days of curing. In this we study the effect of curing time on design mix of M-25 with different types of cement available in market to obtain best possible result.

III. LITERATURE REVIEW

Malhotra V.M. (1988) said that cement generally represent 12-14% of concrete weight. It plays an active part in the mixture by ensuring cohesion between aggregate grains and it introduces a decisive contribution to concrete mechanical strengths. During the hardening process, it generates shrinkage and heat dissipation phenomena which lead to material cracking. Ramezanianpour et.al (1995) concluded that if a concrete is not well cured, particularly at the early age, it will not gain the required properties at desired level due to a lower degree of hydration, and would suffer from irreparable loss. Mamlouk et.al (2006) said if concrete is cured for only three days, it will reach about 60% of the strength of continuously cured concrete; if it is cured for seven days, it will reach 80% of the strength of continuously cured concrete. If curing stops for some time and then resumes again, the strength gain will also stop and reactivate. Baris Ozer et.al (2004) said that the curing conditions affect the strengths of both the OPC concrete and pozzolanic cement concretes.
However, poor curing affects the strength properties of pozzolanic cement concretes more adversely than those of the OPC. For pozzolanic cement concretes, at least an initial 7-day water curing is necessary to expose the pozzolanic activity. Pozzolanic cement concretes, water-cured for at least 14 days, can reach the strength level of the OPC concrete cured continuously in water in periods shorter than 2 months. Usman et.al (2006) concluded curing plays an important role in the strength of concrete.

IV. MATERIALS AND METHODOLOGY

A. Materials

The detail of various materials used in the experimental investigation will be:

- **Coarse Aggregate**: Crushed granite stone aggregate of maximum size 20 mm confirming to IS 383-1970 was used. The specific gravity was found to be 2.925.

- **Sand (Fine Aggregate)**: The fine aggregate used was sand passing through 4.75 mm sieve. The specific gravity was found to be 2.83. The grading zone of fine aggregate was zone I as per IS specification.

- **Cement**: OPC 53 grade and PPC (Ultratech Cement) was used.

- **Water**: Ordinary clean potable water free from suspended particles and chemicals was used for mixing and curing of concrete.

B. Methodology

**Experimental Procedure**: To investigate the effect of variation of curing time on compressive strength of concrete, half of the concrete cubes were cast and cured with normally and were tested for the age of curing and half of the concrete cubes were cured for 7, 14, 21 and 28 days and were tested for characteristic strength. The concrete cube size measuring 150×150×150 mm in dimension will be used. The batching of the concrete was carried out by weight for strength of 25 N/mm². The mould were filled in three layers tamping each layer 25 times.

**Workability**: Workability of cubes mixed was measured before casting of cubes. The workability maintained was medium i.e. slump was maintained between 75 mm to 100 mm for mass concrete.

**Experimental Procedure**: The compressive strength is taken as maximum compressive load resisted by per unit area.

**Table I**

<table>
<thead>
<tr>
<th>M-25, OPC 53 Cement</th>
<th>Test Results for M-25, OPC 53 Grade Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing Time</td>
<td>Test on Respective Day</td>
</tr>
<tr>
<td>7 Days</td>
<td>24.502</td>
</tr>
<tr>
<td>14 Days</td>
<td>32.734</td>
</tr>
<tr>
<td>21 Days</td>
<td>36.418</td>
</tr>
<tr>
<td>28 Days</td>
<td>37.884</td>
</tr>
</tbody>
</table>

**Table II**

<table>
<thead>
<tr>
<th>M25, PPC Cement</th>
<th>Test Results for M-25, PPC Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing Time</td>
<td>Test on Respective Day</td>
</tr>
<tr>
<td>7 Days</td>
<td>24.303</td>
</tr>
<tr>
<td>14 Days</td>
<td>32.675</td>
</tr>
<tr>
<td>21 Days</td>
<td>36.239</td>
</tr>
<tr>
<td>28 Days</td>
<td>37.8</td>
</tr>
</tbody>
</table>
V. CONCLUSIONS

1) Series of experiments were conducted on M-25 concrete. From the results it can be said that, compressive strength attained by 21 Days curing is more than target strength.

2) Concrete cubes cast with PPC cement gives better results than OPC 53 grade cement.

3) 7 Days, 14 Days, 21 Days and 28 Days curing give 83%, 92%, 102%, 122% of the target characteristic strength which is 31.6 N/mm² for M-25 grade of concrete if OPC 53 grade cement is used.

4) 7 Days, 14 Days, 21 Days and 28 Days curing give 85%, 94%, 103%, 118% of the target characteristic strength which is 31.6 N/mm² for M-25 grade of concrete if PPC cement is used.

From the above finding we can conclude that curing of 21 days gives the desired target strength and can be used in construction industry which will be saving about 7 days of curing.

REFERENCES


