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Partial Replacement of Cement by Flyash in Pervious Concrete

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ABSTRACT

Many places were covered with impermeable surfaces like cement concrete and bitumen it leads to major impact on the ground water table. Pervious Concrete pavement is an effective way to minimize this issue. Pervious concrete is an open graded structure with interconnected voids through which rain and storm water is permitted. Pervious concrete is one of the most effective pavement surface to improve ground water level. Porous concrete is an innovative material which is a mixture of coarse aggregate , cement, water and little amount of sand or no sand along with or without chemical admixtures. Porous concrete is a new concept to increase the ground water table level. The main aim of this work is to study the compressive strength of porous concrete by replacing the cement by fly ash.

Keywords: Pervious Concrete, Fly Ash, Strength ,Permeability.

I. INTRODUCTION

In reviewing technology advances through the centuries it is evident that material development plays a key role. Considerable efforts are still being made in every part of the world to develop the new construction materials. About 35% to 70% of our construction sites are being covered by paved surfaces. This impervious surface blocks natural water infiltration into the soil, pervious concrete is one such solution for this problem.

1.1 Pervious concrete / Porous concrete is an innovative material which is a mixture of coarse aggregate, cement, water and little to no sand along with chemical admixtures, containing a network of holes or voids, to allow air or water to move through the concrete. This allows water to drain naturally through it and allows replenishment of groundwater where conventional concrete does not. Absence of sand or fine aggregate permit the properly placed pervious concrete to have about 15 to 30% of void space, the pores can range from 2 to 8mm, which permit water to pass through without causing any damage to the matrix of the porous concrete.

1.2 Fly ash consists of fine, powdery particles that are predominantly spherical in shape, either solid or hollow and mostly glassy (amorphous) in nature, having similar physical characteristic with silt. Compared to its physical properties, its chemical properties are more influenced by the type of burned coal and the techniques used for handling and storage. **Class C** and **Class F fly ash** are classified according to the ASTM C 618. Class C contains more lime than class F fly ash. Class C fly ash has both pozzolanic and cementitious properties and is mostly used in the situations where high early strength is important such as prestressed applications. Class F fly ash is considered an ideal pozzolanic material in mass concrete and in high strength mixes and it is recommended to be used in concrete exposed to ground water.

II. OBJECTIVE OF THE PRESENT WORK

The objective of this study is to investigate the effects on the important engineering properties of pervious concrete with the use of fly ash. The physical properties examined include compressive strength, flexural strength, split tensile strength and permeability of pervious concrete.

III. MATERIALS USED AND ITS PROPERTIES

1. Cement: In the present study ordinary Portland cement of grade 43 is used and tests are conducted as per IS-12269:1987.

Table 1: Properties of cement

Sl No.	*Particulars*	*Results*
1	Specific Gravity	2.8
2	Fineness of Cement	6.92%
3	Standard Consistency	32%
4	Initial Setting Time	41 min

2. Course Aggregate: Crushed Cysts stone with fraction I (25mm passing -20mm retained) , fraction II (12.5mm passing -10mm retained) was adopted. Tests are conducted as per IS-2386:1963.

Table 2: Properties of Course Aggregate

Sl No.	*Particulars*	*Results*
1	Fineness Modulus	7.39%
2	Specific Gravity	2.8
3	Crushing Value	22.43%
5	Water Absorption	0.5% by weight of aggregate.

E. Fly Ash: For the present work Class F fly ash sourced from brick factory shanti nagar wardha and tests are conducted as per IS-3812:2003

Table 4: Chemical Properties of Fly Ash

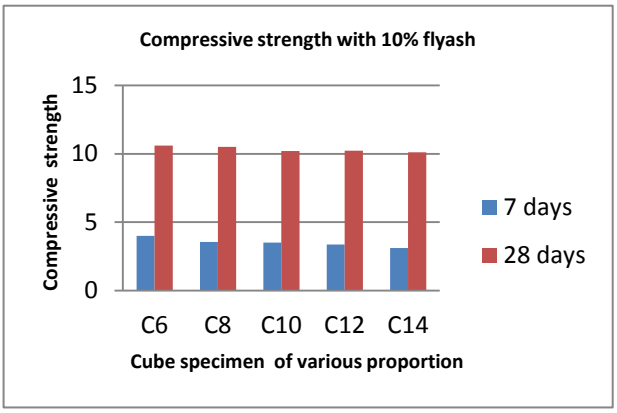
IV. METHODOLOGY ADOPTED

1. Mix design: In the present work, mix design is adopted for M30 grade pervious concrete.

Proportioning: Weigh Batching is used for the experimental study. The weighed cement is mixed with 0%, 10% and 20% fly ash and then with weighed FA&CA aggregates. The whole dry sample is mixed thoroughly by hand mixing. Water is added to the dry sample and mixed well until a uniform homogeneous mix is obtained, the mixing time should not exceed 3-5 minutes.

