

STUDY ON THE BEHAVIOURAL PROPERTIES OF PERVIOUS CONCRETE

Tanmoy Mondal^{1*} and Sabyasachi Ghosh²

¹Department of Civil Engineering, Dr. B. C. Roy Polytechnic, Durgapur-713206, West Bengal, India, Email ID.: tanmoy.mondal@bcrec.ac.in

² Department of Civil Engineering Dr. B. C. Roy Polytechnic, Durgapur-713206, West Bengal, India, Email ID.: sabyasachi.ghosh@bcrec.ac.in

Abstract: Pervious concrete is a form of lightweight porous concrete, obtained by eliminating the sand from the normal concrete mix. The advantages of this type of concrete are lower density, lower cost due to lower cement content, lower thermal conductivity, relatively low drying shrinkage, no segregation and capillary movement of water. It has better insulating characteristics than conventional concrete because of the presence of large voids. The effect of w/c ratio and aggregate size on the strength of pervious concrete are studied. The property of pervious concrete by replacing cement by fly ash is also studied. It is revealed that the compressive strength increases as the water/cement ratio decreases up to optimum w/c ratio and with increase in volume of paste. It is observed that cement can be effectively replaced by fly ash which reduces the cost of pervious concrete. 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 & conplastsp 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 (conplastsp 430) gives good strength.

Key words: Pervious concrete, mix proportioning, compressive strength, super plasticizer, permeability test, coefficient of permeability.

1. 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 porous pores that facilitate store storm water inside them and cut back runoff amount in an exceedingly scientific manner and since it is environmentally friendly artifact EPA (Environmental Protection Agency) has recognized it as Best Management Practice for storm water management. Pervious concrete was first employed in 1800s in Europe however the analysis thereon begun in America & Japan since nineties. Several studies 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.

2. OBJECTIVE

Foremost objective of this paper is listed as

- (i) To study the behaviour of the open structure of pervious concrete.
- (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.

3. 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.

4. 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 & conplastsp 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.

5. 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	Superplasticizer
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*150mm 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.

