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Experimental Study on behavior of Pervious Concrete in Strength and Permeability by Changing Different Parameters

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Abstract

Types of concrete that permits water to penetrate through it because of its high void or porosity is known as pervious concrete. These studies look into the impact of size of aggregate (20mm and 10mm), w/c ratio (0.32 & 0.28), super plasticizers (auramix 400 & conplast sp 430) and different percentage of fibre (i.e 1% & 2%) on the behavior of pervious concrete and were described the resemblance with 4 criteria: Compressive strength, split tensile strength, flexural strength, and permeability test. The result indicates that there is moderate increase in strength with decrease in w/c ratio from 0.32 to 0.28 & moreover super plasticizer (conplast sp 430) gives good strength. Addition of fibre i.e 1% by weight of cement showed a significant role in increase in strength. However porosity was the most consider shrewd potency of porous concrete in calculating efficiency of porous concrete which was affected by addition of certain percentage of fibre. The result of this investigation provided useful information about effectiveness of w/c ratio, super plasticizer, fibre and compaction to achieve the optimal strength drain ability balance, adequate for the different urban uses.

Keyword: Pervious concrete, super plasticizer, polypropylene fibre of 12mm, compressive strength, split tensile strength, flexural strength, permeability test

INTRODUCTION

Types of concrete that permits water to penetrate through it because of its high void or porosity is known as pervious concrete. The restricted amount or absence of fines in pervious concretes extremely sonsy pores that facilitate store storm water inside them and cut back runoff amount in an exceedingly scientific manner and since it is environmental friendly artifact EPA (Environmental Protection Agency) has recognized it as Best Management Practice for storm water management.

Pervious concrete was 1st employed in 1800s in Europe however the analysis thereon begun in America & Japan since nineties. Several studied evince pervious concrete to assign the following advantages:

(i) Allow the natural recharge of the ground water & avoid evaporation of water from the soil beneath.
(ii) Backstreet, driveways, sidewalks, pathways and large parking lots.
(iii) Pervious concrete is used as sub-bases for conventional concrete pavements, pavement edge drains.
(iv) Residential roads and low water crossings.
(v) Noise produced by the vehicles gets reduced and no plash is seen on the surface of pavement due to which glisten throughout night isn't seen.

OBJECTIVE

Foremost objective of this paper is listed as

(i) To study the performance and behavior of the open structure of pervious concrete in Indian Climatic Condition.

(ii) To study the strength properties of conventional concrete with pervious concrete.

(iii) To study the influence of fine aggregate, w/c ratio, admixture on the properties of pervious concrete.

SCOPE

i. Porous Concrete pavement system can offer a valuable storm water management tool.

ii. Storm water retention areas could also be reduced or eliminated.

iii. Ground water level & aquifer recharge can be increase by allowing the rainfall to infiltrate.

MATERIALS

a. Cements:-

The cement used for the experimental investigation was ordinary Portland cement of 53 grades. The physical properties of cement are given as

Specific gravity: 3.15

Initial setting time: 2:04 hrs

Final setting time: 2:58 hrs

b. Aggregate:-

Crushed blue Granite of size 20mm & 10mm coarse aggregate was used. Properties of C.A carries

Specific gravity: 2.73

Water absorption: 1%

Whereas Fine aggregate with diameter of less than 2.5mm was used.

c. Super plasticizer:

Two different types of super plasticizer were used in the experimental investigation. i.e. Auramix 400 & conplast sp 430

Dosage of super plasticizer was 1% to that of cement.

d. Fibre:

Polypropylene fibre of size 12 mm was used in order to gain strength.

PREPARATION OF SAMPLE & SPECIMENS:

The investigation matrix with all the thought of mixes and their code are listed within the following tabulation type.

Table 1: Mixes with different parameters

Control mix types	W/C ratio	Mix ratio	Fibre	Sand	Super plasticizer
Mc	0.32	1:1:3.66	-	-	Conplast 430
M1	0.32	1:4.66	-	7%	Auramix 400
M2	0.32	1:4.66	-	7%	Auramix 400
M3	0.32	1:4.66	2%	7%	Auramix 400
M4	0.32	1:4.66	4%	7%	Auramix 400
M5	0.28	1:4.1	1%	15%	Conplast 430
M6	0.28	1:4.1	2%	15%	Conplast 430
M7	0.28	1:3.5	1%	15%	Conplast 430
M8	0.28	1:3.5	2%	15%	Conplast 430

Specimens of three different sizes were prepared for laboratory test. The specimen whose size was 150*150*150 mm was used to measure the restricted compressive strength. Similarly the specimen of size 100*100*500 mm was used for flexural strength and the specimen of diameter 100mm & length 200 mm was used for split tensile strength as well as permeability.

