PERFORMANCE OF COMpressive STRENGTH OF LIMESTONE AGGREGATE CONCRETE WITH PLASTIC FIBRE

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ABSTRACT

BACKGROUND

Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water. The concrete has become so popular and indispensable because of its inherent in concrete brought a revolution in applications of concrete. Concrete has unlimited opportunities for innovative applications, design and construction techniques. Its great versatility and relative economy in filling wide range of needs has made it very competitive building material. At present, there is depletion for both fine and coarse aggregates. Too much usage of good qualities of materials for concrete works is scare for future generation. Hence, there is a search for other second-grade and novel material to produce desired strength concrete. In this connection, an attempt has been made, the use of limestone aggregate (Replacing of granite aggregate by limestone aggregate in proportion of 25, 50, 75 and 100%) with incorporation of 1% and 2% plastic fibre for concrete works. Here, an attempt made to use of limestone aggregate in concrete to evaluate the workability, compressive strength.

KEYWORDS

Cement Aggregate, Compression, Split and Flexural Strengths.


BACKGROUND

A high consumption level of basic raw materials by the Construction industry generates serious depletion on mineral resources and the associated environmental damage. Concrete industry is particularly important as it is not only responsible for consuming natural resources and energy, but also for its capacity of absorbing other industries waste and by-products. To reduce these effects, the common practice is to substitute the more expensive components (e.g. cement), thus neglecting affordable components regardless of the environmental impacts involved in their extraction and transformation process. As natural sources of natural fine aggregates are becoming exhausted, it turns out urgent to develop concrete technology capable of incorporating also artificial fine aggregates, industrial by-products or waste to reduce the use of those natural resources.

Binici et al have studied some mechanical properties of concrete containing marble and limestone dusts; mixes were modified to 5%, 10% and 15% marble and limestone dusts instead of fine sand aggregates and their compressive strengths were compared. In the specimens containing marble and granite, there is a much better bonding among the additives, cement and aggregates. Furthermore, it may be said that marble and granite replacement rendered a good condensed matrix. The increased durability of concrete can be attributed to the glass content and chemical composition of the granite. The results of this study showed that the marble and granite waste aggregates can be used to improve the mechanical properties, workability and chemical resistance of the conventional concrete mixtures.

Experimental Program

The cubes were cast in steel moulds of inner dimensions of 150 x 150 x 150 mm. All the materials are weighed as per mix design and kept aside separately. The cement, sand, coarse aggregate fibers and limestone aggregate were mixed thoroughly till to reach uniformity to the concrete mix. For all test specimens, moulds were kept on table vibrator and the concrete was poured into the moulds and the compaction was adopted by mechanical vibrator. The moulds were removed after twenty four hours and the specimens were demoulded and were exposed to water bath for 28 days in curing pond. After curing, the specimens in water for a period of 28 days, the specimens were taken out and allow drying under shade. Three cubes were cast for each mix. For all the specimens, the mix proportion was adopted as 1:1.87:3.27 with water cement ratio of 0.50. This mix proportion was arrived based on IS Code.

Materials Used in the Investigation

Cement

Portland Pozzolana Cement was used and which is manufactured by Ultra Tech Company conforming to IS 8112:1989. The specific gravity of the cement was noticed as 3.10. The initial and final setting times were found as 40 minutes and 380 minutes, respectively.

Fine Aggregate

Locally available river sand passing through 4.75 mm LS. Sieve was used. The specific gravity of the sand was found to be 2.7.

Coarse Aggregate

Crushed cement aggregate available from local sources has been used. To obtain a reasonably good grading, 60% of the aggregate passing through 20 mm LS. Sieve and retained on 12.5 mm I.S. Sieve and 40% of the aggregate passing through 12.5 mm I.S. Sieve and retained on 10 mm I.S. The specific gravity of the combined aggregate is 2.7.
Water
Potable fresh water available from local sources was used for mixing and curing.

