Experimental Studies on Strength Properties of Concrete By Partial Replacement of GGBS For Cement And M-Sand For Natural Sand

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Abstract- *Due to the persistent and continuous demands made on concrete to meet the various difficult requirements, extensive and wide spread research work is being carried out in the area of concrete technology. In the present experimental investigation is to find the influence of Ground granulated blast furnace slag (GGBS) and Manufactured sand (M-sand) on the strength properties of concrete. In the present experimental investigation the cement is partially replaced by 10%,20%.30% and 40% of GGBS and natural sand is replaced with 20%,40%,60%,80% and 100% of M-sand. The influence of combined application of GGBS and M-sand on compressive strength and split tensile strength of M30 grade of concrete is investigated. The test results of concrete prepared with GGBS and M-sand are compared with that of conventional concrete. Based on the test results it can be observed that the concrete prepared with 30% GGBS and 60% M-sand combination possess improved strength properties compared to that of the conventional concrete. The increase in various strength characteristics of concrete prepared using GGBS and M-sand can be attributed to the availability of additional binder in the presence of GGBS and good gradation also nice finish of M-sand.*

Keywords- M-sand, Ground granulated blast furnace slag, Permeability, Specific gravity, Consistency, Slump

I. INTRODUCTION

Choice of construction in most countries today is concrete, which intern leading towards vanishing of natural resources. Carbon di oxide emission during the manufacture of cement, leading to deterioration, and inadequate resistance to hostile environment of concrete structures made to the continuous research on concrete. On the other hand, cost of concrete is depending on the cost of its ingredients which intern is becoming expensive. Which has resulted in recycling of industrial wastes also by-products which help to reduce expenses of waste products recycling methods intern it will reduce the destruction of natural resources?

This need of preserving of natural resources has drawn attention of many researchers to explore new alternative materials for cement concreting. Solid waste discharge by steel and iron industries is called blast furnace slag. In order to protect environment recycling of this slag play a very important role. In modern civilization iron and steel are underpins, after a long research the slag which is obtained from the iron and steel industries is considered as a separate material in its own right. The prime constituent of slag is lime and silica.

The consumption of naturally available sand is too high all around the world due to its extensive use in cement concrete. Demand for natural river sand is high in all developing countries which intern lead to scarcity of it. Developing country India is facing a serious problem as natural sand is being used up rapidly which is leading to scarcity of sand. Continuous extraction of natural sand from river bed has led to many problems as, River bed deepening and sliding of banks, vegetation loss on the river banks; aquatic life disturbance also disturbs agriculture because of water table lowering in the well etc. These are some of the examples.. In order to overcome problems as mentioned above various river sand alternatives, such as filtered sand, quarry dust and offshore sand have also been made.

GGBS and M-sand sand (MS) are the solid wastes generated by steel industries and stone crushing industries respectively. This investigation has made attempt to study the feasibility of using locally available GGBS, and M-sand as partial replacements for cement and natural sand respectively in concrete

II. MATERIALS AND METHODOLOGY

1. **Ground granulated blast furnace slag (GGBS):**

Ground granulated blast furnace slag (GGBS) is a byproduct from the iron and steel industries from their blast furnaces which are used to make iron and steel

Chemical compositions of GGBS

Calcium oxide	40%
Silica	35%
Alumina	13%
Magnesia	08%

Various physical tests were conducted on GGBS and the results are as fallows

Sl No.	PARAMETER	VALUE
1	Appearance	Very Fine Powder
2	Particle Size	25 Microns-Mean
3	Color	White
4	Odor	Odorless
5	Specific Gravity	2.95

2. Cement:

Ordinary Portland cement (OPC) of 43 Grade with respect to IS 8112-1989 was considered for present study.

Physical properties of cement

Sl No.	Parameter	Value
1	Specific gravity	3.08
2	Standard consistory	31%
3	Initial setting time	38min
4	Final setting time	480min
5	fineness	5.3%

3. Fine aggregate :

Sand used in this investigation is naturally available river sand passing through 4.75mm size sieve after sieve analysis it is determined that the sand confirms to grading zone II as per IS:383-1970.

Physical properties of fine aggregate

Sl No.	Parameter	Value
1	Fineness modulus	2.52
2	Specific gravity	2.60
3	Moisture content	0.917

4. Coarse aggregate:

The coarse aggregate used in this investigation is 20mm down size locally available crushed stone obtained from quarries. Specifications for coarse aggregate are included in IS: 383-1970

The physical properties have been determined as per IS: 2386-1963

Physical properties of coarse aggregate

Sl No.	Parameter	Value
1	Fineness modulus	6.30
2	Specific gravity	2.67
3	Moisture content	2.30

5. Manufactured sand (M-sand):

M-sand is manufactured in the stone quarries. It is a substitute for the river sand used in the construction

Physical Properties of M-sand

Parameter	Value
Specific gravity	2.62
Fineness modulus	3.02

Methodology is carried out as shown below

1. Journals are collected and reviewed for more clarity of research work.
2. The materials were procured as per the quantities in the design and tests were performed to evaluate the properties of materials.
3. Conventional concrete was prepared and kept as a reference mix.
4. Further, natural sand is substituted by M-sand in 2O%, , 4O% ,6O%,8O% and 1OO%

