Research Article

Strengthening Of Permeable Concrete Using Bitumen Coated Bamboo Rods

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Abstract- Now-a-days we see massive improvement in construction industry and infrastructure development. In India almost all, the metro cities are covered with impermeable concrete pavement that creates an environmental issue, such as decrease of rainwater penetration into the ground. Hence a continuous falls in water table which leads to water disaster during summer. We can overcome the above problem by using permeable concrete. Porous concrete is a special type of concrete, which is normally used for drain the storm water runoff in rainy days. Concrete ingredients such as cement make permeable concrete, coarse aggregate, water and little sand or no sand, make permeable concrete. The intensity of permeable concrete is low when compared to normal concrete. So, permeable concrete is normally used for pedestrian walls, residential streets and parking areas. In order to increase the intensity, we introduce bitumen coated bamboo rods as reinforcement. When compared to steel, bamboo is more efficient in cost and eco-friendly. By using this, we can increase the intensity and compressive strength of permeable concrete.

Keywords: Permeable concrete, normal concrete, Intensity, Bamboo rods.

I INTRODUCTION

Porous concrete is a special type of concrete with a high sponginess used for various concrete applications that allows rainwater and other sources of water to pass directly through drainage or ground to reducing the runoff from a site and allowing groundwater recharge. Porous concrete, which is also known as permeable concrete, is a high-concert pavement concrete, which has high water permeability and absorbency. This high water permeability of pervious concrete drains storm water and allows it to enter into the ground. Ordinary concrete has a void ratio of around 3- 5% and Permeable concrete has higher void ratio of around 18-40%depending on its intensity. Porous concrete are made of using aggregates with little or no fine aggregates. The concrete paste then coats with aggregates and lets water to pass through the concrete slab. Permeable concrete are conventionally used in parking areas, areas with light traffic, housing streets, pedestrian boardwalks, and greenhouses, Low-volume pavements, Pavement edge drains, Sidewalks and pathways, Tennis courts, Swimming pool deck, Slope stabilization, etc., during the past few years, porous concrete has fascinated more and more attention in concrete industry due to the increased attentiveness of environmental protection.

II METHODOLOGY

2.1 LITERATURE SURVEY:

We are studied eight literatures about bamboo and permeable concrete. From those literatures, we gathered lot of information about the properties and testing of permeable concrete.

2.2 MATERIAL COLLECTION:

We are collected five materials to do this project. They are Cement, Coarse aggregate, Water, Bitumen and Bamboo.

2.3 TESTING OF MATERIALS:

We are done five tests for cement, four tests for coarse aggregate and two tests for bitumen.

2.4 MIX DESIGN:

We are done mix design for M30 grade of Permeable concrete by using IS10262:2009.

2.5 TESTING OF FRESHAND HARDENED CONCRETE SPECIMENS:

We are done Slump cone test for fresh concrete and Compression strength test, Split tensile strength test and Flexural strength test for hardened concrete.

2.6 CASTING AND TESTING OF SLABS:

Slab size of 300 x 600 x 100mm was casted for permeable concrete (case 1) and permeable concrete with bitumen coated bamboo rods (case 2). Finally flexural strength test was done for those slabs.

2.7 RESULT AND CONCLUSION:

After testing of slabs, the results was compared and concluded.

TESTING OF MATERIALS

3.1 SPECIFIC GRAVITY OF CEMENT:

Specific gravity of Kerosene is 0.79-0.82.

Specific gravity= $(w_2-w_1)/ (w_2-w_1)-(w_3-w_4)$ x0.82

Where,
W_1=empty weight of conical flask
W_2=conical flask +cement
W_3=conical flask +cement+ kerosene
W_4= conical flask+ kerosene
W_1=30g, W_2=50g, W_3=80g, W4=65g
= ((50-30) / (50-30)-(80-65))*0.79
S_g= 3.20

Fig1: Specific Gravity of Cement

3.2 CONSISTENCY OF CEMENT PASTE:
25% of water added in 350g of cement = 7mm

Fig 2: Consistency of Cement Paste

3.3 FINENESS OF CEMENT:
Amount of cement taken =100g
Retained = 10g

3.4 INITIAL AND FINAL TEST SETTING TIME OF CEMENT PASTE:
Initial setting time of cement: 45 minutes
Final setting time of cement: 10hrs 45minutes

3.5SOUNDNESS OF CEMENT:
For good Cement, the expansion should not exceed 10 mm.
Observation
Initial Reading of Needle = 10mm
Final Reading of Needle = 15mm

