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An Experimental Analysis on Effect of Fibers on Pervious Concrete

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ABSTRACT: Conventional Portland cement Concrete is commonly used for pavement construction. The impervious nature of the concrete pavements contributes to the increased water runoff into the drainage system, over-burdening the infrastructure and causing excessive flooding in built-up areas. Pervious concrete is a special type of concrete with a high porosity used for concrete pavement applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing ground water recharge. The glass fiber and coir fiber can be the effective material to improve the properties of the pervious concrete. The M30 grade of cement for pervious concrete materials used it will explore the use of glass fiber which is environmentally detrimental. The tests to be carried out to analyze the properties of pervious concrete are void ratio, compressive strength, flexural strength, split tensile strength and permeability test with varying fraction of fine aggregate.

KEYWORDS: Glass fiber and coir fiber, compressive strength, flexural strength, tensile strength.

I.INTRODUCTION

Pervious concrete which is also known as no fines, porous, gap graded and permeable concrete and enhance porosity concrete has been found to be a reliable storm water management tool. By definition, pervious concrete is a mixture of gravel or granite stone, cement, water, little to no sand (fine aggregate). When pervious concrete is used for paving, the open cell structures allow storm water to filter through the pavement and into the underlying soils. In other words, pervious concrete helps in protecting the surface of the pavement and its environment.

Pervious concrete has the same basic constituents as conventional concrete that is 15% - 30% of its volume consists of interconnected void network, which allows water to pass through the concrete. High range water reducer and thickening agent are introduced in the concrete to improve its strength and workability. It can allow the passage of 0.014-0.023 m³ of water per minute through its open cells for each square foot 0.0929 m² of surface area which is far greater than most rain occurrences.

II.OBJECTIVES OF THE WORK

- To study the effect of glass fiber and coir fiber in strength of pervious concrete.
- To determine the effect of material proportions on the engineering properties of the pervious concrete.
- The main objective is to investigate the performance characteristic of the pervious concrete such as porosity, compressive strength, infiltration rate etc.

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III.CONSTITUENT MATERIALS

MATERIALS USED: The ingredients used in this work are same as those used in conventional concrete. But here we introduce waste glass powder as a partial replacement for cement. The materials used are cement, sand, waste glass powder, coarse aggregate and water.

CEMENT: In the present work, Ordinary Portland Cement of 53 grade conforming to IS: 12269-1987 has been used. The physical properties of the cement obtained on conducting appropriate tests as per IS: 269/4831.

Table .1: Properties of Cement

Grade	OPC 53
Specific Gravity	3.1
Initial Setting Time	60 min
Final Setting Time	440 min
Standard Consistency	33%
Fineness	4.95

GLASS FIBER: Glass fiber also called as fiber glass. It is material made from extremely fine fibers of glass. Fiber glass is a light weight, extremely strong and robust material. Although strength properties are somewhat lower than carbon fiber and it is less stiff, the material is typically are less brittle, and the raw materials are much less expensive.

Table .2: Properties of Glass Fiber

S.No.	Properties	Glass Fiber
1	Tensile strength	1200 – 1700 Mpa
2	Compression strength	1080 Mpa
3	1080 Mpa	2.7 g/cm ³
4	Shape	Irregular pieces
5	Nature	It does not absorb water
6	Source	Industries

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Coir fiber: Coir fibers are added to the optimum mix by 0.1%, 0.5%, 1%, 1.5% and 2% of weight of cement. The optimum percentage of coir fiber is obtained as 1% of weight of cement with the increase in compressive strength by 64.9% and the decrease in permeability by 17.9% compared to the conventional pervious concrete. Coir fiber used in cement improves the resistance of concrete from sulphate attack. Compressive strength is also improved up to certain percentage.

WATER: Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water are required to be looked into very carefully.

COARSE AGGREGATE: The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below 15%.

Table .3: Properties of Coarse Aggregates

S.No	Particulars	Values
1	Specific Gravity	2.7
2	Fineness Modulus	8.26

IV. MIX DESIGN

Table.4:Mix design: Materials for 1 m³ concrete

Symbol	Cement (Kg)	C.A (Kg)	GF+ CF (Kg)	Water (litre)
0% GF+CF	380	1280	0	171
5% GF+CF	361	1280	19	171
10% GF+ CF	342	1280	38	171
15% GF+ CF	323	1280	57	171
20% GF+ CF	304	1280	76	171

V.CASTING AND CURING INTRODUCTION

The mould specification, preparation of mould method of casting and curing are discussed below.

