



Experimental Study on Porous Concrete with Partial Replacement of Cement by Fly Ash

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Abstract: -Pervious concrete is a type of concrete made by removing the sand from a standard concrete mix. The influence of various ranges of Portland cement content, partial replacement of cement by fly ash (0%,10%,20%,30%) and a chosen plasticizer on a few wet state properties, and on the mechanical, functional and durability properties of pervious concrete with fly ash has been investigated. The object behind the study of pervious concrete is to influence of partial replacement of cement, by fly ash (up to 30%), to examine compressive strength and permeability of pervious concrete, to recommend the optimal mix based on the results by analysis.

Key words: No fine aggregate, permeable, runoff, porous concrete, ground water, interconnectivity etc.

1.INTRODUCTION

'Pervious concrete' is a type of concrete with a high porosity and an interconnected void structure that allows water from precipitation and other sources to pass through the surface of a pavement on purpose.

The aggregate is generally of similar size and is joined together at points of contact with a cement and water mixture. The result is a concrete with a high void content that, when properly operated, allows for rapid percolation of water from the concrete.

The purpose of this research is to assess the structural performance of pervious concrete in civil engineering construction. To accomplish this, the effects of aggregate size variation on the porosity and compressive strength of pervious concrete were investigated. The study focuses on the straightforward application of pervious concrete as a pavement material in the construction of pedestrian walkways and parking lots. Pervious concrete systems have advantages over impervious concrete systems in that they are effective at managing run-off from paved surfaces, preventing contamination in run-off water, and replenishing aquifers.

1.1 Benefits of pervious concrete

- Reduce the quantity of runoff water.
- Prevent water from entering into the stream and also prevents it from being polluted.
- Improve water quality.

1.2 BASIC PRINCIPLE

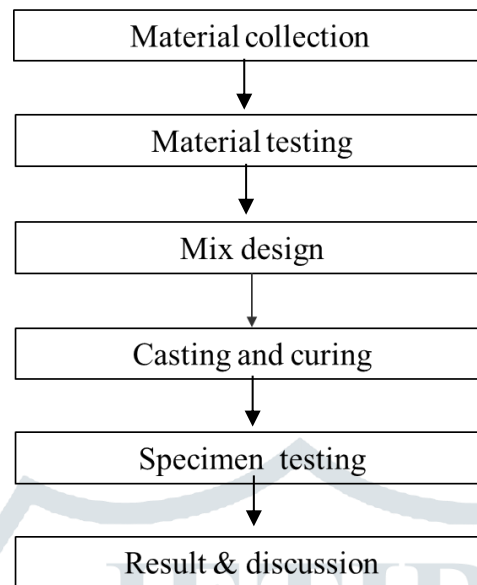
Pervious concrete is made from carefully controlled amounts of water and cementitious materials used to create a paste that from a thick coating around aggregate particles. Unlike conventional concrete, the mixture contains little or no sand, creating a substantial void content-between 15 to 25 percent.

1.3 OBJECT

- To study the influence of partial replacement of cement by fly ash (up to 30%).
- TO examine compressive strength and permeability of pervious concrete.

- To Recommend the optimal mix based on the results by analysis.

1.4 METHODOLOGY



2. EXPERIMENTAL PROGRAM AND APPROACH

2.1.1 AGGREGATES:- In pervious concrete generally singular size of coarse aggregate are used. For design of pervious concrete, we used 12.5mm passed and 10mm retained of coarse aggregate as per the IS code 10262:2009 for mix design and also if coarse aggregate size decrease compressive strength increase.

Test on Aggregate

1) Sieve analysis :-

IS sieve (M2)	wt. of aggregate retained	percentage retained	cumulative retain	cumulative % passing
80	0			
40	0		0	100
20	46		2.3	97.7
16	635	31.75	34.05	65.95
12.5	1279	63.95	95.7	4.3
10	33	1.65	65.6	34.4
6.3	4	0.2	1.85	98.15
4.75	0	0	0.2	99.8
		Total	199.7	

Fineness modulus of C.A. = $(199.7/100) = 1.99 = \underline{2\%}$

2) Specific gravity

Empty wt. of pycnometer (W1) gm	577.2
wt. of pycnometer + aggregate (W2) gm	1576.4
wt. of pycnometer + aggregate + water(W3) gm	2226.2
wt. of pycnometer + water(W4) gm	1571.5
G	$= \frac{(W2-W1)}{(W4-W1)-(W3-W2)} = \underline{2.90}$

3) *Aggregate Impact value*

WT. of sample (w1) = 366gm

WT. of sample passing 2.36 mm(w2) = 24gm

$$\text{Aggregate impact value} = \frac{w2}{w1} * 100 = = \underline{6.56\%}$$

4) *Aggregate crushing value*

WT. of sample (w1) = 3227gm

WT. of sample passing 2.36 mm(w2) = 662gm

$$\text{Crushing value} = \frac{w2}{w1} * 100 = = \underline{20.51\%}$$

5) *Water absorption of aggregate*

WT. of SSD sample (W1) - 999.2gm

WT. of oven dry sample (W2) - 982.5gm

$$\text{Water Absorption} = \frac{w1-w2}{w2} * 100 = = \underline{1.70\%}$$

2.1.2 CEMENTATIOUS MATERIAL: - We used ordinary Portland cement of grade-53 (Ultratech cement) as per the IS code 12269-1982.