5. Further, cement is substituted by GGBS in 1O%, 2O%, 3O%, 4O% along with partial replacement of river sand by M-sand in 2O%, , 4O% ,6O%,8O% and 1OO%
6. Concrete cubes and cylinders were casted and cured for a period of 28 days.
7. The water level was maintained in such a way that to keep the specimens completely immersed after 7 and 28days the specimens were removed and allowed to dry at room temperature. Compressive strength test, split tensile strength test were performed.For strength tests CTM has been used. Lastly the results were tabulated and compared with respect to conventional concrete and conclusions remarked

Mix design:

The M3O grade concrete is adopted for the present work. A test on different trial mixes has carried out. The mix proportions that gives0required cube compressive strength for 28 days with minimum cement content and required w0rkability of 1OOmm is selected. Detailed mix proportion is obtained for O.4 W/C ratio. As per code IS: 1O262-2OO9

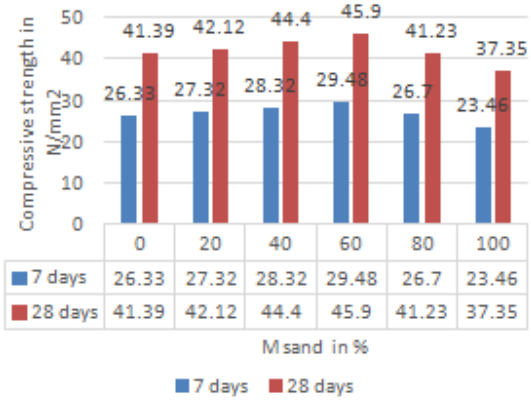
Mix proportion of normal concrete

Con crete	Cement	Sand	Coarse Aggrega te	Water
Nor mal	432.5 kg	640kg	1169 kg	1.92 lit

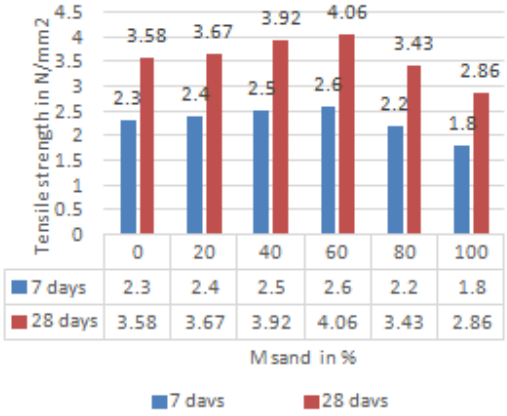
III. RESULTS AND DISCUSSIONS

Compression test on concrete cubes and split tensile strength on concrete cylinders were carried out on the test specimens, as a result both compression and tensile strength for 3O% replacement of GGBS has increased when compared with 1O and 2O% replacement.it is also observed that strength is maximum when natural sand is replaced with M-sand by 6O%

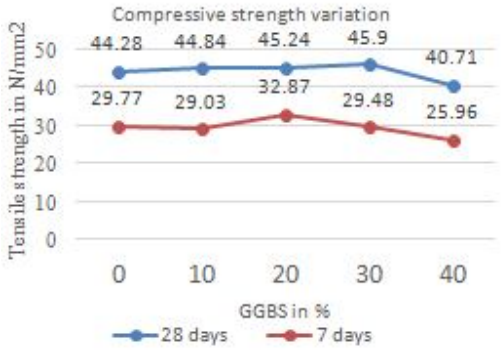
This increase in strength of concrete is due to bonding property of C-S-H(calcium-silicate-hydrogen) bond between the matrix and aggregates thus reducing porosity band makes concrete dense which in turn increase strength



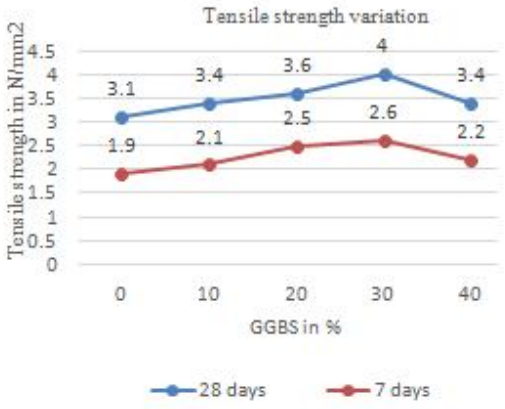
Compressive strength of concrete with 3O% GGBS and variation of M-sand



Tensile strength result of concrete with 3O% GGBS and variation of M-sand



Compression strength of concrete with 6O% of M-sand and variation in GGBS%



tensile strength of concrete with 6O% of M-sand and variation fin GGBS%

IV. CONCLUSIONS

Following conclusion are obtained based on the experimental investigations

1. It is observed that the concrete with partial replacement of GGBS and M-sand have achieved strength, maximum compressive strength is obtained for 7 and 28 days for 6O% M-sand 3O% GGBS
2. Split tensile strength is optimum at 7 days for 28 days for 6O% M-sand 3O% GGBS
3. As the percentage of M-sand increases compressive strength and split tensile strength of concrete increases up to 6O% replacement of natural sand by M-sand
4. As the percentage of GGBS increases compressive strength and split tensile strength of concrete increases up to 3O% replacement of cement by GGBS

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