CASTING: During moulding, the human is formed and concrete is conveyed in pans from hand to hand. The concrete shall be put gently in the Ace shape mould thickness not exceeding 6cm and compacted by the mechanical compressive machine with help of unskilled labour. The materials were weighed as per the designed mix proportion and they were

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mixed using concrete mixer. The mixing operation was continued till a good uniform, homogeneous concrete was obtained. General mixing time of 5 to 10 minutes was followed. Steel moulds were used for casting the specimens.

MOULD PREPARATION: The cube mould was placed in position on an even surface. All the interior faces and sides were coated with mud oil to prevent the sticking of concrete to the mould.

MIXING: The grade of concrete selected is M30 and water cement ratio adopted was 0.45. The selection of this low water content of 0.45 was done because of spherical nature of aggregates. The mix proportion taken was and mixing satisfies the requirement of IS 456-2000. Concrete is mixed in roller type of mixing machine.

VI.RESULTS AND DISCUSSION

Compressive strength: Concrete cube specimen used to find out the compressive strength of concrete.

Testing on concrete cubes



Fig. 2: compressive strength test for specimen cubes.

Table .5: Testing results: compressive strength

%	7 days	14 days	28 days
M30	Compressive Strength (N/mm²)	Compressive Strength (N/mm²)	Compressive Strength (N/mm²)
0	22.08	25.46	34.56
5	21.80	27.05	35.16
10	21.40	27.67	35.80
15	22.45	27.89	37.10
20	22.60	25.04	35.89

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Compressive strength: Bar Charts

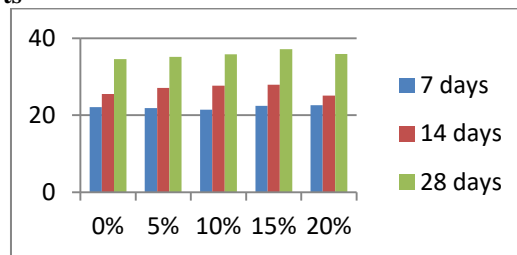


fig.3: Compressive strength (x) vs various mix design (y)

Flexural strength: The flexural strength test is conducted on the beam and results are shown in the table 8.



Fig. 4: Testing on beam

Table.6: Testing Results: Flexural Strength

%	Ultimate load (kN)	Deflection (mm)	Energy absorption (kN-mm)	Ductility factor	Stiffness kN/mm
0	44	4.6	151	1.31	8.57
5	46	5.3	160	1.61	9.5
10	50	6.4	180.5	1.73	11
15	54	6.7	195	1.86	13.18
20	46	5.6	156	1.6	5

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Split tensile strength

The split tensile strength test obtained from 28 days of curing in water.



Table.7: Testing Results

S.No.	Percentage of fiber added	Average split tensile strength in 28 days(N/mm ²)	Percentage increase in strength
1	0	2.81	-
2	5	3.02	7.4
3	10	3.12	11.1
4	15	3.33	18.5
5	20	3.75	33.3

Split tensile strength: Bar Charts

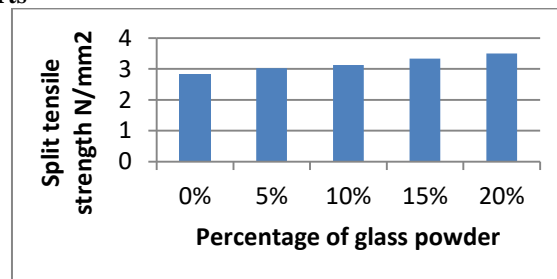


Fig.7: Split tensile strength strength(x) vs. various mix design (y)

VII. CONCLUSIONS

The following conclusions are made from the study on properties of pervious concrete with the replacement of cement by 1.5% of glass fiber and coir fiber:

1. The void content is observed to be in the range of 15% to 22% with average void content.

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2. The void content of 10% fine aggregate is decreased by 16.5% and 20% fine aggregate is decreased by 28.4% compared to 0% fine aggregate.
3. The compressive strength of 10% fine aggregate is increased by 7.3% and 20% fine aggregate is increased by 14% compared to 0% fine aggregate and ranges between 25Mpa to 32Mpa for 28 days of curing.
4. The compressive strength of 20% fine aggregate increased by 15% compared to conventional concrete without glass fiber.
5. The compressive strength of concrete with 0% glass fiber is increased by 28% compared to 1.5% of glass fiber.
6. The Split tensile strength increased by 18% for 10% fines and by 26% for 20% fines compared to 0% fines and ranges between 1.9Mpa to 3Mpa for 28 days.
7. The flexural strength increased by 13% for 10% fines and by 21% for 20% fines compared to 0% fines and ranges between 1.8Mpa to 2.6Mpa for 28 days.
8. The permeability of 10% fine aggregate is decreased by 29% for 10% fine aggregate and decreased by 38% for 20% fine aggregate compared to 0% fine aggregate and ranges between 6.3mm/sec to 3.9 mm/sec.

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