Research Paper Engineering

Study of Strength Developemnet in Pervious Concrete Made With OPC by Replacing it With GGBS

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ABSTRACT

Water is a basic source of living and its wastage may lead to its scarcity. Pervious concrete helps in preventing large amount of water waste by its percolation it into the ground. In many developed countries, the use of pervious concrete for the construction of pavements, car parks and driveways is becoming popular. In order to develop material specification for pervious concrete, it is necessary to conduct testing to evaluate its performance. The effect of paste density on properties of hardened concrete by addition of various cementitious admixtures such as GGBS is assessed in this paper. Ground Granulated Burnt Slag (GGBS) are chosen mainly based on the criteria of cost and their durable qualities., Not only this, Environmental pollution can also be decreased to some extent because the emission of harmful gases like carbon monoxide & carbon dioxide are very limited. This paper mainly focuses on the compressive strength of the pervious concrete. To investigate the compressive strength, "Cubes" of size 150mm x 150mm x 150mm are prepared and cured at a regular interval of 3,7,14 and 28 days, the specimens were tested I compression testing machine. Pervious concrete is made by replacing cement by GGBS to the extent of 10% by strength tests were carried out. Different concrete mix proportions such as 1:4, 1:6 and 1:8 are prepared to the check the compressive strength of pervious concrete. The results indicate the pervious concrete containing 10% GGBS can achieve compressive strength of 9.95 N/mm2, 9.46 N/mm2, 6.20 N/mm2 for the proportion of 1:4, 1:6 and 1:8 for 28 days of curing respectively, whereas the strength of pervious concrete for normal PPC cement without mixing any admixture are 9.14 N/mm2, 5.92 N/mm2, 4.28 N/mm2 for 28 days of curing respectively.

KEYWORDS : Pervious Concrete, Ground granulated blast furnace slag(GGBS), Compressive Strength.

I. INTRODUCTION:

Pervious concrete (also called porous concrete, permeable concrete, no fines concrete and porous pavement) is a special type of concrete with a high porosity used for concrete flat applications allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Pervious concrete is made using large aggregates with little to no fine aggregates. The concrete paste then coats the aggregates and allows water to pass through the concrete slab. It seemed that porous concrete was the best material for that period. Porous concrete continued to gain popularity and its use spread to areas such as Venezuela, West Africa, Australia, Russia and the Middle East. After World War II, porous concrete became wide spread for applications such as cast-in-place load-bearing walls of single and multistory houses and, in some Instances in high-rise buildings, prefabricated panels, and stem-cured blocks. Also applications Include walls for two-story houses, load-bearing walls for high-rise buildings (up to 10 stories) and infill panels for high-rise buildings Ground Granulated Blast furnace Slag (GGBS) is a by product from the blast furnaces used to make iron. GGBS is used to make durable concrete structures in combination with ordinary Portland cement and/or other pozzolanic materials. Concrete made with GGBS cement sets more slowly than concrete made with ordinary Portland cement, depending on the amount of GGBS in the cementitious material, but also continues to gain strength over a longer period in production conditions. GGBS replaces a substantial portion of the normal Portland cement concrete, generally about 50 %, but sometimes up to 70%. The higher the portion, the better is the durability. GGBS is used as a direct replacement for Portland cement, on a one-to-one basis by weight. Replacement levels for GGBS vary from 30% to up to 85%. Typically 40 to 50% is used in most instances. For on the ground concrete structures with higher early-age strength requirement, the replacement ratio would usually be 20 to 30%. For underground concrete structures with average strength requirement, the replacement ratio would usually be 30 to 50%. For mass concrete or concrete structures with strict temperature rise requirement, the replacement ratio would usually be 50 to 65%. For the special concrete structures with higher requirement on durability i.e, corrosion resistance for marine structures, sewarage treatment plants etc,. the replacement ratio would usually be 50 to 70%. In this research we prepared specimen of cubes for compressive strength test. Three samples for each set of percentage have been taken for conducting test and average of results are taken. The samples were tested at the age of 3 days,7 days,14 days and 28 days.

II. OBJECTIVES

The following objectives are there of our study

- To study the compressive strength development of GGBS mixed pervious concrete.
- To study the development of compressive strength of pervious concrete made with ordinary Portland cement without mixing any admixtures in it.
- To compare the compressive strength development of plain pervious concrete and pervious concrete made with incorporation of admixtures that is GGBS.

III. METHODOLOGY

Pervious concrete of different mix proportion is prepared with standard method in concrete technology laboratory o f kct engineering collage kalaburgi the mix ratios maintained are 1:4, 1:6 and 1:8 by using 20mm and down size aggregate and ordinary portland cement of 53 grade in which cement is replaced by ggbs to the extent of 10% with water cemet ratio of 0.45. The cube of 150x150x150mm sizes are prepared and minimum of 3 cubes were cast for each batch and they are cured for 3, 7, 14 and 28 days of curing totaling the quantum of cubes to 36 numbers. Similarly pervious concrete with only mixing cement and coarse aggregate similar in sizes as above mentioned without replacing cement with GGBS are cast totaling to 36 numbers. Thereafter all the cubes were cured for respective curing period and tested in compression testing machine of building material of testing laboratory of KCT engineering collage kalaburgi.

