Experimental study of Pervious (No Fine) Concrete

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Abstract— Pervious concrete is a composite fabric which consists of cement, Coarse aggregate and water.This paper discusses the combos of pervious concrete with diverse substances like Polypropylene fiber and SuperPlasticizer.Various tests like compressive strength, Flexural strength and Split Tensile strength tests are executed to observe the strength traits of Pervious concrete.The strength of the mixes like plain pervious concrete, mix with polypropylene fiber and concrete mix with both Polypropylene and SuperPlasticizer are in comparison.The result shows that there is a widespread increase in the strength of the Pervious concrete while Polypropylene Fiber and SuperPlasticizer are added to it while as compared to normal Pervious concrete.

Index Terms— Pervious concrete, super plasticizer, Polypropylene fiber, Plain Pervious concrete, Compressive strength, Flexural Strength, Split Tensile Strength

1. INTRODUCTION

Pervious concrete is a special form of concrete which includes cement, coarse aggregate and water.No fine aggregates are used in this concrete.It creates an open cellular shape that allows water to pass through it.Optimum water cement ratio is adopted to acquire the maximum strength. It has a high porosity and lets in rain water to penetrate through it.It also enables in improving the ground water recharge thereby decreasing the run off. It is an important application in sustainable construction Pervious concrete also certainly filters water from rainfall and can lessen the pollutant loads moving into streams, ponds and rivers. So in this way it helps in ground water recharge. Pervious concrete has very high permeability that drains water quickly.

Pervious concrete was 1st employed in 1800s in Europe but the analysis thereon begun in America and Japan since 90s.

OBJECTIVE

- To study the characteristics of pervious concrete using polypropylene fiber and super plasticizers by doing compressive strength test and water permeability test.
- To study the behaviour of Pervious concrete under loading conditions.
- To enhance the use of Pervious concrete in construction industry by providing a better experimental results.

APPLICATIONS

- Parking lots
- Streets, road shoulders
- Bridge embankments
- Driveways, sidewalks
- Tennis courts
- Swimming pool decks
- Greenhouse floors
- Zoo areas, animal barn

ADVANTAGES

S.NO	DESCRIPTION	RESULT
1	Specific Gravity	2.44

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educes the storm water runoff.

- Allow greater efficient land development.
- To assist restore ground water supply.
- Reduce the pollutants of coastal water.
- Recharge ground water table.
- Reduces risk of flooding and topsoil wash away.

2. MATERIALS AND THEIR PROPERTIES

2.1 Cement

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cements used in construction are normally inorganic, often lime or calcium silicate based, and may be characterized as either hydraulic or non-hydraulic, relying on the potential of the cement to set in the presence of water. Portland cement is hydraulic cement while mixed in the proper proportions with water, wherein OPC and PPC typically used.

S.NO	DESCRIPTION	RESULT
1	Fineness of Cement	8%
2	Standard Consistency	32%
3	Specific gravity	3.15
4	Initial setting time	30 mins
5	Final setting time	10 hrs

For this study Ordinary Portland cement of 53grade was used for preparation of pervious concrete. The various properties of cement are tabulated below:

Table 1: Properties of cement

2.2 Coarse Aggregate

Aggregates are coarse particulate rock like material consisting of a collection of particles ranging in size from 12.5mm to 20mm. It includes gravel and crushed rock. The properties of aggregates depend upon the parent rock which may be igneous, sedimentary or metamorphic. In concrete, aggregate is used to reduce any cracks and to provide strength to the structure. Aggregate accounts for 60% to 75% of the volume of concrete.

Table 2: Properties of coarse aggregate

2.3 Water

Water is one of the important materials for the pervious concrete Potable water with pH value 6.5-8.5 is used for mixing and curing throughout the experiment.

2.4 Moulds

- The size of the cube mould is 150 x 150 x 150 mm.
- The size of the cylinder mould is 150 x 300 mm.
- The size of the Rectangular Prism mould is 150 x 150 x 500 mm.

2.5 PolyPropylene Fiber

Polypropylene Fiber is a light weight synthetic fiber. Density of the polypropylene is 0.91gm/cm^3 which is the lowest of all synthetic fiber. It have the lowest thermal conductivity of all fibers. It provides excellent chemical resistance to acids and alkalis, high abrasion resistance and resistance to insects and pests.

2.6 Super Plasticizer

Conplast SP430 is a chloride free, superplasticizing admixture based on selected sulphonated napthalene polymers. It is supplied as a brown solution which instantly disperses in water. It is water reducing agent.

3. MIX PROPORTIONS

Cement : 528kg/m^3

Water cement ratio : 0.25

Coarse Aggregate : 1253kg

Water : 132 litres

Super Plasticizer : 1.5% of weight of cement /kg

Polypropylene : 0.6% to weight of cement/kg

4. CASTING OF SPECIMEN

4.1 Cube

After 24hrs of casting the moulds were removed and the specimens were cured in water for 28days. The size of the cube mould is 150 x 150 x 150 mm.

