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Pervious concrete with glass fiber

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Abstract- Pervious concrete is a mixture of cement, coarse aggregate and water. Pervious concrete is also known as zero slump concrete. Pervious concrete have less compressive strength so cannot be used for heavy traffic roads. In this thesis, glass fiber is used as a partial replacement of cement to increase the strength of the pervious concrete. The cement is partially replaced with glass fiber in volume of 1%, 1.5% and 2%. A large number of trial mixes are required to select the desired optimum replacement of cement by waste material glass fiber.

Keywords- Pervious concrete, glass fiber, cement, compressive strength, partial replacement.

1. INTRODUCTION

Groundwater is an important natural source of water to increase water level of rivers, lakes, etc. Seeing the present infrastructure development, the transportation facilities by roads are increased which increases soil erosion, pollution, runoff of water. Pervious concrete helps in decreasing the side effects of problems mentioned above. Pervious concrete is an eco friendly pavement is also known as a no fine aggregate or zero slump concrete. Being a void contained pavement, pervious concrete does not give more strength, so it is used in parking areas, footpaths, internal roads joining one or two buildings or campus roads. . With the increasing demands of the materials, waste products also increase; to dump them useful land is wasted for dumping these waste products. Later, the land is of no use or unyieldable. So, we used glass fiber, a waste product obtained from broken glasses to increase the compressive strength of the pervious concrete. Glass fiber was selected as a replacement material because it shows similar properties to cement.

1.1 Objectives

1. To study the effect of glass fiber in strength of pervious concrete.
2. To achieve the target strength of pervious concrete using mix design.
3. To analyze the variations in the infiltration rate & storm water runoff.

1.2 Applications

1. Pervious concrete can be used for residential roads and driveways. It can be applied for sidewalks and pathways.
2. Pervious concrete can also be used for parking areas.
3. On tennis courts pervious pavements can be used.
4. It can also be used for slope stabilization. Pervious concrete can also be applied for Pavement edge drains,
5. Noise Barriers.
6. Recharge of local aquifer.

2. LITERATURE REVIEW

Kolli. Ramujee et. al. (2013)[1], had compressive strength and splitting tensile strength tests reveals that, the strengths were increased proportionately with the increase in volume ratios of Polypropylene Fibers with reference to the controlled mix without admixtures.

A.V. Pradeepa et. al. (2014)[2], obtained experimentally that the mechanical properties were enhanced when GGBF Slag is reinforced with the Glass fiber polymer and also the specimen having 15% (largest constituent of GGBF Slag percent among all other specimens) possesses better Tensile Strength, Compression Strength, Flexural Strength, Impact strength and Hardness.

Chandana Priya.C et. al. (2016)[3], studied the mechanical properties of glass fiber and fly ash by replacement of 0%, 20% and 40% by weight with addition of glass fiber at four different volume fractions 0%, 0.5%, 1%, 1.5% which increases the compressive strength at 20% to 25% strength.

3. EXPERIMENTAL MATERIAL AND EQUIPMENT

3.1 Materials

Cement– We used Ordinary Portland cement of 53 Grade. It will be used for casting all the specimens. The compressive strength measured in standard mortar at 28 days was 54MPa. The choice of brand and type of cement affects the rate of hydration, so

that the strengths at early ages can be considerably influenced by the particular cement used.

Aggregate- Locally available crushed blue granite stones conforming to graded aggregate of nominal size 14 mm- 20. The specific gravity is 2.7 and retained on 13.2mm sieve and passing through 16mm. Several investigation concluded that as the aggregate size increase compressive strength of the mix decreases. Bulk density of aggregate is 1737 Kg/m^3

Water – To mix the ingredients of concrete, tap water has been used. Water has been used in necessary amount.

Glass Fiber– Glass Fiber Reinforced Concrete (GFRC) or (GRC) is a type of fiber reinforced concrete. Glass fiber is mainly used in exterior building façade panels and as architectural precast concrete. This material is very good in making shapes on the front of any building and it is less dense than steel.

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The specifications of the glass fiber used in this thesis are as follows:

- Length of the glass fiber used is 12mm
- Filament diameter: 14µm / 0.00055^0
- Specific gravity of glass fiber is 2.68g/cm^3
- Moisture (%): 0.50max.
- Material: Alkali resistant glass
- Softening point: 860^0C (1580^0F)
- Modulus of elasticity: 72Gpa

3.2 Equipments

Universal Testing Machine – UTM is used to test the compressive strength and tensile strength of materials. The "universal" part of the name reflects that it can perform many standard compression and tensile strength on material, component and structures.

Mould - Cubical Mould of size 150X150X 150mm is used for this thesis.