Analysis of Test Results
The fresh and harden concrete properties were presented in the table 2 to 5. All the tests were conducted in the laboratory. The mixes were denoted differently in the tables. The detailed nomenclature of the mixes were read as-
NC-0
Where NC refers to granite aggregate concrete, ‘0’ refers to % replacement of natural coarse aggregate by limestone concrete. Replacement of natural coarse aggregate by lime concrete.
LC-25
Where LC refers to limestone concrete and ‘25’ refers to % replacement of granite aggregate by limestone aggregate.
LC-50
Where LC refers to limestone concrete and ‘50’ refers to % replacement of granite aggregate by limestone aggregate.
LC-75
Where LC refers to limestone concrete and ‘75’ refers to % replacement of granite aggregate by limestone aggregate.
LC-100
Where LC refers to limestone concrete and ‘100’ refers to % replacement of granite aggregate by limestone aggregate.

Fresh Concrete Property (Workability)
The workability of mixes have been measured by Vee-Bee time test. The values of Vee-Bee time results are presented in Table 1. From this, it is observed that the Vee-Bee time increase with increase in the % of limestone in the concrete mix. Hankfi Binci et al (2008) has also reported same type of result for marble concrete.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Nomenclature</th>
<th>Vee-Bee Time</th>
<th>Vee-Bee Time With 1% Plastic Fibre</th>
<th>Vee-Bee Time 2% Plastic Fibre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NC</td>
<td>4.5</td>
<td>5.6</td>
<td>8.2</td>
</tr>
<tr>
<td>2.</td>
<td>LC 25</td>
<td>5.3</td>
<td>6.1</td>
<td>9.4</td>
</tr>
<tr>
<td>3.</td>
<td>LC 50</td>
<td>6.2</td>
<td>6.9</td>
<td>10.5</td>
</tr>
<tr>
<td>4.</td>
<td>LC 75</td>
<td>7.6</td>
<td>8.2</td>
<td>11.2</td>
</tr>
<tr>
<td>5.</td>
<td>LC 100</td>
<td>7.7</td>
<td>8.8</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Table 1. Workability by Vee-Bee Time

Influence of Limestone on Compressive Strength
The compressive strengths for all mixes are presented in Table 2 and Figures 1. From this, it can be observed that the 28 days compressive strength decrease with the increase in the percentage of limestone up to 100%. For 25% replacement of limestone aggregate, there is decrease in cube compressive strength by 10.58% over granite aggregate concrete. For 75% replacement level, the compressive strength has decreased by 19.44% when compared with reference concrete. At 100% replacement of limestone, the compressive strength has decreased by 41.42% over granite aggregate concrete.

Plastic Fibre Effect on Compressive Strength
From Table 2 and Figure 1, it is observed that as the % of volume fraction of fibre increases, the compressive strength increases. But, for limestone aggregate, concrete with fibres has shown increase in strength when compared with control specimens. The decrease in strength is about 12 to 40% for the concrete made with natural aggregate for 1% volume fraction of fibre. For 2% volume fraction of fibre, there is a decrease about 12 to 38% when compared with concrete made with natural aggregate (with fibers). The incorporation of fibres increases the bond between the matrix. So, this maybe the reason to enhance the strength in the matrix of concrete.

CONCLUSIONS
The following Concussions were drawn from the Present Experimental Work
- The workability for limestone aggregate increases when compared with granite aggregate concrete.
- The compressive strengths were decreased with increase in the limestone aggregate in the concrete mix.
- The incorporation of plastic fibres enhances the strengths about 10 to 20% when compared with plain concrete (without steel fibres).
- For 25 to 100% replacement of limestone aggregate concrete, there is a decrease in strengths.
- There is an enhancement in the strengths for respective replacement of aggregate with incorporation of steel fibres compared with natural aggregate concrete.
- The usage of limestone up to 75% is beneficial for the concrete works.
- The failure modes are similar for both limestone and granite aggregate concrete.

REFERENCES


