



Experimental Investigation on Strength Development of Fly Ash Pervious Concrete

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ABSTRACT

Pervious concrete is a special high porosity concrete used for flatwork applications that allows water from precipitation and other source to pass through there by reducing the runoff from a site and recharging ground water levels. Since authors noticed that less quantum of research is carried out on this topic hence out of motivation this work under consideration is carried out. Herein the concrete is cast by ordinary Portland cement. Herein this investigation the cement is replaced by Fly ash in which ordinary Portland cement has been reduced by introducing fly ash as a compendious agent. Compressive Strength is carried out on hardened Pervious Concrete. This paper mainly focuses on the Compressive Strength of pervious concrete. To investigate the compressive strength, "Cubes" of size 150 mm x 150 mm x 150 mm are prepared and cured at a regular interval of 3,7,14 and 28 days, the specimens were tested in compression testing machine. Pervious concrete is made by replacing cement with fly ash to the extent of 10% by weight and strength tests were carried out. Different concrete mix proportions such as 1:4, 1:6 and 1:8 are prepared to check the compressive strength of pervious concrete. The results indicated the pervious concrete containing 10% fly ash can achieve compressive strength of 13.9 N/mm², 9.1 N/mm², 5.89N/mm² for the mix 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 concrete 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, Porosity, Hardened Properties, Compressive Strength

I. INTRODUCTION

Pervious concrete is a special high porosity concrete used for flat work applications that allows water from precipitation and other source to pass through there by reducing the runoff from a site and recharging ground water levels. Concrete is a homogeneous mixture of cement, aggregate (fine aggregate and coarse aggregate) and water. Now a day's special concrete is more preferred in the construction industry. Some of the special concretes are pervious concrete, transparent concrete, high volume fly ash concrete, self compacted and curing concrete because of their special properties which is better compared to conventional concrete. Pervious Concrete is a special type of concrete in which no fine aggregates are used and gravel has been used in place of the coarse aggregate. Pervious Concrete is also called as "no-fines" concrete. Compressive strength and Flexural strength of pervious concrete does depend primarily on the porosity, it is also affected by aggregate / gravel size, shape and gradation. The compressive strength of pervious concrete is in the range of 2.8 MPa to 28 MPa. So, pervious concrete cannot be used for structural work but it has so many other applications in which it should be significantly used. 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. Pervious concrete is traditionally used in areas meant for parking, areas with light traffic, residential areas, walking area of pedestrian and green houses parking². It is an important application for sustainable con-

struction and is one of many low impact development techniques used by builders to protect water quality. Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls.³ Cost efficiency was the main motive due to a decreased amount of cement.³ It became popular again in the 1920s for two storey homes in Scotland and England. It became increasingly viable in Europe after the Second World War due to the scarcity of cement. It did not become as popular in the US until the 1970s.³ In India it became popular in 2000 pervious concrete consists of cement, coarse aggregate and water with little to no fine aggregates. The addition of a small amount of sand will increase the strength. The mixture has a water-to-cement ratio of 0.28 to 0.40 with a void content of 15 to 25 percent.⁷

II OBJECTIVES

The following objectives are there of our study

To study the compressive strength development of fly ash 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 admixture that is fly ash.

III. METHODOLOGY

Pervious concrete of different mix proportions is prepared with standard method in concrete technology laboratory of KCT Engineering college kalburgi the mix ratios maintained are 1:4, 1:6, and 1:8 by using 20mm and down size aggregates and ordinary Portland cement of 53grade in which cement is replaced by fly ash to the extent of 10% with water cent ratio of 0.45. The cubes of 15x15x15cms sizes are prepared and minimum of three cubes were cast for each batch and they are cured for 3, 7, 14, 28 days of curing totalling the quantum of cubes to 36 numbers. Similarly pervious concrete with only mixing cement and coarse aggregates similar in sizes as above mentioned without replacing cement with fly ash are cast totalling to 36 numbers. Thereafter all the cubes were cured for respective curing period and tested in compression testing machine of building material testing laboratory of KCT Engineering college kalburgi.

HARDENED PROPERTIES OF PERVIOUS CONCRETE:

1. COMPRESSIVE STRENGTH TEST [IS516:1959]

The compressive strength test will be carried out on the pervious concrete specimens at the

end of 3days ,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 x 150 mm. The axes of the specimen are to be carefully aligned with the canter 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 in N/mm² from the maximum load sustained by the cube before failure.

$$\text{Compressive Strength} = P/A \text{ (N/mm}^2\text{)}$$

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/mm ²)	38.49 N/mm ²	43 N/mm ²

Compressive strength at 28 days (N/mm ²)	52.31 N/mm ²	53 N/mm ²
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TABLE 2 CHEMICAL COMPOSITIONS OF ORDINARY PORTLAND CEMENT 53 GRADE (OPC)

Oxide	Cement (%) in OPC
Lime CaO	60 -67
Silica SiO ₂	17 – 25
Alumina Al ₂ O ₃	3 – 8
Iron Oxide Fe ₂ O ₃	0.5 – 0.6
Magnesia MgO	0.5 - 4
Alkaline K ₂ O, Na ₂ O	0.3 – 1.2
Sulfates SO ₃	1.0 – 3.0M

PHYSICAL PROPERTIES OF FLY ASH

TESTS	RESULTS
Specific Gravity	1.76
Absorption	0.3-0.5%
Bulk density	1027.6kg/m ³

III. EXPERIMENTAL RESULTS: AND DISCUSSION

* Compressive strength of 13.9 N/mm², 9.1 N/mm², 5.89N/mm² for the mix proportion of 1:4, 1:6, and 1:8 for 28 days of curing respectively were obtained with fly ash mixed pervious concrete.

* whereas the strength of pervious concrete for normal PPC cement concrete without mixing any admixture are 9.14 N/mm², 5.92 N/mm², 4.28 N/mm² 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 fly ash mixed pervious concrete giving higher strength for all the mixed proportions and at all the stages of curing compared to previous concrete made without fly ash.

TABLE 3 Compressive Strength Test results of pervious concrete in N/mm² with OPC 53 Grade Cement replaced by fly ash [IS516:1959]

Admixture	Concrete mix	3 days	7 days	14 days	28 days
Fly Ash 10%	1:4	5.96	9.64	13.10	13.90
	1:6	3.68	5.98	8.12	9.10
	1:8	2.48	3.96	5.06	5.89

TABLE 3 Compressive 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. CONCLUSIONS

From the experimental result following conclusions were found out,

1. Compressive strength of 13.9 N/mm², 9.1 N/mm²,

5.89N/mm² for the mix proportion of 1:4, 1:6, and 1:8 for 28 days of curing respectively were obtained with fly ash mixed pervious concrete.

2. whereas the strength of pervious concrete for normal PPC cement concrete without mixing any admixture are 9.14 N/mm², 5.92 N/mm², 4.28 N/mm² 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 fly ash mixed pervious concrete giving higher strength for all the mixed proportions and at all the stages of curing compared to previous concrete made without fly ash.

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