Fig 3: Soundness of Cement

3.6 SPECIFIC GRAVITY OF COARSE AGGREGATE:

Coarse aggregate = 10mm aggregate

Specific gravity $=w_2-w_1/ (w_2-w_1)-(w3-w_4)$ x1

Where,

W_1= Empty weight of Pycnometer ; W_1=0.410kg

W_2= Pycnometer +aggregate; W_2=0.985kg

W_3= Pycnometer + aggregate+ water; W3=1.575kg

W_4= Pycnometer +water; W4=1.225kg

S_g=(0.985-0.410)/(0.985-0.410)-(1.575-1.225)*1

=0.75/0.225

S_g=2.670

Fig 4: Specific Gravity of Coarse Aggregate

3.7 AGGREGATE WATER ABSORPTION TEST:

Formula:

Water absorption (%) = $[(w_2 – w_1) / w_2] \times 100$

Observation:

Dry aggregate, w_1 = 2000g

Wet aggregate, w_2 = 2025g (after 24 hrs.)

Water absorption = ((2025 – 2000)/2000) x 100

= 1.25%

3.8 ABRASION TEST:

W_1 = 2kg (initial sample)

W_2 = 0.055kg (after revolutions)

$= (w_2 / w_1) \times 100$

$= (0.055/2) \times 100$

Percentage of wear = 2.75 %

3.9 SIEVE ANALYSIS OF COARSE AGGREGATE:

Fineness modulus = 689.5 / 100

Fineness modulus = 6.89

Fig 5:Sieve analysis of Coarse Aggregate

3.10 PENETRATION TEST ON BITUMEN:

Fig 6: Penetration Test on Bitumen

Observation:
Penetration value = 47.7mm

3.11VISCOSITY TEST:

Observation:
Softening point = 47^0c

4. MIX DESIGN CALCULATION FOR M40 GRADE OF PERMEABLE CONCRETE:

Data
Concrete: M40 grade
Cement used: OPC43 grade
Nominal size of aggregate: 10mm
Minimum cement content: 320kg/m
Specific gravity of cement: 3.15
Specific gravity coarse aggregate: 2.67

Mix proportion

Cement = 320 kg/m^3
Water = 208 litres
Coarse aggregate = 949 kg/ m^3
Water cement ratio = 0.40

CEMENT	WATER	COARSE AGGREGATE	WATER CEMENT RATIO
320 Kg/m^3	208 litres	949 kg/m^3	0.40

Table 1: Mix Proportion

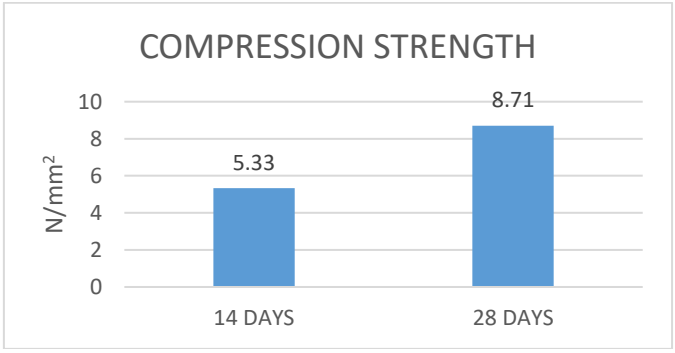
Ratio = (C: FA: CA) = (1 : 0 : 3)

5. TEST REPORT OF SPECIMENS OF PERMEABLE CONCRETE:

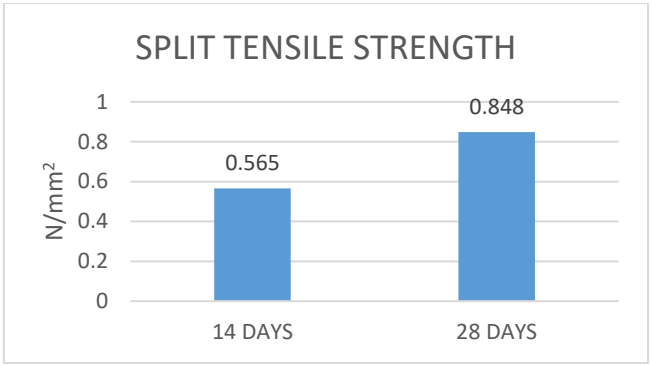
TESTS	14 DAYS	28 DAYS
Compression Strength test	5.33N/mm^2	8.71N/mm^2
Split tensile Strength test	0.565 N/mm^2	0.848 N/mm^2
Flexural Strength test	1 N/mm^2	1.5 N/mm^2

