Effect of Partial Replacement of River Sand By GBS Sand And Crushed Sand on Strength Characteristics of Concrete

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Abstract- *nowadays it is very important to make the concrete economical. Therefore the present work has initiated to make the concrete economical by replacing the natural sand by crushed sand and GBS sand in the concrete. The investigations are to be carried out using several test which include workability test, compressive test, tensile test, flexural test, rebound hammer test and ultra sonic pulse velocity test. From our study it is concluded that different Crushed sand gives different results for compressive strength depending on different quarries and from study of different research paper at 40% to 60% replacement of crushed sand the maximum compressive strength is obtained. The maximum tensile strength of concrete is obtain at 60% and 70% replacement of natural sand with Crushed sand. The concrete with crushed sand performed better than concrete with natural sand as the property of crush sand is better than that of natural sand. The environment problems are very common in India due to generation of industrial by-products. Due to industrialization enormous by-products are produced and to utilize these by-products is the main challenge faced in India. Iron slag is one of the industrial by-products from the iron and steel making industries. In this study, the compressive strength of the iron slag concrete was studied. The results confirm that the use of iron slag overcome the pollution problems in the environment. The results shows that the iron slag added to the concrete had greater strength than the plain concrete.*

Keywords- GBS Sand, Crushed Sand, compressive test, tensile test, flexural test.

I. INTRODUCTION

Currently, India is developing country. Now days so many infrastructural projects running. It can be requirement of Globalization. In recent years, concrete technology has made significant advances which have resulted in economical improvements in strength of concrete. This economic development depends upon the intelligent use of locally available materials. One of the important ingredients of conventional concrete is natural sand or river sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. Digging sand, from river bed, in access quantity is hazardous to environment and causing bank slides, loss of vegetation on the bank of rivers.

A. Crushed Sand

Mankind has been blessed with fairly abundant natural resources. Society has to face the fury of nature, if they are over exploited. Sometimes it may be catastrophic. One such disaster was witnessed in Uttarkhand. Indiscriminate mining of Sand also amounts to overexploitation of the natural resources, adversely impacting the environment in several ways. It is also imperative to keep pace with the growth in construction and sand is one of the vital construction materials. One of the attractive alternatives to Sand is Crushed Sand. It possesses properties similar to that of river sand and is a more sustainable construction material.

This issue focuses on **"Crushed Sand – *the need of the hour*".**

B. GBS Sand

GBS Slag is a by-product generated during manufacturing of pig iron and steel. It is produced by action of various fluxes upon gangue materials within the iron ore during the process of pig iron making in blast furnace and steel manufacturing in steel melting shop. Primarily, the slag consists of calcium, magnesium, manganese and aluminium silicates in various combinations. The cooling process of slag is responsible mainly for generating different types of slags required for various end-use consumers. Although, the chemical composition of slag may remain unchanged, physical properties vary widely with the changing process of cooling.

EXPERIMENTAL DESIGN, MATERIALS AND TEST RESULTS

A. Experimental Design

Table 1 shows experimental details of this study. This experimental design is programmed to evaluate the application of high performance concrete using CS. To study the Material Test of Sieve Analysis, Specific Gravity, Water Absorption and Bulk Density of Sand. To study the compressive strength, flexural strength and split tensile strength of concrete on using combination of GBS Sand and Crushed Sand (at 40%, 50%, 60%, and 100%) as partial replacement/ replacement of River Sand. To study the compressive strength, flexural strength and split tensile strength of concrete on using combination of GBS Sand, Crushed Sand and River Sand (at 40%, 50%, 60%, and 100%) as fully replacement of River Sand.

B. Materials

Type 1 ordinary Portland cement of Penna Cement Company, GBS Sand of JSW Cement LIMITED Company were used and Crushed Sand of Aditya Sand Supplier.

C. Physical Properties of aggregate

The specific gravity of an aggregate is the define as the ratio of the mass of the solid in a given volume to a mass of the equal volume of the water at the same temperature.The specific gravity is required for the calculation of the yields concrete or of the quantity of the aggregate required for a given volume of the concrete. The specific gravity of an aggregate gives valuable information on its quality and properties. It is seen that the higher the specific gravity of an aggregate, the harder and the stronger it will be.

