MANTECH Publications

Journal of Ceramics and Concrete Technology
Volume 6 Issue 3
ISSN: 2457-0826 (Online)

Comparison of Test Results of Pervious Concrete with Silica Fume and Polypropylene Fiber

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Abstract

Pervious concrete is a unique kind of concrete with high porosity. That reduces the water runoff particular site and promote to ground water recharge. In this project Silica Fume (S.F) be used in percentages as (0.5%, 5% and 10%) the mechanical properties were studied. Moreover, (0.05%, 0.1% and 0.15%) are the proportions of polypropylene fibers (P.P.F) by volume, which used to improve the pervious concrete mechanical properties. To study the physical and mechanical properties of hardened concrete containing compression strength, flexural strength and split tensile strength.

Keywords: *Porous concrete, Silica fume, Polypropylene fibers, MIX proportion, Flexural strength, Compressive strength, Split tensile strength.*

INTRODUCTION

Pervious concrete is special type of concrete with a high porosity. pervious concrete was first used in the 1800s in Europe. It became popular again in the 1920s for two story homes in Scotland and England. It became increasingly viable in Europe after the second world war due to the scarcity of cement. It did not become as popular in the US until the 1970s. Pervious concrete sometimes referred to as "no- fines concrete. Generally used for concrete flatwork applications. Allows water from precipitation and other sources. Reducing the runoff from a site and allowing ground water recharge. The high porosity is attained by a highly interconnected void content. It is a mixture of hydraulic cement, coarse aggregate of smaller size, admixtures and water.

Typically, pervious concrete does not contain any sand and its air void content varies between 15 and 30%. This concrete is being used as paving material to solve or reduce the storm water runoff to the drainage system and minimize water logging problems.

OBJECTIVE OF THEWORK

- To determine the properties and strength of pervious concrete withfibers.

- To The effect of polypropylene fiber and silica fume variation in aggregate sizes and water cement ratio on pervious concrete.

MATERIALS

A. Cement

Cement is a binding material and it is grinding together calcareous(lime stone or chalk) and argillaceous (shale or clay) and other. Cement is invented by joseph Aspdin in 1824 a brick layer in Leeds, UK, Alumina or iron oxide bearing materials. The mixture is burnt in a kiln at a temperature of about 13000C to 15000C. Gypsum about 2 to 3 percent is mixed at the time of grinding to prevent flash setting.

Fig.1 Applications of pervious concrete

TABLE I. Composition of Portland Cement

OXIDE	COMPOSITION
CaO	60-65%
SiO_2	17-25%
Al_2O_3	3-8%
Fe_2O_3	0.5-6%
MgO	0.1-4%
Alkalis	0.4-1.3%
Sulphur	1-3%

B. Fine aggregate

According to IS 383, defined as aggregate most of which will pass through 4.75mm IS sieve and entirely retained on 75-micron sieve. Fine aggregate content is limited in pervious concrete.

C. Coarse aggregate

Coarse aggregate is kept to a narrow gradation and it is retained on 4.75mm sieve and pass through 80mm sieve. A narrow grading is the important characteristic. Larger aggregates provide a rougher surface. The smallest sized aggregate feasible is used for aesthetic reasons. Coarse aggregate size 9.5mm top size has been used extensively for parking lots and pedestrian applications. Both rounded aggregate (gravel) and angular aggregate (crushed stone) have been used to produce pervious concrete. Typically, higher strengths are achieved with rounded aggregate, although angular aggregates are generally suitable.

D. Water

Potable water.PH value generally not less than 6 as per IS 456-2000.

E. Admixtures

These are the chemical compounds used for improving the characteristics of concrete such as workability, setting time etc. Without affecting the strength of concrete.

Fig.2 Pervious concrete

BENEFITS OF SILICA FUME

- It gives high early compressive strength
- High tensile flexural strength and modulus of elasticity.
- Enhanced durability and increases toughness.
- Higher bond strength, high electrical resistivity and low permeability.

BENEFITS OF POLYPROPYLENE FIBER

Polypropylene fiber is a light fiber, its density 0.91gm/cm3 is the lowest of all synthetic fibers.

- It does not absorb moisture. This means the wet and dry properties of the fibers are identical.
- It has excellent chemical resistance.
- Polypropylene fibers are very resistant to most acids and alkalis.
- The thermal conductivity of polypropylene fibers is lower than that of other fibers.

TEST CONDUCTED ON PERVIOUS CONCRETE

- Flexural strength test: Flexural strength test is carried out on prism specimens of dimensions 100 mm x 100 mm x 500 mm. The test is carried out by applying two-point loading on the prism at the age of 7 and 28 days. The tests are carried out at various percentages of steel fibers. The results are tabulated below.

- Compressive strength test: Compressive strength tests are carried out on cubes of size 150 mm x 150 mm x150 mm. The specimens are tested after keeping it for curing at the age of 7 and 28 days. The results obtained are compared with the results of a control mix specimens. The results are tabulated below.

