Research Paper Engineering

Floating Concrete by Using Light Weight Aggregate and Air Entraining Agent in Partial Replacement of Cement By Ground Granulated Blast Furnace Slag

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ABSTRACT

Floating concrete is a non structural concrete. GGBS ground granulated blast furnace slag is an environmentally friendly construction material, hence in this paper study on incorporation of GGBS in floating concrete is carried out. The optimum GGBS replacement as cementation material is characterized by high compressive strength, low heat of hydration, resistance to chemical attack, better workability, good durability and cost-effectiveness. The production of GGBS requires little additional energy compared with the energy required for the production of Portland cement. The replacement of Portland cement with GGBS will lead to a significant reduction of carbon dioxide gas emission. GGBS is therefore an environmentally friendly construction material. It can be used to replace as much as 80% of the Portland cement when used in concrete. GGBS concrete has better water impermeability characteristics as well as improved resistance to corrosion and sulphate attack. As a result, the service life of a structure is enhanced and the maintenance cost reduced. Here in this study authors tried to bring the density of concrete below water, pumice is light weight aggregate and aluminium powder as air entraining agent has been used. The results showed that sample 4 gives dosage whose cost is less than that of brick masonry. The optimum results are given by sample 4 which the density of light weight concrete is less than the density of water and hence we can conclude that it gives a higher efficiency and durability and compressive strength.

KEYWORDS : GGBS, Workability, Compressive strength, Tensile strength , Flexural strength pumice stone , aluminium powder.

I.INTRODUCTION

GGBS means the ground granulated blast furnace slag is a by-product of the manufacturing of pig iron. Iron ore, coke and Lime-stone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500oC to 1600oC. The molten slag has a composition close to the chemical composition of Portland cement. After the molten iron is tapped off, the remaining molten slag, which consists of mainly siliceous and aluminous residue is then water-quenched rapidly, resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size, which is known as ground granulated blast furnace slag (GGBS). Floating concrete is made by introducing air or gas into concrete slurry, so that when the mix sets and hardens, uniform cellular structure is formed. Thus it is a mixture of water, cement and finely crushed sand. We mix fine powder of Aluminum to the slurry and it reacts with the calcium hydroxide present in it thus producing hydrogen gas. This hydrogen gas when contained in the slurry mix gives the cellular structure and thus makes the concrete lighter than the conventional concrete. Pumice stone is a lightweight aggregate of low specific gravity. It is a highly porous material with a high percentage of water absorption[4]. In this we do not use the conventional aggregate and replace it by the pumice stone. Pumice is the specimen of highly Porous rocks having density approximately 500-600 Kg/m3. In this we have added ggbs approximately about 20% by weight of cement which gives us the optimum result. Pumice has an average porosity of 60-80% and initially floats on water[1]. The results of compressive strength tensile strength and drying shrinkage showed that light weight conretes meets the requirements of structural light weight concrete[2]

II.MATERIALS USED

Cement : Ordinary Portland 53-grade
GGBS as 20% by weight of cement.
Admixtures : Aluminium Powder
Water : Potable tap water
Mixed Procedure : hand mixing
Compaction : ramming, tamping
Curing practice : Curing by submersion
Cube size : 15cm×15cm×15cm
Testing of cubes : By using CTM after 3,7,21 & 28 days
Sand used: River bedded sand

III. EXPERIMENTAL PROGRAM TESTING OF MATERIALS

Sr. no	Description of Test	Results
1	Specific gravity a) Cement b) Fine aggregate	 3.15 2.61
2	Fineness of cement	05%
3	Standard consistency of cement	34%
4	Setting time of cement a) initial setting time b) final setting time	 40 minutes 262 minutes
5	Density of pumice stone	641 kg/m3
6	Specific gravity of GGBS	2.86

Sample1: 12 cubes
Cement: 68kg
Crushed sand:92kg

Pumice stone (< 20 mm):20kg
Water: 37.4kg
Admixture: aluminium powder 2%
Ggbs 20% by weight of cement : 12.8kg

RESULTS: AFTER 3 DAYS CURING

Sq. No.	Wt. kg	Density kg/m	Average Density kg/m3	LoadKN	Strength N/mm2	Avg. comp strength N/mm2
1	6.57	1946.66		287	12.755	
2	6.88	2038.518	2015.800	293	13.022	13.259
3	6.96	2062.22		315	14.00	