Steel tamping rod – 16mm diameter rod of rounded ends is used for tamping purpose.

Curing – Jute bags are used for curing process. To prevent the top surface of the pervious concrete from drying we used Jute bags.

4. SELECTION OF MATERIAL

4.1 Comparison of glass fiber and polypropylene

	GLASS FIBER	POLYPROPYLENE
TENSILE STRENGTH	1200-1700MPa	550-70 MPa
COMPRESION STRENGTH	1080MPa	as % increases compressive strength increases
SPECIFIC GRAVITY	2.7 g/cm^3	0.91 g/cm^3
SHAPE	irregular pieces	Wavy
NATURE	It does not absorb water	It has hydrophobic nature
PRICE	40 Rs/kg	140 Rs/kg
SOURCE	Industries	Chemical industry
		

Based on the above comparison of glass fiber and polypropylene, glass fiber is selected as it has more similar properties as cement. Polypropylene was used before in a paper so used to compare here. Glass fiber used in this project has some standard sizes.

5. MIX DESIGN

Based on ACI 522R-10

Pervious concrete of strength 20 MPa

Design average cube strength at 28 days

20/0.75 = 26.66 N/mm^2

Bulk Density of aggregate – 1737 Kg/m^3

Water-cement ratio- 0.38

b/b_o – 0.99 (table 6.1)

Dry weight of aggregate – 52.75Kg

% void – 15%

% paste – 27%

Cement Content – 11.8Kg

Water content – 5 liter

Replacement of glass fiber – 1%, 1.5% and 2% by volume.

6. RESULTS

6.1 Glass Fiber (1% replacement)

	Strength (MPa)	Strength (MPa)	Strength (MPa)
Days	7 Days	14Days	28 Days
Cube 1	10.19	14.70	14.27
Cube 2	11.27	13.60	15
Cube 3	9.87	14.87	15.67

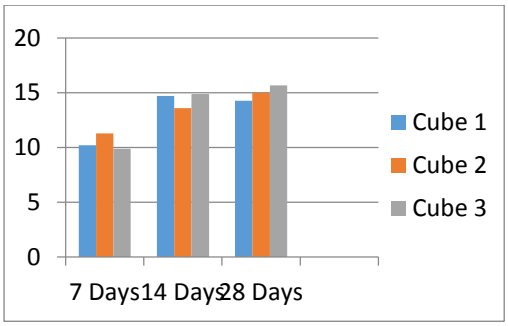

Chart 6.1 (1% Glass Fiber)

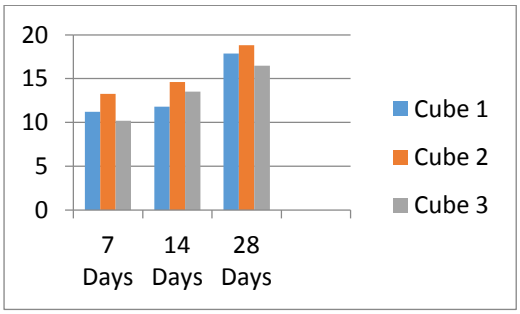

Chart 6.2 (1.5% Glass Fiber)

6.2 Glass Fiber (1.5% replacement)

	Strength (MPa)	Strength (MPa)	Strength (MPa)
Days	7 Days	14Days	28 Days
Cube 1	11.19	11.80	17.85
Cube 2	13.27	14.6	18.80
Cube 3	10.20	13.50	16.48

6.3 Glass Fiber (2% replacement)

	Strength (MPa)	Strength (MPa)	Strength (MPa)
Days	7 Days	14 Days	28 Days
Cube 1	11.77	13.56	15.22
Cube 2	10.01	14.25	15.67
Cube 3	9.34	14.19	17.28

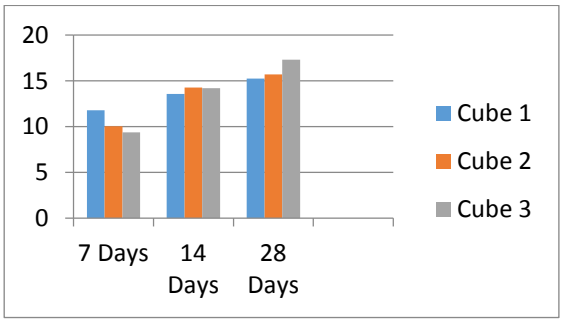

Chart 6.3 (2% Glass Fiber)

7. CONCLUSION

On the basis of above results the following conclusion can be made:
From 1.5 to 2% the compressive strength is increasing. So, can be taken any replacement of any number between 1.5% to 2%. The optimum value can be obtained between this range.

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