6. RESULTS AND DISCUSSIONS

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

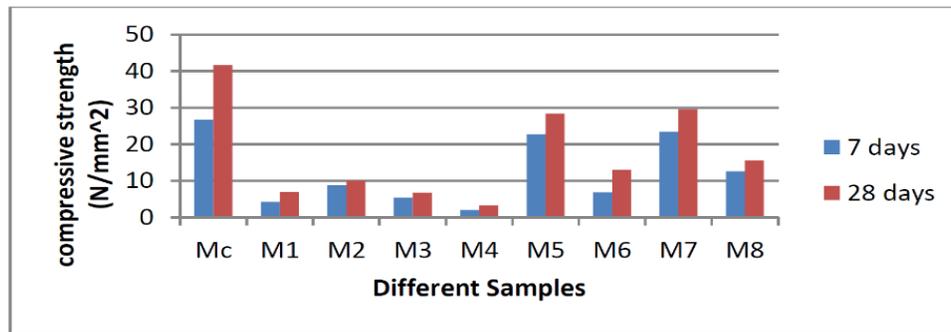


Figure 1: Graphical representation of compressive strength

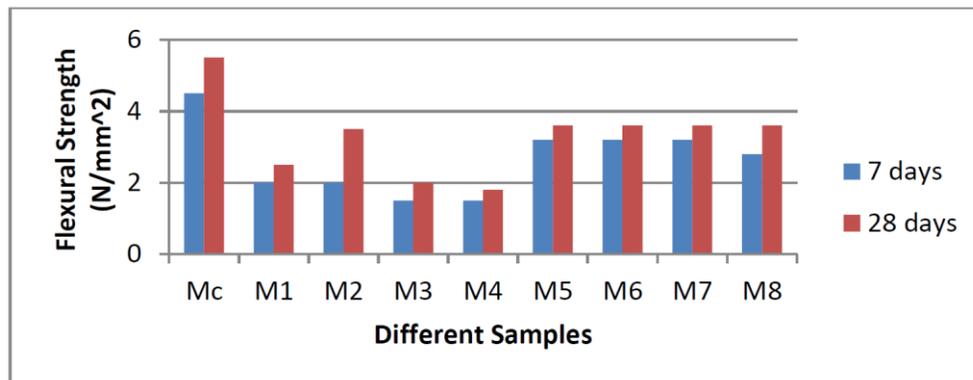


Figure 2: Graphical representation of flexural strength

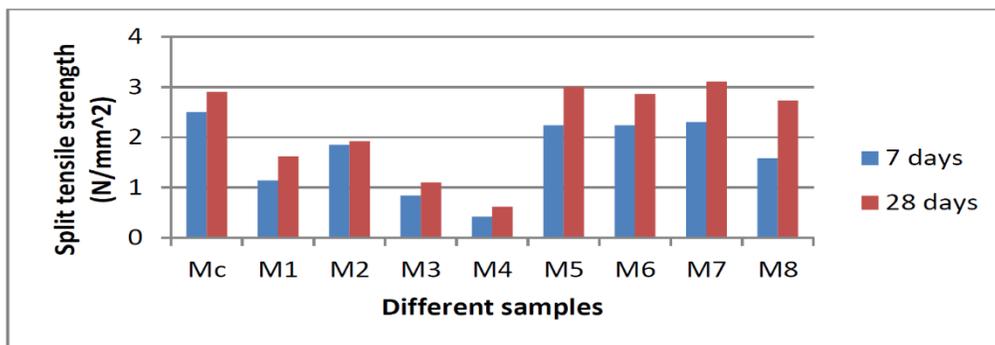


Figure 3: Graphical representation of Split tensile strength

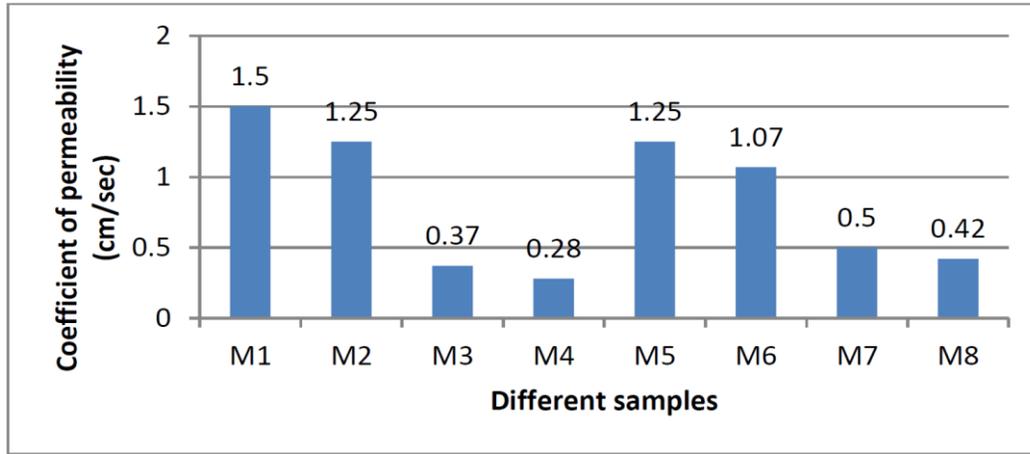


Figure 4: Graphical representation of coefficient of permeability

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 whereas 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

7. 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.

REFERENCES

1. IS: 383 (1970), 'Code of practice for the Specification for coarse and fine aggregate from natural source for concrete', Bureau of Indian Standards, New Delhi.
2. IS: 456 (2000), 'Code of practice for Plain and Reinforcement concrete', Bureau of Indian Standards, New Delhi.
3. IS: 1199 (1959), 'Code of practice for Methods of sampling and Analysis of concrete', Bureau of Indian Standards, New Delhi.
4. IS: 2386 (part 1), (part 2), (part 3) (2002), 'Methods of test for aggregate for concrete', Bureau of Indian Standards, New Delhi.
5. IS: 10262 (2009). "Concrete Mix Proportioning – Guidelines", Bureau of Indian Standards, New Delhi.
6. Shetty. M.S. (2006), 'Text book on 'Concrete Technology', S. Chand & Company LTD, New Delhi.
7. Rui Zhong, Kay Wille (2015) – 'Material design and Characterization of high-performance pervious concrete', Construction and Building materials 98, 51-60.
8. Dr. R.R. Singh and Er. A.S Sidhu (2015) "Strengthening of pervious concrete for high load road application"