- Split tensile strength test: For the determination of split tensile strength of concrete, cylinder specimens of diameter 150 mm and height 300 mm were casted. The cylinders were casted for different addition of steel fibers. The tests were conducted on cylinders at an age of 7 and 28 days. The results are tabulated below.

Fig.3 Storm water runoff difference between normal concrete and pervious concrete

EXPERIMENTAL WORK PROCEDURE

Two different mixes of pervious concrete have been prepared in the laboratory; each mix contains 0.3 ratios. The first mix only reinforced with polypropylene fiber, the second mix reinforced with silica fume. For Compressive Strength Test, cubes for each proportion have been prepared and tested in 7 days,14 days and 28 days curing period, in the laboratory.

For Flexural Strength Test, beams sample of each proportion have been prepared and tested in 28 days curing period. The best ratio has been chosen based on the Flexural strength and Compressive Strength obtained results.

MIX PROPORTION

Mix (C: C. A)	Proportions
M1(1:5)	C. A 100% (>16mm&≤ 20mm)
M2(1:5)	C. A 100% (>10mm&≤ 12.5mm)
M3(1:5)	C. A 60% (>16mm&≤ 20mm) & 100% (>10mm&≤ 12.5mm)
M4(1:6)	C. A 100% (>16mm&≤ 20mm)
M5(1:6)	C. A 100% (>10mm&≤ 12.5mm)
M6(1:6)	C. A 60% (>16mm&≤ 20mm) & 100% (>10mm&≤ 12.5mm)

PROPERTIES OF MATERIALSUSED

A.Properties of cement

TABLE III. Properties of cement

S.No	PROPERTIES	VALUES
1.	Specific Gravity	3.89
2.	Bulk Density	1440 kg/m3
3.	Surface area	225 m2/kg
4.	Initial setting time	30 min
5.	Final setting time	600 min

A. Properties of fineaggregate

TABLE IV. Properties of fine aggregate

S.No	PROPERTIES	VALUES
1.	Specific Gravity	2.67
2.	Bulk Density	1326.20 kg/m3

B. Properties of coarseaggregate

TABLE V. Properties of coarse aggregate

S.No	PROPERTIES	VALUES
1.	Specific Gravity	2.71
2.	Bulk Density	1414.5 kg/m3
3.	Size	10 mm

TEST RESULTS

TABLE VI. Compressive Strength & Flexural Strength Results of Pervious Concrete

Mix	Compressive strength (M pa) days			Split tensile strength (M pa) 28 days	Flexural strength (M pa) 28 days
	3	7	28		
M1	8.58	11.65	14.76	2.35	2.25
M2	11.5	11.26	17.63	2.4	2.28
M3	12.34	12.29	22.37	2.5	2.67
M4	4.77	7.66	9.85	1.5	1.65
M5	4.39	7.26	9.48	2.36	2.51
M6	5.63	7.44	9.74	2.23	2.44

TABLE VII. Compressive Strength & Flexural Strength Results of Pervious Concrete using Silica Fume

Mix	Percentage of Silica Fume		Percentage of Silica Fume	
	5%	10%	5%	10%
	Compressive strength (M pa) 28 days	Compressive strength (M pa) 28 days	Flexural strength (M pa) 28 days	Flexural strength (M pa) 28 days
M1	16.3	18.88	2.81	3.02
M2	19.34	21.37	3.07	3.23
M3	26.09	28.07	3.57	3.70

M4	11.72	13.64	2.39	2.58
M5	12.88	14.33	7.42	2.62
M6	12.56	14.56	2.48	2.76

TABLE VIII. Flexural Strength of Pervious Concrete using Polypropylene Fibers

Mix	Percentages of Polypropylene Fibers		
	0.05%	0.1%	0.15%
M1	3.42	3.89	3.78
M2	3.56	4.07	3.92
M3	3.91	4.15	4.15
M4	2.87	3.15	3.02
M5	3.07	3.47	3.23
M6	3.57	3.88	3.77

CONCLUSION

1. The Mix proportion M3(1:5) has got a high Compressive strength.

2. The Mix proportion M3(1:5) has got a high Split tensile strength.

3. The Mix proportion M3(1:5) has got a high Flexural strength.

4. There was an increase in Compressive strength with increase in silica fume and max compressive strength pervious concrete 28.07 M pa at 28 days of age found in mix proportion M (1:5).

5. There was an increase in Flexural strength by adding polypropylene fibers.

6. The Max Flexural Strength of Pervious concrete was 4.15 M pa at 28 days of age found in mix proportion M3(1:5) with 0.1% Polypropylene fiber by volume of concrete.

7. The compressive strength, the split tensile strength and the flexural strength increase with increase in the percentage fiber content up to 2% only.

8. Satisfactory workability was maintained with increasing volume fraction of fibers by using super plasticizer.

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