Fig 4.1 Cube

4.2 Cylinder

After 24hrs of casting the moulds were removed and the specimens were cured in water for 28days. The size of the cylinder mould is 150 x 300 mm.

Fig 4.2 Cylinder

4.3 Rectangular Prism

After 24hrs of casting the moulds were removed and the specimens were cured in water for 28days. The size of the Rectangular Prism mould is 150 x 150 x 500 mm.

Fig 4.3 Rectangular Prism

5. TESTING PROCEDURE

5.1 Compression Strength Test

In a compression test a material experiences opposing forces that push inward upon the specimen from opposite sides or is otherwise compressed, squashed, crushed, or flattened. The test sample is usually placed in between two plates that distribute the applied load across the whole surface area of two opposite faces of the test sample and then the plates are pushed together by a universal testing machine causing the sample to flatten. A compressed sample is typically shortened within the direction of the applied forces and expands within the direction perpendicular to the force. The compressive strength of specimen after 7 days and 28 days are calculated and tabulated in Table 3 and Table 4.

Table 3: Compressive strength of the concrete after 7 days

Cube	Compressive strength after 7 days (N/mm^2)			Mean (N/mm^2)
	S1	S2	S3	
Plain Pervious Concrete	10.4	10.59	11.98	10.99

Polypropyl-ene Fiber	10.98	11.66	11.57	11.40
Polypropyl ene Fiber + Super Plasticizers	11.76	11.65	12.03	11.81

Table 4: Compressive strength of the concrete after 28 days

Cube	Compressive strength after 28 days (N/mm²)			Mean (N/mm²)
	S1	S2	S3	
Plain Pervi-ous Concrete	16.57	17.09	16.89	16.85
Polypropyl-ene Fiber	18.50	18.38	19.07	18.65
Polypropyl ene Fiber + Super Plasticizers	19.22	19.65	19.58	19.42

5.2 Split Tensile Strength Test

The sample tested in this method is generally cylinder specimen.The test sample is generally placed in between two plates that distribute the applied load across the entire surface area of two opposite faces of the test sample and then the plates are pushed together by a universal testing machine which cause the sample to flatten. A compressed sample is usually shortened in the direction of the applied forces and expands in the direction perpendicular to the force.

Table 5: Split Tensile strength of the concrete after 28 days

Cylinder	Split Tensile strength after 28 days (N/mm²)			Mean (N/mm²)
	S1	S2	S3	
Plain Pervious Concrete	8.12	7.93	8.76	8.27
Polypropyl-ene Fiber	8.97	9.28	9.53	9.26
Polypropyl ene Fiber + Super Plasticizers	9.96	9.72	10.43	10.03

5.3 Flexural Strength Test

Flexural strength test is to check the ability of unreinforced concrete beam to withstand failure in bending .The results of flexural test on concrete expressed as a modulus of rupture which is denoted in MPa or psi. It evaluates the tensile strength of concrete indirectly. The flexural test on concrete are often conducted using either three point load test (ASTM C78) or center point load test (ASTM C293).The modulus of rupture value obtained by center point load test arrangement is smaller than three point load test. It is observed that low modulus of rupture is achieved when larger size concrete specimen is considered. The specimen generally used for this test is rectangular prism.

Table 6: Flexural strength of the concrete after 28 days

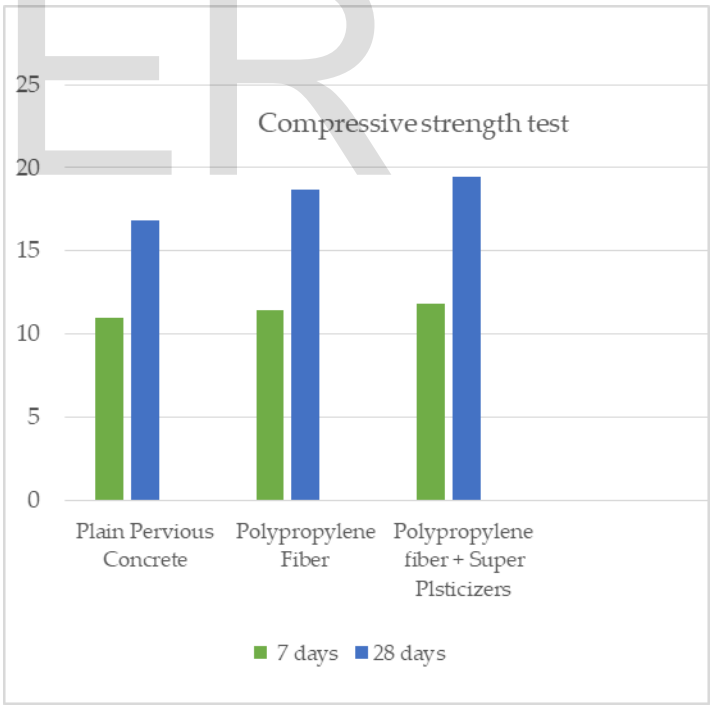
Rectangular Prism	Flexural strength after 28 days (N/mm²)			Mean (N/mm²)
	S1	S2	S3	
Plain Pervi-ous Concrete	6.20	5.98	5.88	6.02
Polypropyl-ene Fiber	6.98	7.43	7.02	7.14
Polypropyl ene Fiber + Super Plasticizers	7.93	7.46	7.85	7.75

6. RESULT AND DISCUSSION

6.1 Compressive Strength Test

From the Table 6.1 and 6.2, it is observed that the compressive strength is in increasing order when admixtures are used. It is also observed that the compressive strength of concrete with polypropylene fibers and superplasticizer is greater than that of plain pervious concrete. The variation in compressive strength is presented in fig.6.1.