Table-I Physical Properties of aggregate

	For Crushed Sand	For GBS Sand	For River Sand
Specific gravity	2.75	2.06	2.54
Water absorption %	3.95	6.38	3.09
Fineness Modulus	2.94	2.81	3.02
Loose Bulk density (kg/litter)	1.89	1.03	1.78

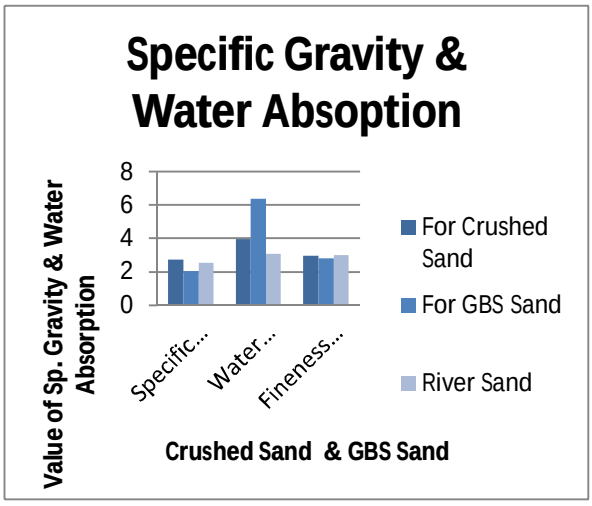

Fig.1 Specific Gravity and Water Absorption

Table-II Proportion of Concrete Mixtures

Mix Designation M25	Water (W) kg/m3	Cement (C) kg/m3	Fine Aggregate(FA)			Coarse Aggregates (CA) kg/m3	Ratio of W:C:FA:CA
			River Sand kg/m3	Crushed Sand kg/m3	GBS Sand kg/m3		
MIX-1 100% R.S.	197	394	792	0	0	1076	0.5:1:2.01:1.35
MIX-2 100% C.S.	197	394	0	857	0	1076	0.5:1:2.17:1.35
MIX-3 100% GBS.S.	197	394	0	0	617	1112	0.5:1:1.56:2.82

D. Compressive Strength of Concrete

Compression test is the most common test conducted on the hardened concrete, partly because it is very easy and simple to perform and partly because many of the desirable properties of concrete are qualitatively related to its compressive strength. Three types of compressive test specimens are uses: cube sand prisms. Cubes are used in Great Britain, Germany and many other countries in Europe. The size of standard cube specimen is 150mm×150mm×150mm. if the largest nominal size of the aggregate does not exceed 20mm, 100mm×100mm×100mm size cubes may also be used as an alternative.

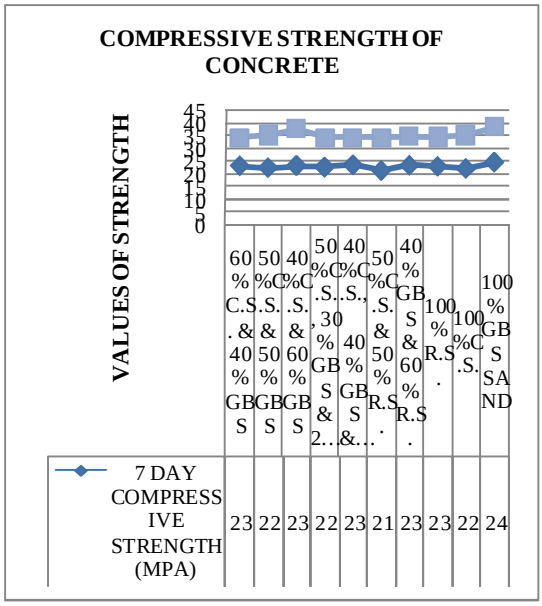

Fig.2 Compressive Strength of Concrete for Different Combination of Sand

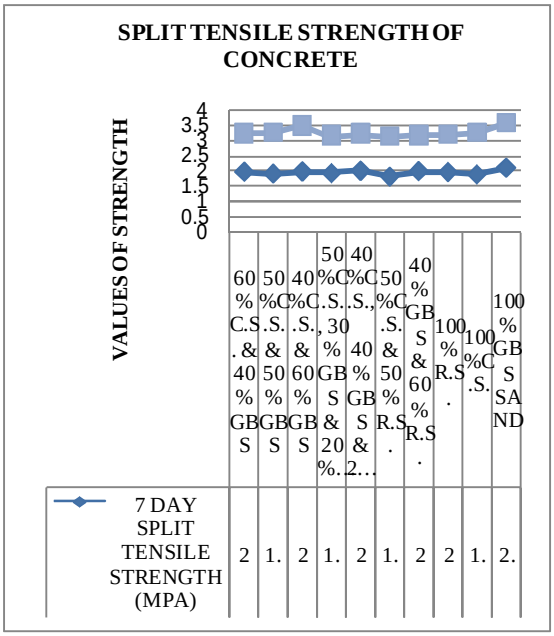

Fig.3 Split Tensile Strength of Concrete for Different Combination of Sand

E. Split tensile strength of concrete

The split tensile strength of concrete is determined by casting cylinders of size 150 mm X 300 mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing tank at age of 7, 28 and 56 days of moist curing and tested after surface water dipped down from specimens. This test was performed on Universal Testing Machine (UTM). The magnitude of tensile stress (T) acting uniformly to the line of action of applied loading is given by formula

T= 0.637P/dl

Where,

T = Split Tensile Strength in MPa
P = Applied load,
D = Diameter of Concrete cylinder sample in mm.
L =Length of Concrete cylinder sample in mm.