1.Trial mix: The main objective of the trial mixes were to determine the percentage of fly ash required to achieve a suitable workability for pervious concrete and also to determine the optimum proportion which give better strength and permeability results.

2.Final mix: Based on the results of trial mix or batches the proportions which is resulted in higher compressive strength value with good workability



is selected for the final mix, to find the 28th days compressive strength.

3.Curing: After 24 hrs of moulding, concrete specimens are removed from the moulds and kept for curing in water bath for 7 days & 28 days as per standard procedure.

4.Test: The specimens are tested for compressive strength and percolation rate as per Indian standard code.

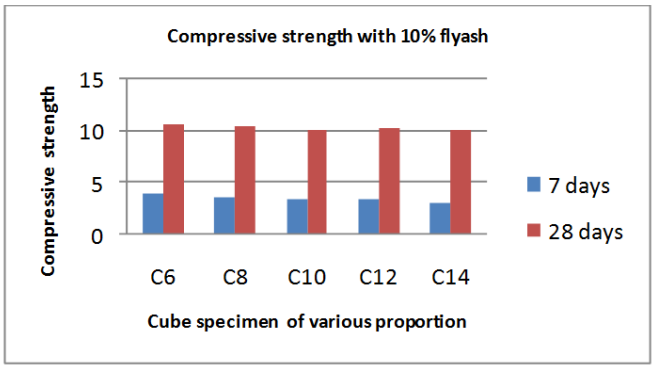
V. RESULTS AND DISCUSSION

A. 7th DAYS AS & 28th DAY STRENGTH CHARACTERISTICS OF PERVIOUS CONCRETE

The basic tests were conducted as per the Indian standards for adopted concrete mix to study the behavior of the pervious concrete. The specimen used for this test is 150X150X150 mm cubes for compressive strength test.

Cubes	Aggregate Proportion (mm)		Fly ash	Avg. strength N/mm²	
	20 mm	10mm	0 %	7 days	28 days
C1	100%	0%	0 %	3.5	10.1
C2	75 %	25	0 %	3.55	10.12
C3	50 %	50	0 %	3.5	10.1
C4	25 %	75	0 %	3.54	10.20
C5	0%	100%	0 %	3.11	10

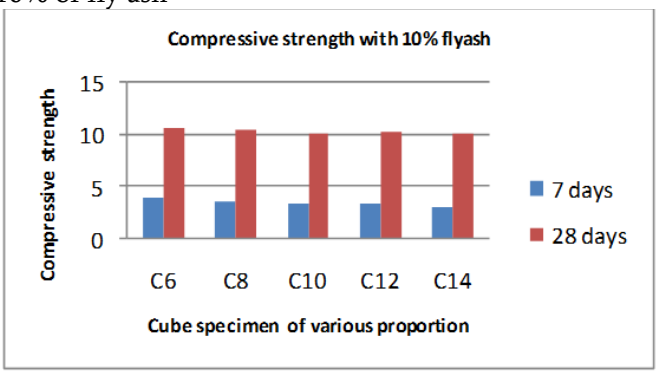
Table 5: 7th&28th days average strength values without fly ash



Graph 5.1:7th&28th days average strength values without fly ash

Cubes	Aggregate Proportion (mm)		Fly ash	Avg. strength N/mm²	
	20mm	10mm	10%	7 days	28 days
C1	100%	0%	10%	4	10.6
C2	75%	25	10%	3.55	10.5
C3	50%	50	10%	3.5	10.2
C4	25%	75	10%	3.37	10.12
C5	0%	100%	10%	3.11	10.05

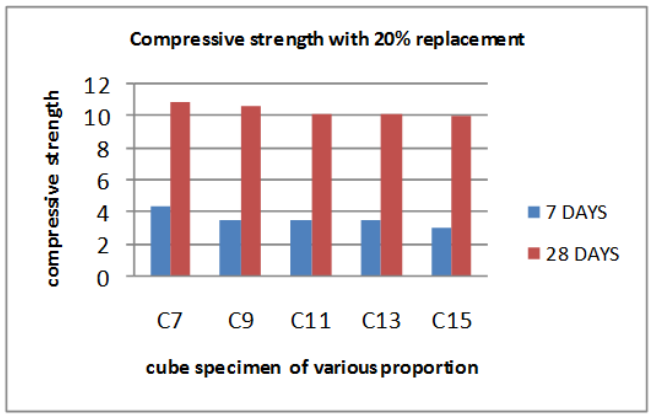
Table 6: 7th&28th days average strength values with 10% of fly ash



Graph 6.1:7th&28th days average strength values with 10% of fly ash

Cubes	Aggregate Proportion (mm)		Fly ash	Avg. strength N/mm²	
	20mm	10mm	20%	7 days	28 days
C1	100%	0%	20%	4.44	10.9
C2	75%	25	20%	3.56	10.6
C3	50%	50	20%	3.5	10.2
C4	25%	75	20%	3.6	10.22
C5	0%	100%	20%	3.51	10.1

Table 7: 7th&28th days average strength values with 20% of fly ash



Graph 7.1:7th&28th days average strength values with 20% of fly ash

a) As observed from the table 5,6& 7 specimen with 20% replacement are showing strength higher than the strength of controlled concrete in compression.
b) Specimen with 10% replacement showing less strength than compared to controlled specimen.
c) Hence, we adopted with 20% replacement of cement with fly ash as final mix for 28th day compressive strength and other engineering properties of pervious concrete.