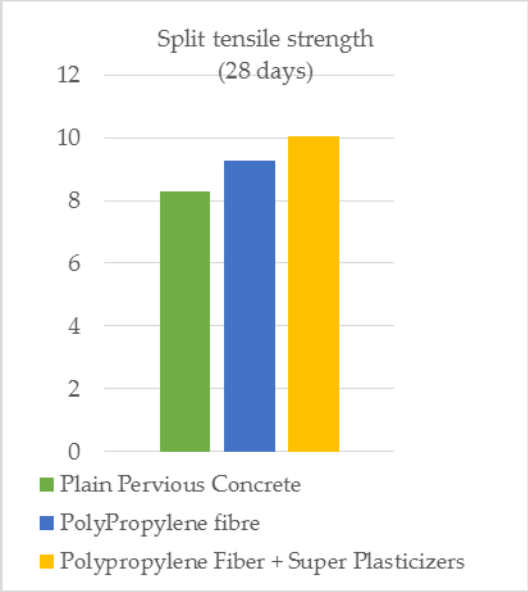
Fig 6.1 Compressive strength of Concrete in 7 daysand 28 days



6.2 Split Tensile Strength Test

From the Table 5, it is observed that the split tensile strength is in increasing order when admixtures are used. It is also observed that the split tensile strength of concrete with polypropylene fibers and superplasticizer is greater than that of plain pervious concrete. The variation in split tensile strength is presented in fig.6.2.

Fig 6.2 Split tensile strength of concrete in 28 days



6.3 Flexural Strength Test

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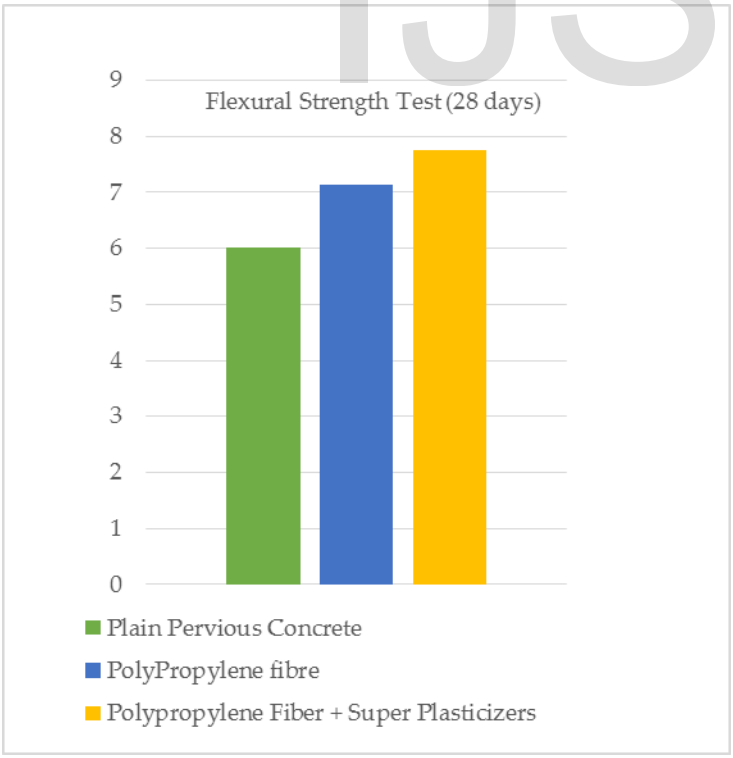
Fig 6.3 Flexural strength of concrete in 28 days



7. CONCLUSION

From the test results, the following conclusions were made

- Compressive strength of the concrete attained at an age of 7 days is about 60-75% of the compressive strength of the concrete attained at an age of 28 days.
- The compressive strength of Polypropylene mixed pervious concrete is increased when compared to plain pervious concrete, when the fiber is added to the concrete at a rate of 0.6% of the weight of cement.
- The increase in strength is because of the Polypropylene fiber in pervious concrete enhances the bonding between the coarse aggregate and cement paste.
- The strength can be further increased by adding superplasticizer (ConplastSP430) to the Polypropylene fiber added Pervious concrete, when the super plasticizer is added at a rate of 1.5% of the weight of cement.
- It was observed that there is an increment in compressive, flexural and split tensile strength of pervious concrete with polypropylene fiber and super plasticizer, when compared with plain pervious concrete mix.

8. REFERENCE

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