Use of Stone Dust in Artificial Sand

V.N. Karhale¹, Dr. S.D. Vikhe², Dr. R. V. Shinde³

¹Contractual teacher, Civil Engineering, College of Agricultural Engineering and Technology, VNMKV, Parbhani, India
²Assistant Professor Civil Engineering, College of Agricultural Engineering and Technology, VNMKV, Parbhani, India
³Assistant Professor Physics, College of Agricultural Engineering and Technology, VNMKV, Parbhani, India

Abstract - Common river sand is expensive due to excessive cost of transportation from natural sources. Also, large scale depletion of these sources creates environmental problems. The study was conducted to evaluate workability and the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. The mix is prepared for natural and artificial sand containing dust varying from 0%, 10%, 20% to 30%. The concrete mix properties were studied in fresh and hardened state for that slump cone test.

The study was conducted to evaluate the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. In this study dust which is a waste material stone crusher plant was used as a additive in artificial sand and the concrete made by using artificial sand with 20 % dust were found to be satisfactory. The workability of concrete made by using artificial sand with dust as additive was found greater than natural sand made concrete.

Index Terms - Artificial sand, Stone dust, Slump test, Compressive strength, Workability of concrete.

INTRODUCTION

Common river sand is expensive due to excessive cost of transportation from natural sources. Also, large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. Current India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures concrete plays the rightful role and a large quantity of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. Current India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures concrete plays the rightful role and a large quantum of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. to meet these requirements artificial sand can be used effectively.

Pofale and Quadri (2013) had taken up investigation with a view to verify the suitability, feasibility and potential use of crusher dust, a waste product from aggregate crushing plant in concrete mixes, in context of its compressive strength workability and in terms of slump, compaction factor, flow table and modified
flow. Mogre and Parbat (2013) Presented the study of replacement of natural sand with artificial sand in concrete conventionally concrete is a mix of cement sand and aggregate there is a large variation in the strength of concrete due to variation in strength of aggregate. Singh and P.K. Mehta (2014) Concrete grade M-25 concrete mix was used investigation. The test results indicate that stone dust can be effectively used in partial replacement of fine aggregate in concrete. S.D. Vikhe et al: (2018) The maximum strength of test 7 was found as 16.44 N/mm² and 28.66 N/mm² for 7 and 28 days respectively which more among all the combinations. For all mixes observed slump value lies between 30 to 45 mm. Thus cement, stone dust, sand, and coarse aggregate proportion of 6:4.8:7.2:24 gave optimum result.

In this research work the concrete mix was done for concrete M-25 grade, the mix was prepared for natural and artificial sand containing dust varying from 0%, 10%, 20%, & 30% by weight of artificial sand. The concrete mix properties were studied in fresh and hardened state for that slump cone test, compressive strength test.

MATERIALS AND METHODS

Cement
53 grade Ordinary Portland cement (BIRLA cement) is used throughout the experimental work.

Coarse aggregate
Locally available crush stone with size 20mm and 10mm confirming to IS 383:1970 are used.

Table 1. Properties of the coarse aggregate

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Specific gravity</td>
<td>2.87</td>
</tr>
<tr>
<td>02</td>
<td>Crushing value</td>
<td>10.78%</td>
</tr>
<tr>
<td>03</td>
<td>Impact value</td>
<td>4.3%</td>
</tr>
<tr>
<td>04</td>
<td>Fineness modulus</td>
<td>6.42</td>
</tr>
<tr>
<td>05</td>
<td>Water absorption</td>
<td>1.06 %</td>
</tr>
</tbody>
</table>

Table 2. Properties of artificial sand

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fineness modulus</td>
<td>3.22</td>
</tr>
<tr>
<td>2.</td>
<td>Water absorption</td>
<td>2.876 %</td>
</tr>
<tr>
<td>3.</td>
<td>Specific gravity</td>
<td>2.722</td>
</tr>
</tbody>
</table>