Permeability Test

Permeability of pervious concrete is calculated by falling head method as per ASTM C1701. It shows time required to percolate from different proportion of cubes.

Specimen	Proportion of Aggregate		Infiltration rate In\hr
	20 (mm)	10 (mm)	
C1	100%	0%	207
C2	75%	25%	266
C3	50%	50%	302
C4	25%	75%	323
C5	0%	100%	348

Table 8: Infiltration rate of pervious concrete with 0% of fly ash

Specimen	Proportion of Aggregate		Infiltration rate In\hr
	20 (mm)	10 (mm)	
C6	100%	0%	201
C7	75%	25%	240
C8	50%	50%	279
C9	25%	75%	299
C10	0%	100%	304

Table 9: Infiltration rate of pervious concrete with 10% of fly ash

Specimen	Proportion of Aggregate		Infiltration rate In\hr
	20 (mm)	10 (mm)	
C11	100%	0%	198
C12	75%	25%	229
C13	50%	50%	261
C14	25%	75%	273
C15	0%	100%	332

Table 10: Infiltration rate of pervious concrete with 20% of fly ash

VI. CONCLUSION

Based on the analysis of results following conclusion are drawn

1. The compressive strength of concrete with 20% replacement results in increased strength compared to the pervious concrete without fly ash.
2. By the use of cementicious material fly ash, the usage of cement can be reduced which will reduce the cost of concrete to certain extent.
3. Hence it is concluded that the percolation rate decreses with increase in percentage of fly assh.
4. As the pervious concrete with 20% replacement of fly ash gives slight increase in compressive strength, hence this material can be used for road pavement at the places of low volume of traffic road, parking lots, play grounds etc which helps in recharging underground water table.

VII. REFERENCES

[1]. Maguesvari M.U. and Narasimha V.L., Studies on Characterization of Pervious Concrete for Pavement Applications , Procedia - Social and Behavioral Sciences, 2nd Conference of Transportation Research Group of India,104 (2013):pp.198–207.

[2]. Aoki Y., Ravindrarajah R. and Khabbaz H.,Properties of pervious concrete containing fly ash Road Materials and Pavement Design,13(2012): pp.1–11

[3]. Nanyang R. and Yukari A., Environmentally friendly pervious concrete for sustainable construction, 35th Conference on Our world in concrete & structures,Singapore 25 – 27 August 2010:pp.2-9.

[4]. Maguesvari M.U. and Narasimha V.L., Studies on Characterization of Pervious Concrete for Pavement Applications , Procedia - Social and Behavioral Sciences, 2nd Conference of Transportation Research Group of India,104 (2013):pp.198–207.

[5]. Alaica A.L. ,Dolatabadi M.H. Sucic A. and Shehata M.,Optimizing the strength and permeability of pervious concrete, Paper prepared for presentation at the permeable pavement design and technology session of the annual conference of the transportation association of Canada Halifax, Nova Scotia,(2010).

[6]. Zaetang Y., Wongsa A., Sata V. and Chindaprasirt P.,Use of coal as geopolymer binder and coarse aggregate in pervious concrete, Construction and Building Materials, 96 (2015) .

[7]. Shah D.S. and Pitroda J.,Pervious Concrete: New Era For Rural Road Pavement ,International Journal of Engineering Trends and Technology , ISSN: 2231-5381,4(2013). :pp.3495-3498 .

[8]. Rahman S.Henderson V.Tighe S.L. and McLeod N.W., The long term drainage performance of pervious concrete pavements in Canada , Paper prepared for presentation Design, Construction and Maintenance of Permeable Pavement Session Conference of the Transportation Association of Canada Montreal, Québec (2014).

[9]. Lime.,Tan K.H and Fang T., Effect of Mix Proportion on Strength and Permeability of Pervious Concrete for Use in Pavement ,Journal of Eastern Asia Society for Transportation studies , 10(2013):pp.659-672.

[10]. Aoki Y., Ravindrarajah R. and Khabbaz H.,Properties of pervious concrete containing fly ash Road Materials and Pavement Design,13(2012).

[11]. Darshan S.Shah etl, “Pervious Concrete: New Era for Rural Road Pavement”, International Journal of Engineering Trends and Technology, Volume 4, Issue 8, August 2013.