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Investigation on Comparative Study of Porous Concrete using Waste Material

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Abstract: *The aim of this project to investigate the properties of porous concrete made with different waste material available in local area, the objective at porous concrete is, and concrete was made with replacement of aggregate with 10% 20% and 30% with coconut shell. Like this replacement of cement with fly ash and replacement of cement with blast furnace Slag. At 7, 14, 28 days of age, concrete made from the compressive resistance and porosity test with normal porous concrete and results are computed.*

Keywords: Cement, Coarse Aggregate, Sand, Coconut Shell, Blast Furnace Slag, Fly Ash, etc.

I. INTRODUCTION

Porous concrete was first seen in the 1800s in Europe and was used for various structural purposes, including load-bearing walls, infill panels, and pavement surfacing. It became popular again overseas after World War II due to the scarcity of cement.

Porous concrete or water permeable concrete is a concrete with a high void content to allow water or air to permeate. In general, porous concrete has pores with sizes in the range of 2–8 mm

With proper installation and maintenance, porous paving allows for infiltration of up to 80% of annual runoff volume. Additionally, studies indicate that porous concrete systems can remove up to 65% of undissolved nutrients from runoff and up to 95% of sediment in runoff.

1.1 POROUS CONCRETE

Porous concrete is defined as a "hydraulic-cement concrete proportioned with sufficient, distributed, interconnected macroscopic voids that allow water to flow through the material under the action of gravity alone"

1.2 CLASSIFICATION OF CONCRETE

Concrete in bifurcated with 3 main categories as replacement of aggregate with coconut shell, replacement of cement with blast furnace slag and replacement of cement with fly ash. Each type of replacement is done with 10% 20% and 30%.

II. METHODOLOGY

2.1 Steps included in concrete making

2.1.1 Material Testing

Compressive Strength:- This metric determines the compressive strength of reinforced concrete. The compressive strength of concrete is shown by the compressive test in optimal circumstances. The compressive strength of concrete is an indicator of its strength once it has hardened. Testing should be carried out with care. The test was carried out at a standardized stress of 140 kg/cm2/minute after the specimen was centered in the measurement unit. Loading continued until the dial gauge needle simply reversed its movement. The needle's path has been redirected, meaning that the specimen failed. The dial gauge reading at the time, which was maximum load, was registered. The ultimate cube compressive power is proportional to the ultimate load separated by the specimen's cross sectional area. The compressive strength of concrete reveals information about the material's general quality. The test specimen is hexagonal in shape and measures 230x118x60 If the highest normal dimension of the aggregate is less than 20mm, 10mm cubes would be used instead. Compressive strength checks are conducted on specimens of proven age, ideally from different batches made for each age of processing. All of the cubes were tested in a saturated condition after the

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surface moisture was removed. At 14 days and 28 days of porous concrete each trail mix mixture three cube was tested using a compression measuring machine with a capacity of 2000KN according to IS 516-1959.

TEST ON CEMENT

Fineness test of cement

This test of cement is performed to check the fineness of cement according to standard specifications. The fineness of cement can be measured either by the grain size of cement or by the surface area of cement. The sieve Test (IS 4031-part-1) - 90 µ size sieve. The fineness of cement has a significant effect on the hydration and in increasing the rate of gain strength.

Table-2: Result of Fineness test

Sr. No.	W1 (Wt. of Sample of Cement)	W2 (Wt. of Sample Retained in 90µ Sieve)
01	100	5.3 %

Standard Consistency Test

Standard consistency test on cement. It is used to find out the percentage of water required to produce cement paste of standard consistency. It is also sometimes called as Normal Consistency (CPNC).The Standard consistency of a cement paste is defined as that consistency which will permit a Vicat's apparatus plunger having 10mm dia. and 50mm length to penetrate to a depth of 33-35 mm from the top of the mould.

Table-3: Result of Standard Consistency Test

Sr. No.	Wt. of Cement(gm)	% of water of dry cement	Amount of water added	Penetration-on (mm)
01	400	20%	110ml	28%

TEST ON AGGREGATE

Crushing Strength of Aggregate

The test consists of subjecting the specimen of aggregate in standard mould to a compression test under standard load conditions Dry aggregates. The specimen is subjected to a compressive load of 40 tones gradually applied at the rate of 4 tones per minute. A value less than 10 signifies an exceptionally strong aggregate while above 35 would normally be regarded as weak aggregates.

Table- 4: Result of Crushing Strength of Aggregate

Sr. No.	Wt. of dry Sample taken (W1)	Wt. of sample passing through 4.75mm Sieve (W2)
01	2.892	0.489

Abrasion Test On Aggregate

Abrasion test is carried out to test the hardness property of aggregates and to decide whether they are suitable for different pavement construction works. Los Angeles abrasion test is a preferred one for carrying out the hardness property and has been standardized in India (IS: 2386 part-IV).

Table- 5: Result of Abrasion Test on Aggregate

Sr. No.	Original Wt. of Sample (W1)	Wt. of retained on 270mm Sieve (W2)
01	500gm	440.8gm

2.1.2 Manufacturing

Table-1: Material Required

Sr. No	**Material Used**
1	Cement
2	Course Aggregate
3	Sand

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4	Coconut Shell
5	Furnace Slag
6	Fly Ash

We made porous concrete using waste material which is available in nearby area. We casted total 21 blocks the 1st type we made is normal porous concrete which is made with coarse aggregates cement and water. Then we made concrete blocks with replacement of aggregate with coconut shell as 10% 20% and 30%. Then we replaced cement with fly ash with 10% 20% and 30% . As above we replaced cement with blast furnace slag. After 2nd day of casting we demoulded moulds and blocks are placed for curing. After curing compressive strength and porosity test are taken and results are concluded. Selection of Raw Materials: The materials used in this Project are Ordinary Portland cement (OPC), Coarse Aggregate, natural sand coconut shell, blast furnace slag, and fly ash which is a waste material easily available in nearby area.

2.1.3 Mould size :- 230mm x118mm x60mm.

2.1.4 Testing On Blocks

Table- 6: Aggregate replacement with Coconut Shell

% of replacement	14 Days (KN)	28 Days (KN)
10%	9	20
20%	14	27
30%	13	29

Table- 7: Aggregate replacement with Fly Ash

% of replacement	14 Days (KN)	28 Days (KN)
10%	10	12
20%	9	11
30%	10	10

Table- 8: Aggregate replacement with Blast Furnace Slag

% of replacement	14 Days (KN)	28 Days (KN)
10%	14	16
20%	13	9
30%	9	10

- The best result we found in concrete with coconut shell is of replacement of 30% as 29KN at 28 days.
- The best result we found in concrete with fly as his of replacement of 10% as 12 KN at 28 days.
- The best result we found in concrete with blast furnace slag is of replacement of 10% as 16KN at 28 days.

Percentage of Porosity

Table- 9: Concrete with Coconut Shell

Replacement	% of Porosity
10%	2.00%
20%	3.24%
30%	4.20%

Table- 10: Concrete with Fly Ash

Replacement	% of Porosity
10%	1.00%
20%	0.9%
30%	0.8%

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Table- 11: Concrete with Blast Furnace Slag

Replacement	% of Porosity
10%	1.60%
20%	0.6%
30%	0.8%

- In Concrete replacement of Coconut Shell increases the Porosity of Concrete.
- In Concrete with Fly Ash % of replacement decreases Porosity increase.
- In Concrete with Blast Furnace Slag % of replacement decreases Porosity increases.

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