Table 3. Summary of Concrete Mix Design

<table>
<thead>
<tr>
<th>Observation and Calculation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Characteristic Compressive Strength</td>
<td>25 N/mm²</td>
</tr>
<tr>
<td>2 Degree of quality control</td>
<td>Good</td>
</tr>
<tr>
<td>3 Standard deviation(S)</td>
<td>4</td>
</tr>
</tbody>
</table>

Casting procedure
Cubes were casted for natural and artificial sand containing dust to check the compressive strength of concrete. The percentage of dust were varied as 0%, 10%, 20%, & 30% by weight of artificial sand. Compressive test is carried to determine compressive strength of concrete cubes. It is the most common test conducted on hardened concrete partly because it is an easy test to perform and partly because most of the desirable characteristics properties of concrete are quantitatively related to its compressive strength. The compressive test was carried out on cube specimen of the test size 15x15x15 cm.

Before assembling the mould, their mating surfaces were covered with mineral oil and a thin layer of the oil was applied to its inner surface to prevent a bond development between the mould and the concrete. Mix the concrete ingredients thoroughly as per the mix design. Concrete ingredients are filled in to the mould in three layers and each layer is compacted by tamping rod not less than 25 blows or by using surface vibrator. Then level the top surface and smoothen it with the trowel.

The test specimens are stored in a moist air for 24 hours and after this period the specimen are removed from the mould and marked. Then cubes kept in the clear fresh water until taken out prior to test. Minimum three specimens should be tested at each selected age. If strength of any specimen varies more than 15 percent of average strength results of such specimen was rejected. Average of three specimens gives the compressive strength of concrete.

Workability test on concrete by Slump cone test.
The slump test is the most well-known and widely used test method to characterize the workability of fresh concrete. The inexpensive test, which measures consistency, is used on job sites to determine rapidly whether a concrete batch should be accepted or rejected. The test method is widely standardized throughout the world. The apparatus consists of a mold in the shape of a frustum of a cone with a base diameter of 20 cm a top diameter of 10 cm, and a height of 30 centimeters. The mold is filled with concrete in three layers of equal volume. Each layer is compacted with 25 strokes of a tamping rod. The slump cone mold is lifted vertically upward and the change in height of the concrete is measured. The only type of slump permissible is frequently referred to as the true slump, where the concrete remains intact and retains a symmetric shape. A zero slump and a collapsed slump are both outside the range of workability that can be measured with the slump test. Specifically, IS advises caution in interpreting test results less than 1.25 cm and greater than. If part of the concrete shears from the mass, the test must be repeated with a different sample of concrete. A concrete that exhibits a shear slump in a second test is not sufficiently cohesive and should be rejected.

RESULTS AND DISCUSSION

The test procedure followed was as per the specifications of the relevant Indian standards. The test was carried out after 7, 28 days of curing and test results are as follows.

Table 4. Test result for cubic compressive strength of concrete.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Type of Mix</th>
<th>Slump value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concrete mix for natural sand</td>
<td>95</td>
</tr>
<tr>
<td>2</td>
<td>Concrete mix for artificial sand</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>Concrete mix with 10% dust</td>
<td>102</td>
</tr>
<tr>
<td>4</td>
<td>Concrete mix with 20% dust</td>
<td>98</td>
</tr>
<tr>
<td>5</td>
<td>Concrete mix with 30% dust</td>
<td>104</td>
</tr>
</tbody>
</table>

From above table it observed that as increase in percentage of stone dust in artificial sand slump value also increases.

CONCLUSION

The study was conducted to evaluate the strength characteristics of concrete with variable dust percentage in artificial sand. The concrete mix design was done for M25 grade concrete. In this study dust which is a waste material stone crusher plant was used as an additive in artificial sand and the concrete made by using artificial sand with 20 % dust were found to be satisfactory. The workability of concrete made by using artificial sand with dust as additive was found greater than natural sand made concrete.

REFERENCES