F. Flexural strength of concrete

Flexural strength is the one of the measure of the tensile strength. It is measure of the unreinforced concrete slab or beam to resist the failure in the bending. Flexural strength is also called as the modulus of the rapture. Flexural strength of the concrete is about 10 to 20 percentage of the compressive strength of the concrete depending on the size, type and the volume of the coarse aggregate.

The finding modules of rapture, three cases should be considered.

Case (a):

When a > 200mm for 150mm specimen
a > 133mm for 100mm specimen.
$fcr = PL / bd^2$
Where, P = fracture load for beam b = width of beam L = span d = depth of beam

Case (b):

When 170mm < a < 200mm for 150mm specimen
When 110mm < a < 133mm for 100mm specimen
$fcr = 3.P.a / bd^2$

Case(c):

When a < 170mm for 150mm specimen

a < 110 mm for 100mm specimen.

When a designer wishes to use an estimate of the tensile strength from the compressive strength, the following formula may be used.

$fcr = 0.7(fck)^{1/2}$

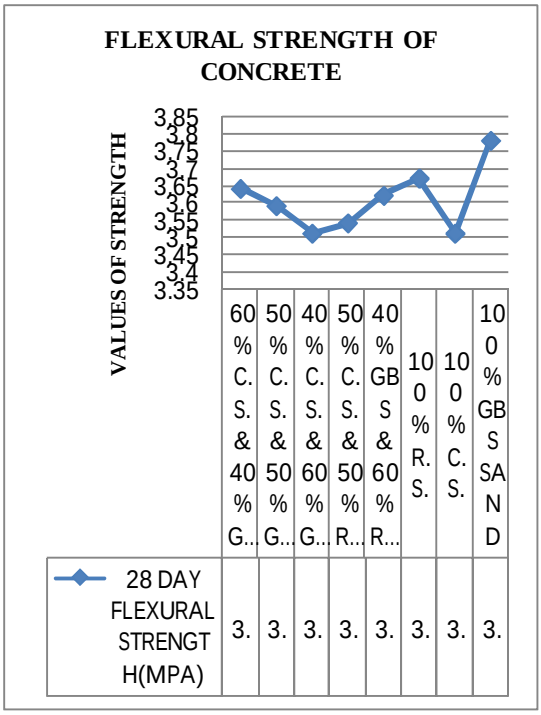

Fig.4 Flexural Strength of Concrete for Different Combination of Sand

III. CONCLUSIONS

In this study it was investigated the practical use of high performance concrete with various ratios of both Crushed Sand and GBS Sand produced in PUNE and evaluated the mutual correlation of mixing parameters. It was found that:

1) At 28 days, compressive strengths of the specimens using Crushed Sand aggregates combining less than 50 % of CS were evaluated lower or similar strength properties to that of a control concrete. while that of specimens using 100 % of CS was increased average 2.13%.
2) At 28 days, compressive strengths of the specimens using GBS Sand aggregates combining with crushed sand less than 50 % of were evaluated lower or similar strength properties to that of a control concrete. While that of specimens using more than 50 % of GBS Sand with crushed sand was increased average 9.72%. While that of specimens using 100 % of GBS Sand was increased average 11.91%.
3) At 28 days, split tensile strength of the specimens using Crushed Sand aggregates combining less than 50 % of CS were evaluated lower or similar strength properties to that of a control concrete. While that of specimens using 100 % of CS was increased average 1.89%.
4) At 28 days, split tensile strength of the specimens using GBS Sand aggregates combining with crushed sand less than 50 % of were evaluated lower or similar strength properties to that of a control concrete. While that of specimens using more than 50 % of GBS Sand with crushed sand was increased average 9.49%. While that of specimens using 100 % of GBS Sand was increased average 11.70%.
5) At 28 days, flexural strength of the specimens using Crushed Sand aggregates combining less than 50 % of CS were evaluated lower or similar strength properties to that of a control concrete. While that of specimens using 100 % of CS was decrease average 4.35%.
6) At 28 days, flexural strengths of the specimens using GBS Sand aggregates combining with crushed sand less than 50 % of were evaluated lower or similar strength properties to that of a control concrete. While that of specimens using more than 50 % of GBS Sand with crushed sand was decreased average 4.35%. While that of specimens using 100 % of GBS Sand was increased average 2.99%.
7) Cost comparison of sand is below:-
   River Sand: - approx. 7000/- per brass
   Crushed Sand: - approx. 3000/- per brass
   GBS Sand: - approx. 4725/- per brass

IV. ACKNOWLEDGMENT

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