Sample 2: 12 cubes
Cement: 32kg
Pumice powder:10kg
Pumice stone: (< 20 mm): 20kg
Water: 17.6kg
Admixture: aluminium powder 2%
Ggbs 20% by weight of cement :6.4kg

RESULTS: After 7 days of curing

Sp. No.	Wt. kg	Density kg/m3	Avg Density kg/m3	Load KN	Strength N/mm2	Avg. Strength N/mm2
1	4.14	1227		167	7.42	
2	4.26	1262	1232.66	197	8.76	8.15
3	4.08	1209		186	8.27	

Sample 3: 12cubes
Cement: 24kg
Pumice powder: 10kg
Pumice stone: (10 to 20 mm): 20kg
Water: 13.2kg
Admixture: Aluminum powder 2%
Ggbs 20% by weight of cement : 4.8kg

RESULTS: After 21 days of cube testing

Sq. No.	Wt. kg	Density kg/m3	Average Density kg/m3	Load KN	Strength N/mm2	Avg. comp strength N/mm2
1	3.84	1137		202	8.97	
2	3.14	930	1052.33	84	3.73	6.956
3	3.68	1090		184	8.17	

Sample 4: 12 cubes
Cement: 16 kg
Pumice powder: 12 kg
Pumice stone: (10 to 20 mm): 20 kg
Water: 8.8kg
Admixture: Aluminium powder 2%
Ggbs 20% by weight of cement: 4.8kg

RESULTS: 28 days cube testing

Sl No.	Wt. kg	Density kg/m3	Average Density kg/m3	Load KN	Strength N/mm2	Avg. Strength N/mm2
1	2.98	883		68	3.022	
2	3.27	968.88	925.44	74	3.288	3.1551
3	3.12	924		71	3.155	

III. RESULTS AND DISCUSSION

Sample1 gives average compressive strength 13.259 N/mm2, which is good for lightweight concrete. Also it give save rage density 2015.8 kg/m3, but we have to reduce the density of concrete to nearly equals to density of water, so it is to be required that reduce the quantity of crush sand and that's why we reduced the quantity of crushed sand and also replaced it with pumice sand passing through IS sieve of size 4.75 mm. in next sample. Also we used two fractions of Aggregate i.e. M1 (10mm to 20 mm) and M2 (4.75 mm to 10 mm).

Sample 2 gives the improved results having average density 1232.66 kg/m3 and average compressive strength 8.15 N/mm2, but average density of concrete is not nearly equals to the density of water. Also the quantity of cement is high, so we discussed this situation with our guide. He told us that if you reduce the quantity of cement it will help us to reduce the density as well as to achieve economy. Therefore in next sample we reduced the cement quantityand increased the pumice sand.

Sample 3 gives lightweight concrete having average compressive strength 6.956 N/mm2and average density 1052.33 kg/m3. Which is less than the density of water hence the concrete cube It was light as desired but its finishing was not good. It happens because of the large sized aggregate. So we have decided to eliminate large size aggregate completely from concrete .

Sample 4 gives lightweight concrete having surface flat & smooth and showing a good finish. Its average density 925.49 kg/m3 and average compressive strength 3.1551 N/mm2. From the above results it seems that the compressive strength is increased even if the density is nearly same as the previous sample. So this sample is perfect for the mix proportion.

IV. CONCLUSION

Here we have determine the influences of aggregate types and the amount on the compressive strength of concrete. Using different proportions pumice stone and four lightweight concrete mixtures were produced with a satisfied strength. Hence we have analysed that aggregate size and proportion affects the unit weight and compressive strength of concrete. Moreover, the result showed that it is possible to produce a Floating and satisfied strength concrete by using pumice as aggregate. It was also seen that, using light

weight aggregate in the concrete mixture can reduce the dead load but decreases the concrete strength. Sample 4 gives lightweight concrete having surface flat & smooth and showing a good finish. Its average density 925.49 kg/m3 and average compressive strength 3.1551 N/mm2.it has been observed that ggbs used gives rapid curing at ambient temperatures. It also gives high tensile, flexure, compressive strength.These concrete does not satisfies the strength requirements for load bearing structural elements. In this study only strength, unit weight and specially density of the sample was taken into consideration so as to get the sample to float on

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