Figure a: Cubes

Figure b: Cylinders

Figure c: Beam

TESTING METHODS:

Compressive strength:

Compressive strength tests were conducted on a cube of size 150*150*150 mm at age of 7 days & 28 days curing. Standard testing machine with a most capability of 2000 KN was used at commonplace rate of loading as per IS 516-1959. Compressive strength, C = P/A. Its unit is N/mm^2.

Figure d: Cube without fibre

Figure e: Cube with fibre

Split Tensile Strength:

Tests were conducted on cylindrical specimen with diameter 100 mm & length 200 mm on a standard testing machine with a maximum capacity of 2000 KN at standard rate of loading as per IS 516-1959.Split Tensile strength = 2P/(πDL). Its unit is N/mm^2.

Figure f: Split tensile strength

Flexural strength test:

The test specimens for flexural strength test were beams having a size of 100mm*100mm*500mm.Flexural test was carried according to two point loading as per IS 516-1959. The illustration is set in the machine in such a path, to the point that the store is associated with the most noteworthy surface as tossed in the shape along two lines isolated. Flexural strength = PL/ (bd^2) and its unit is N/mm^2.

Figure g: Flexural test (without fibre)

Figure h: Flexural test (with fibre)

Permeability Test:

The coefficient of permeability was deduced from Darcy's law, which was preliminary used as a falling head test to obtain its coefficient as per ASTM D2434. It was calculated as

$K = \frac{QL}{HAt}$ Q = quantity of water collected in cm^3

K = coefficient of permeability (cm/s)

L = length of specimen (cm)

T = time (sec)

A = Cross section area of specimen (cm^2)

H = Water head (cm)

Figure I: Permeability test

RESULTS AND DISCUSSIONS

Results obtained from different test mentioned above are represented in following graphical forms:

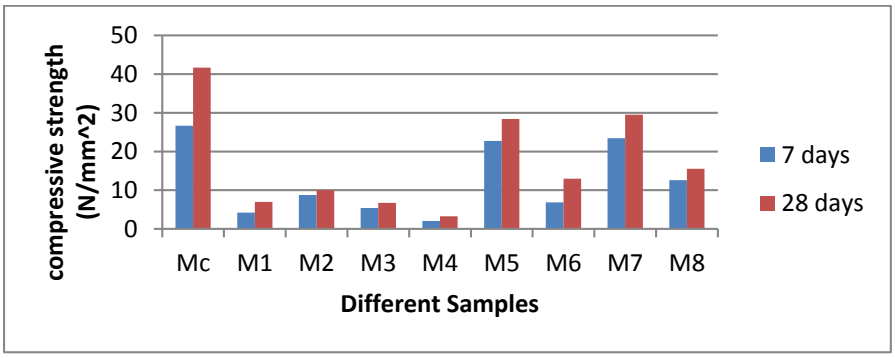

Figure 1: Graphical representation of compressive strength

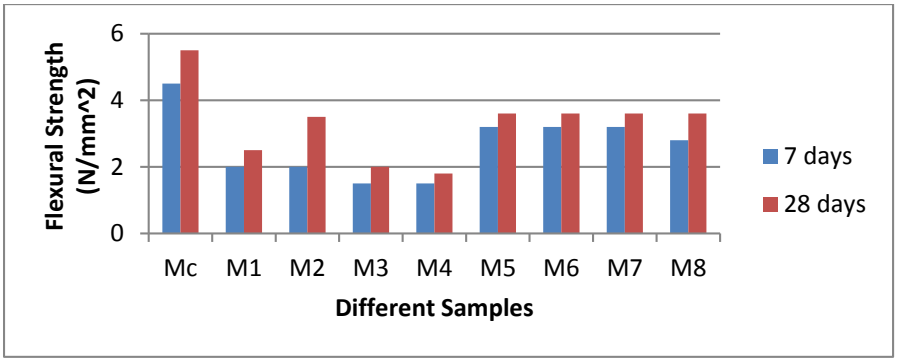

Figure 2: Graphical representation of flexural strength

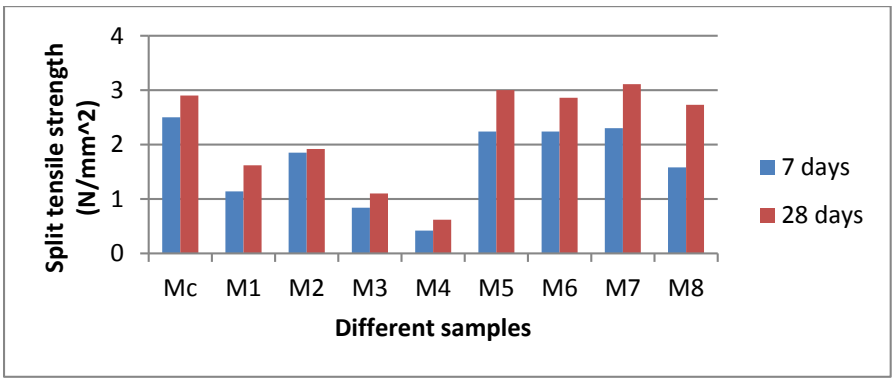

Figure 3: Graphical representation of Split tensile strength

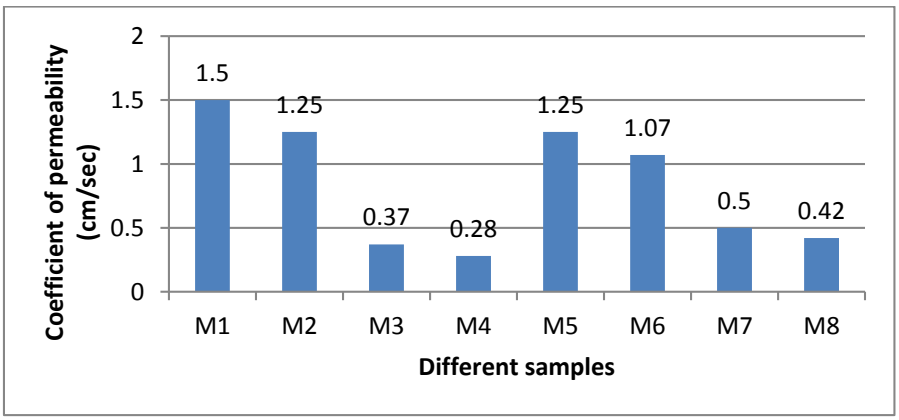

Figure 4: Graphical representation of coefficient of permeability

The mixes were tested with respect to strength and permeability. Result of Compressive strength varies from 3.23 N/mm^2 to 29.5 N/mm^2 where as for flexural strength it varies from 1.8 N/mm^2 to 3.6 N/mm^2. Similarly for split tensile strength and Coefficient of permeability result lies between 0.62 N/mm^2 to 3.11 N/mm^2 and 0.28 cm/sec to 1.5 cm/sec. The result of addition of sand & fibre at the side of influence of w/c; super plasticizer & c/a ratio magnitude relation were evaluated & are discussed below:

Influence of Fibre & sand:

Having gone through the result it was observed that quantity of fibre in mixes had great influence in strength & permeability. I.e. Compressive strength increases with increase in fibre up to 1% by weight of cement but its values decreases on further increased in fibre. From this observation it can be concluded that sample M5 which contained 1% fibre had achieved good strength & permeability than that of sample M2, M3, M4, M6, M7 & M8.

Similarly addition of sand was found to be directly proportion to compressive strength of pervious concrete but was

inversely proportion to the permeability. i.e. Sample M1 & M2 containing no sand showed poor strength but it gave good permeability.

Influence of w/c ratio & C/A ratio:

After analyzing all the results mentioned in graph it showed that with decease in w/c ratio, strength of pervious concrete increased. i.e. Sample M1 to M4 bearing w/c ratio of 0.32 has comparatively less strength than that of sample M5 to M8 which contain w/c ratio of 0.28. Similarly c/a ratio was inversely proportion to strength & directly proportional to permeability of pervious concrete. i.e. M1 to M4 < M5 & M6 < M7 & M8 where as for permeability M1 to M4 > M5 & M6 > M7 & M8.

CONCLUSION

Based on the information obtained during this study, the subsequent conclusion is also drawn as below:

- Fibre content has high effect on compressive strength where as it shows an average effect on flexural & split tensile strength. i.e. with increase in 100% fibre, compressive strength decreases by 50% & moreover coefficient of permeability also decreases.
- Addition of fibre by weight of cement in pervious concrete increases strength rather than replacing by weight of coarse aggregate.
- Pervious concrete with fibres is more flexible than without fibre.
- Though sample M1 has the highest coefficient of permeability it can't be recommended for pavement because of its low compressive strength.
- Sample M7 shows maximum compressive strength of 29.50 N/mm^2 but it's coefficient of permeability 0.5 cm/sec. Hence sample M5 bearing compressive strength of 28.39 N/mm^2 & coefficient of permeability 1.25 cm/sec which is good enough for the construction of low traffic volume pavements and parking lots.

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