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Experimental Study on Behaviour of High Performance Concrete using GGBS and M Sand

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***Abstract*:- Cement is the major constituent of concrete which is produced by natural raw materials like limestone rock, clay and chalk etc. These are produced by blasting quarries. Industrial wastes like Ground Granulated Blast Furnace Slag (GGBS) show chemical properties similar to cement. Use of pozzolanic material like GGBS will reduced the cost of concrete and helps to reduce rate of cement consumption. The present investigation deals with the development of high performance concrete when the cement and river sand are replaced by GGBS and Manufacture sand in various proportions. This study mainly focuses on the discussion of strength and workability characteristics of high performance concrete, when the cement is replaced by GGBS partially in various proportions, together with the replacement of river sand by Manufacture sand in various proportions. Compressive, split and flexural test were conducted on concrete specimens for strength analysis and for durability studies RCPT, Sorptivity and water permeability.**

1. INTRODUCTION

Concrete is the most widely used construction material and has high compressive strength. The Ordinary Portland Cement (OPC) is the main component for making concrete. Production of one tonne of cement requires about 2 tonnes of raw materials of shale and limestone, and also releases large amount of carbon dioxide to the atmosphere that significantly contributes to green house gas emissions. One method to reduce the carbon dioxide emissions of the concrete is the replacement of Ground Granulated Blast Furnace Slag. GGBS is the by product of the industrial waste used as supplementary cementitious material in concrete. The supplementary cementitious materials not only improve the mechanical properties of concrete and also reduce the cement consumption by replacing part of cement with these pozzolanic materials. Also, Conventional fine Aggregate River sand has become scarce and its excessive use causes degradation of river bed and reduction in ground water recharge. Manufacture sand produced from granite stone, has been used as an alternative fine aggregate that completely replaces the river sand which is far superior than river sand in all aspects. To offset with these two challenges, an attempt has been made to produce concrete with supplementary and alternative materials. This project work is to determine the material properties of cement, GGBS, aggregates and manufactured sand and to study about the mechanical and durability properties of high performance concrete with GGBS and M sand.

2. MATERIALS USED

In the present work various materials used with their respective properties namely OPC 53 grade cement, GGBS , coarse aggregate , Manufacture sand and water.

a. Cement:

The ordinary portland cement of 53 grade properties given below in table no. 1

Specific Gravity	3.15
Normal consistency value of cement	6mm
Initial setting time	30 minutes
Final setting time	600 minutes

b. Fine Aggregate:

Manufacture sand conforming to IS 383 - 1970 the properties given in table no.2

Specific gravity	2.56
Fineness modulus	3.52
Bulk density	1903 kg / m^3
Water absorption	2.67
Grading zone	Zone II

c. Coarse Aggregate:

Coarse aggregate (12mm and 20mm) conforming to IS 383 - 1970 the properties given in table no.3

Property	Coarse aggregate(12mm)	Coarse aggregate(20mm)
Specific gravity	2.73	2.76
Water absorption	0.50	0.33
Bulk density	1556 kg / m^3	1612 kg / m^3
Fineness modulus	2.42	3.08
Grading zone	Graded aggregate	Single sized aggregate

d. GGBS

The specific gravity of ground granulated blast furnace slag is 2.85

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e.Water:
In this work portable water free from organic substances was used for mixing as well as curing of concrete.

3. MIX DESIGN:

The concrete mix is designed for M40 grade as per IS 10262-2009 and IS 456-2000.In this study 30% , 40% and 50% GGBS replaced with cement and 100% of Manufactures sand replaced with the water cement ratio 0.38.

Properties	Weight Kg/m^3
Cement	315
Coarse aggregate 12 mm	445
Coarse aggregate 20mm	714
Fine aggregate	678
GGBS	135
Total water	193

4. CASTING:

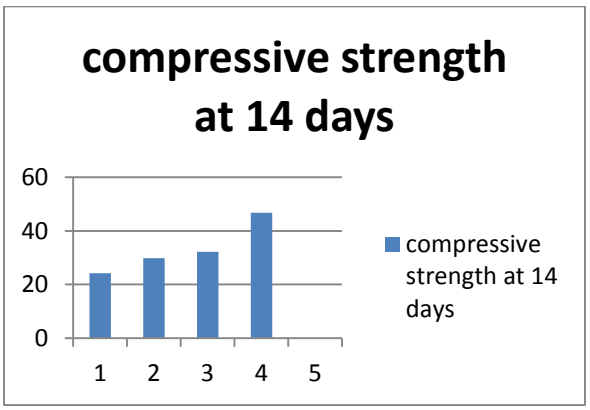
The materials mentioned were taken in proper proportion for making concrete. The materials were mixed in dry state and water along with admixture were added and mixed thoroughly. Cubes (150x150x150mm), cylinders (70x150mm) and (100x200mm), prism (100x100x500mm) were casted for strength characteristics. Specimens were kept under water curing and taken for testing.

5. TESTING:

Specimens were taken from curing tank and dried. The specimens were tested for compressive strength for 14 days and the value were recorded based on 3 trials.

a. Compressive strength:
Compressive testing machine was used for testing cubes. Testing was done for specimens kept for curing of 14 days.

Type of mix	Compressive strength of 14 days (N/mm^2)
Control mix	24.25
Mix 1	29.81
Mix 2	32.17
Mix 3	46.72



6. RESULTS AND SCOPER FOR FURTHER STUDY:

Based on the result of compressive strength at 14 days , the compressive strength increases by increase in percentage of GGBS. Manufactures sand can be used as one of the alternative material of river sand. To determine the mechanical and durability properties of GGBS replaced with cement and manufactures sand with concrete specimens at the 28 and 56 days can be considered as a scope for further studies.

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