*Test on Cement*1) *standard consistency*

Trail no.	Wt. of cement (GM)	Wt. of water (GM)	Water (%)	Needle penetration (mm)	Remark
1	400	112	28	22	Standard
2	400	120	30	16	Consistency
3	400	124	31	10	At 28 degree
4	400	128	32	5	Temperature

Standard consistency (P): 32%

2) *Initial and Final setting time*

Normal consistency	32%
Time when water is added to cement	10:00 am
Time at initial setting	11.04 am
Total time taken for initial setting	64min
Time at final setting	3.00 pm
Total time taken for final setting	236 min

Result: - **1. Initial setting time = 64 min 2. Final setting time = 236 min**

2.1.3 ADMIXTURES: - We used mineral admixtures as fly ash as (0%,10%,20%,30%) and water reducing agent as plasticizer(choskey).

3.MIX DESIGN

Previous concrete does not have the same mix proportion as conventional concrete. There is no codal provision for mix design preparation. The mix proportion is determined by a review of the literature.

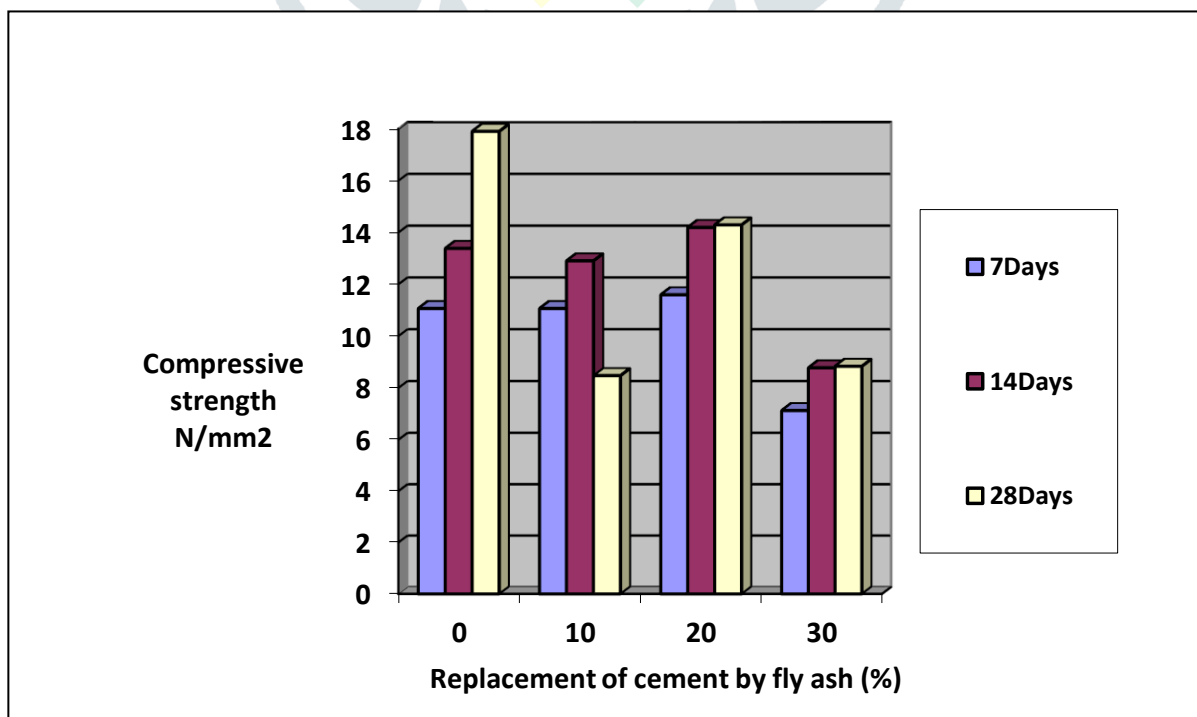
The proportion of material used have been give below (cement:coars aggregate:w/c ratio)=(1:4:0.3)

% Replacement	Water cement ratio	Fly ash (kg)	Cement (kg)	Coarse aggregates (kg)	Water content (ltr)	Glass Fiber (2%) (kg)	Plasticizer (2%) (Kg)
0	0.3	0	30.482	121.941	9.136	0.608	0.609
10	0.3	3.048	27.433	121.941	9.136	0.608	0.609
20	0.3	6.096	24.385	121.941	9.136	0608	0.609
30	0.3	9.144	21.337	121.941	9.136	0.608	0.609

4. RESULTS

A) Compressive Strength

FLY ASH REPLACEMENT (%)	7 Day's Compressive strength (N/mm ²)	14 Day's Compressive strength (N/mm ²)	28 Day's Compressive strength (N/mm ²)
0	11.07	13.39	17.91
10	11.07	12.91	8.48
20	11.6	14.2	14.43
30	7.13	8.78	8.84



B)

PERMEABILITY TEST

The infiltration test was carried out in accordance with the test procedure outlined in ASTM C1701. The infiltration test was used to determine the water passing ability of a pervious concrete panel that had been cast and placed in the field. The infiltration test was performed by hand.

$$I = \frac{KM}{D^2}$$

Where,

I=infiltration

M=water mass

D=ring diameter

T=time

K=constant

FLYASH REPLACEMENT (%)	Time (Sec)	Infiltration Rate (Cm/Sec)
0	21.31	0.656
10	20.90	0.669
20	21.49	0.651
30	22.32	0.626

5. CONCLUSIONS

- I. Mixes of industrial waste 10%,20%,30% Fly Ash give low cost pervious concrete with high strength.
- II. The compressive strength of pervious concrete increases as the water/cement ratio decreases up to optimum w/c ratio of 0.3.
- III. Based on compressive strength, infiltration rate optimum mix found to be 20%
- IV. There is no significant effect on infiltration rate with varying fly ash as (0%, 10%, 20% & 30%)
- V. It was observed that compressive strength of fly ash based pervious concrete decrease with fly ash percentage increase.

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