Table 2: Test Report of Specimens of Permeable Concrete

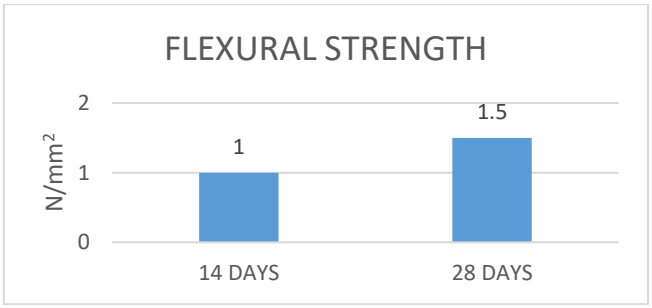
5.1 GRAPHICAL REPRESENTATION OF RESULTS:



Graph 1: Compression Strength Test



Graph 2: Split Tensile Strength Test



Graph 3: Flexural Strength Test

6. CASTING AND TESTING OF SPECIMENS

6.1 CASTING OF SLABS

6.1.1 CASTING OF PERMEABLE CONCRETE SLAB:

Slab size = 300x600x100mm

In this case, concrete is poured upto 100 mm and taken for curing process for 28 days.

6.1.2 CASTING OF PERMEABLE CONCRETE SLAB WITH BITUMEN COATED BAMBOO RODS AS REINFORCEMENT:

Slab size = 300x600x100mm

In this case, concrete is poured upto 50 mm and bitumen coated bamboo grid is kept as reinforcement and concrete is filled upto 100 mm and taken for curing process for 28 days.

6.2 TESTING OF SLAB

6.2.1 RATE OF INFILTRATION TEST:

Fig 13: Rate of Infiltration

Volume of water = 1lit
Water penetration area =1589.62 mm^2
Observation:
Conventional slab = 51sec
Bitumen coated bamboo reinforcement = 50.3sec

6.2.2 FLEXURAL STRENGTH TEST OF SLABS:

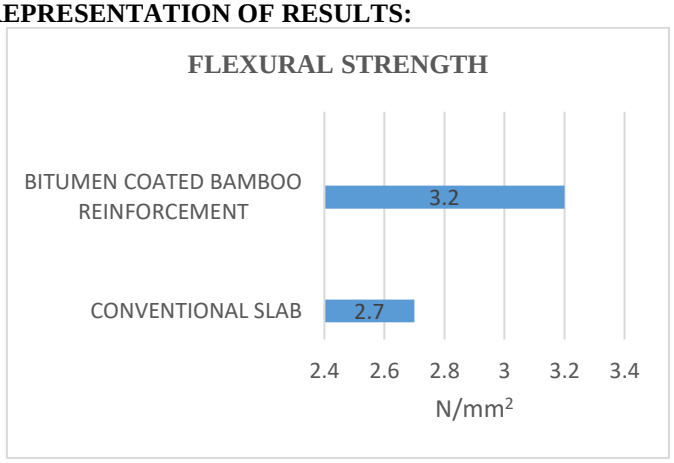
Fig 14: Flexural Strength Test

6.2.3 FINAL TEST REPORT OF FLEXURAL STRENGTH OF PERMEABLE CONCRETE SLABS:

SL NO	SLABS	FLEXURAL STRENGTH
1	Permeable concrete slab	2.7 N/mm^2
2	Bitumen coated bamboo reinforcement	3.2 N/mm^2

Table 3: Final Test Report of Slabs

6.2.4 GRAPHICAL REPRESENTATION OF RESULTS:



Graph 4: Flexural Strength of Permeable Concrete Slabs

7. RESULT AND CONCLUSION:

In this experiment, Compared to conventional permeable concrete slab, the strength is increased by using bitumen coated bamboo rods as reinforcement. The flexural strength of predictable permeable concrete is 2.7 N/mm^2 and conventional permeable concrete with bitumen coated bamboo reinforcement is 3.2 N/mm^2.This result indicates bitumen coated bamboo reinforced concrete have more strong point when equated to predictable permeable concrete. Comparatively the rate of infiltration is not affected by the bamboo reinforcement and both slabs has approximately equal rate of infiltration.

From this, we concluded that the bitumen coated bamboo rods gave strength to the conventional permeable concrete. Therefore, we can provide it as reinforcement for conventional permeable concrete pavements for future use to attain good strength.

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