HARDENED PROPERTIES OF PERVIOUS CONCRETE:

1. COMPRESSIVE STRENGTH TEST: [IS 516:1959]

The compressive strength test will be carried out on the pervious concrete specimens at the end of 3 days, 7 days, 14 days and 28 days of curing. The procedure to be followed is as given below.

After cleaning the bearing surface of the compression testing machine, the concrete Block will be placed on its face side having dimension 150 mm × 150 mm. The axes of the specimen are to be carefully aligned with the center of the lower pressure plate of compression testing machine. Then an upper pressure plate is to be lowered till the distance between the pressure plate and the top surface of the specimen achieved. No packing used between the face of the pressure plates and block.

The load will be applied without shock and increased gradually at the rate of 35kg/cm2/min until the specimen was crushed.

The compressive strength calculated inN/mm2from the maximum load sustained by the cube before failure.

Compressive Strength= P/A (N/mm2)

Where, P = Failure Load (N)

A = Cross Sectional Area (mm2)

An average of three values was taken for determining compressive strength of concrete

TABLE 1 PHYSICAL PROPERTIES OF ORDINARY PORTLAND CEMENT 53 GRADE (OPC)

Properties	Value for cement for OPC	IS code Recommendations IS : 12269 – 1987
Specific Gravity	3.15	3.10-3.15
Consistency (%)	28%	30 – 35(%)
Initial setting time (min)	35 min	Minimum 30 min
Final setting time (min)	178 min	Maximum 60 min
Compressive strength at 7 days (N/mm2)	38.49 N/mm2	43 N/mm2
Compressive strength at 28 days (N/mm2)	52.31 N/mm2	53 N/mm2

TABLE 2 CHEMICAL COMPOSITIONS OF ORDINARY PORTLAND CEMENT 53 GRADE (OPC)

Oxide	Cement (%)in OPC
Lime CaO	60 -67
Silica SiO2	17 – 25
Alumina Al2O3	3 – 8
Iron Oxide Fe2O3	0.5 – 0.6
Magnesia MgO	0.5 – 4
Alkaline K2O, Na2O	0.3 – 1.2
Sulfates SO3	1.0 – 3.0M

PHYSICAL PROPERTIES GGBS

Property	Coarse aggregate (20mm)
Bulk density Loose (kg/m3)	1501
Specific gravity	2.5
Fineness modulus	6.6
Bulk density compacted Kg/m3	1563

IV. EXPERIMENTAL RESULT AND DISCUSSION

Compressive strength of 9.95 N/mm^2, 9.46 N/mm^2, 6.20 N/mm^2 for the mix proportion of 1:4, 1:6 and 1:8 for 28 days of curing respectively were obtained with GGBS mix pervious concrete

Whereas the strength of pervious concrete for normal PPC cement concrete without mixing any admixture are 9.14 N/mm^2, 5.92 N/mm^2, 4.28 N/mm^2 for mix proportion of 1:4, 1:6 and 1:8 after 28 days of curing respectively.

The development of compressive strength for the admixture that is GGBS mixed pervious concrete higher strength for all mix proportion and at all the stages of curing compared to pervious concrete without GGBS.

TABLE 3 Compressive Strength Test results in (N/mm2) on Cube with OPC 53 Grade Cement replaced with GGBS [IS516:1959]

Admixture	Concrete mix	3 days	7 days	14 days	28 days
GGBS	1:4	4.08	6.58	8.96	9.95
	1:6	3.82	6.21	8.22	9.46
	1:8	2.48	3.72	5.45	6.20

TABLE 3Compressive Strength Test results of plain concrete in N/mm2 with OPC 53 Grade Cement [IS516:1959]

Concrete mix	3 days	7 days	14 days	28 days
1:4	3.85	5.96	8.30	9.14
1:6	2.48	3.87	5.21	5.92
1:8	2.28	3.72	4.06	4.28

V. CONCLUSION

From the experimental result following conclusion were found out,

1. Compressive strength of 9.95 N/mm^2, 9.46 N/mm^2, 6.20 N/mm^2 for the mix proportion of 1:4, 1:6 and 1:8 for 28 days of curing respectively were obtained with GGBS mix pervious concrete
2. Whereas the strength of pervious concrete for normal PPC cement concrete without mixing any admixture are 9.14 N/mm^2, 5.92 N/mm^2, 4.28 N/mm^2 for mix proportion of 1:4, 1:6 and 1:8 after 28 days of curing respectively.
3. The development of compressive strength for the admixture that is GGBS mixed pervious concrete higher strength for all mix proportion and at all the stages of curing compared to pervious concrete without GGBS.

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