AN EXPERIMENTAL STUDY ON STEEL FIBER REINFORCED FLY ASH CONCRETE

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Abstract—Concrete is a composite material made from cement, water, fine aggregate and coarse aggregate. But present researchers are in interest of finding new cementing materials by waste materials or waste products produced from industries which are disturbance to human life. Our project deals on M25 grade of concrete by partial replacement of cement with fly ash and steel fibers are added to the concrete volume. First fly ash having high silica content is made partial replacement of cement in 10%, 15%, 20%, 25% and optimum percentage of replacement is found out without loss of strength. Now steel fibers are added to the optimum fly ash replacement in volumetric ratio of concrete. Steel fibers are added in 0.5%, 1.0% and 1.5% and optimum percentage of steel fibers is determined. All the cubes and cylinders are tested at 7 days, 28 days & 56 days.

I. INTRODUCTION
Concrete has been the basic building material ever seen the field of construction has come into existence. With the technological advancement the definition of concrete has undergone a few modifications but the prime goal has remained same. The reason behind the modification and evolution is the birth of additive materials like fly ash, silica fume, rice husk etc. which once being a residue has now found one of the important place in the manufacturing of high performance concrete.

Fly ash is generally finely divided residue ash particle resulting from the combustion of coal in the furnaces which blows along with flue gas of the furnace. These ash are collected with the help of electric precipitators and termed as fly ash. Fly ash is the most widely used pozzolonic material all over the world. In UK it is termed as pulverized fuel ash i.e. PFA Although it is a residue of coal but it contain chemical components like silicon dioxide, aluminum oxide, iron oxide in major quality and apart from these substance reactive silica, magnesium oxide, sodium oxide, calcium oxide, titanium, lead oxide are also found in major quantity which marks fly ash suitable to be used in combination with cement in the production of concrete.

II. CONSITUENT OF CONCRETE:

2.1 Fly Ash:
Fly ash, also known as "pulverized fuel ash" in the United Kingdom, is one of the coal combustion products, composed of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler, it is known as coal.

III. MATERIALS AND METHODS

3.1 Cement:
Ordinary Portland cement of 53 grade conforming to IS 8112-1989 is used. The basic properties of cement showed in table.

3.2 Fine aggregate:
Natural river sand of size below 4.75 mm conforming to zone II of IS 383-1970 is used as fine aggregate. The test results of basic properties of fine aggregates are showed in table.

3.3 Coarse aggregate:
Natural crushed stone with 20 mm down size is used as coarse aggregate. The basic properties of coarse aggregates are showed in table.
3.4 Water:
Ordinary portable water is used in this investigation both for mixing and curing.

3.5 Superplasticizers:
Superplasticizers are used to improve the properties of concrete workability. Ceraplast 300 which is available in liquid form and brown in color and which is having a specific gravity of 1.2.

IV. STEEL FIBERS

- Provides uniform multi-directional concrete reinforcement
- Increases crack resistance, ductility energy absorption (or) toughness of concrete
- Improves impact resistance, fatigue endurance and shear strength of concrete
- High tensile strength fiber bridging joints and cracked to provide tighter aggregate interlock Resulting in increased load carrying capacity

<table>
<thead>
<tr>
<th>Component</th>
<th>Bituminous</th>
<th>Sub bituminous</th>
<th>Lignite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon dioxide SiO2 (%)</td>
<td>20-60</td>
<td>40-60</td>
<td>15-45</td>
</tr>
<tr>
<td>Aluminum oxide Al2O3 (%)</td>
<td>5-35</td>
<td>20-30</td>
<td>20-25</td>
</tr>
<tr>
<td>Iron oxide Fe2O3 (%)</td>
<td>10-40</td>
<td>4-10</td>
<td>4-15</td>
</tr>
<tr>
<td>Calcium oxide CaO (%)</td>
<td>1-12</td>
<td>5-30</td>
<td>15-40</td>
</tr>
<tr>
<td>Loss on ignition LOI (%)</td>
<td>0-15</td>
<td>0-3</td>
<td>0-5</td>
</tr>
</tbody>
</table>

Table 1: Chemical Composition of Fly Ash

6.0 Mix Proportions for M 25 Grade Concrete

5.0 Mix Proportions for M 25 Grade Concrete The Quantities of Mix design Proportions is Cement: Fine Aggregate: Coarse Aggregate: Water is 1:1.9:2.28

V. TEST RESULTS

6.1 Workability:
This section describes the results of the tests carried out to investigate the various properties of the different concrete mixes prepared in contrast with the control mixes. In the succeeding parts, the results for workability, unit weight, compressive strength test, Split tensile strength test, and flexural strength test are presented. Analysis and discussions are also made on the findings.

6.2 Compressive Strength:
Compressive test was carried out on 150 x 150 x 150 mm size cubes. The specimens were loaded at a constant strain rate until failure. The compressive strength is decreased with an increase in the percentage of GGBS and Robo Sand in Cement and Fine aggregate. Results for compressive strength of cubes for 3 days, 7 days and 28 days N/mm².

6.3 Split Tensile Strength:
The test method covers the determination of the splitting tensile strength of cylindrical concrete specimens of size 150 mm dia and 300 mm height, such as molded cylinders. This test method consists of applying a diametral compressive force along the length of a cylindrical concrete specimen at a rate that is within a prescribed range until failure occurs.

<table>
<thead>
<tr>
<th>PERCENTAGE OF FLY ASH ADDED</th>
<th>COMPRESSION STRENGTH(N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td>0</td>
<td>20.98</td>
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<tr>
<td>10</td>
<td>20.36</td>
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<tr>
<td>15</td>
<td>17.21</td>
</tr>
<tr>
<td>20</td>
<td>16.28</td>
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Compressive strength of fly ash concrete

<table>
<thead>
<tr>
<th>PERCENTAGE OF FIBER ADDED</th>
<th>COMPRRESSIVE STRENGTH(N/mm2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 DAYS</td>
</tr>
<tr>
<td>0.50</td>
<td>19.10</td>
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<tr>
<td>1.0</td>
<td>20.70</td>
</tr>
<tr>
<td>15</td>
<td>18.20</td>
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<tr>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Split Tensile Strength of Fly Ash Concrete with Steel Fibers

VI. RESULTS & CONCLUSIONS:

Based on this experimental study, it can be concluded that

1. The compressive strength of M 25 grade of concrete increases when the partial replacement of cement with fly ash is up to 15%. Further replacement of fly ash leads to decrease of strength.

2. At 15% Partial replacement of cement with fly ash there is an increase in compressive strength of 7% and tensile strength is increased by 5%.

3. The compressive strength of fly ash concrete is low at 28 days than nominal concrete. Increase of strength of concrete is done at 56 days. Addition of steel fibers will be done for 15% replacement of cement with fly ash by its weight.

4. The increase of tensile strength of concrete is high at 1.0% addition of steel fibers to the concrete volume.

5. The increase in compressive strength of concrete after adding steel fibers for optimum fly ash content is 27% and tensile stress is increased by 38%.

6. Utilization of fly ash in concrete leads to development of construction industry and reduces the problem of disposal of fly ash.
REFERENCES


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