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Porous Concrete With Using Over Burnt Brick

[1]Dr. Pinki Deb, [2]Sarvesh Koli , [3]Shubham Telave, [4]Omkar Kolhapure , [5]Tejas Desai

[1]Professer, [2]Student, [3]Student,[4]Student , [5]Student

Department Of Civil Engineering ,

[1]Sharad Institute of Technology and Engineering ,Yadrav, India.

Abstract: In the search of alternate construction materials, over burnt brick aggregate has enrolled its appellation as a low cost sustainable alternate material. In the north-eastern part of India, especially in Tripura, the shortage of natural stone aggregate has opened up the field for over burnt brick aggregate to be used as an alternate pavement material. This study mainly focuses on the characterization of pervious concrete mixes produced with over burnt brick as coarse aggregate. Pervious concrete, in the recent era, has been considered as the emergent technology due to its prominence as an environmentally and hydrologically sustainable pavement system. In this paper, a series of test samples are produced using various design variables and then the mechanical strength and the pore properties of porous mixes are evaluated. Aggregate gradation, water-cement ratio and the percentage of fine aggregate are chosen as the design variables and their effect in the compressive strength, tensile strength, flexural strength, porosity, permeability, etc. are estimated. The statistical analysis is also carried out using the experimental test data and prediction equations are developed to estimate the porosity, permeability and the compressive strength of the pervious concrete mixes. The predicted equations fitted well and showed a very good agreement with the calculated results. These equations can be directly used for the selection of the mix proportion and the designing of pervious concrete mixes made with over burnt brick aggregate.

***Index Terms* –** Cement ,Overburnt Brick , Porous Material , Tests .

I. INTRODUCTION

Porous concrete renowned for its ability to mitigate storm water runoff, reduce urban heat island effects, and promote sustainable urban drainage systems, has emerged as a pivotal solution in contemporary civil engineering. Over burnt bricks, a byproduct of traditional brick-making processes, have recently garnered attention as a potential ingredient in porous concrete mixtures.

This introduction explores the integration of over burnt bricks in porous concrete formulations,highlighting its environmental benefits, structural properties, and implications for sustainable infrastructure development.

Porous pavement or permeable pavement, is an engineered hardscaping surface that allows water to flow through it. This differs from traditional types of pavement, which are impermeable and convert most rainfall to runoff.

Porous concrete, also known as pervious or permeable concrete, is designed to facilitate water drainage through its structure. With a high void content—typically between 15% and 25%—this type of concrete effectively manages storm water runoff, mitigates flooding risks, and supports groundwater recharge. These characteristics are increasingly vital in urban environments where impervious surfaces lead to increased water accumulation and drainage issues.

Over burnt bricks, produced as a byproduct of the brick manufacturing process, often end up in landfills due to their perceived defects resulting from excessive firing in kilns. However, these bricks possess unique properties that can significantly enhance the performance of porous concrete. Their high compressive strength, durability, and thermal mass make them an attractive material for construction, providing an opportunity to turn waste into a valuable resource.

II.MATERIAL

2.1 . Cement

Type: Ordinary Portland Cement (OPC) is commonly used.

Role: Acts as the binding agent, providing strength and durability to the concrete mix.

of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

Figure No.01 Cement

2.2 Crushed Over-Burnt Bricks

Size: Should be crushed to a uniform size 20mm.

Properties: Lightweight, high porosity, and good thermal insulation

Figure No. 02 Sample of over burnt brick aggregate

2.3 Coarse Aggregate
Options: Can include gravel, crushed stone, or additional lightweight aggregates.
Role: Provides bulk and structural support.

2.4. Fine Aggregate
Type: Natural sand or crushed stone dust.

2.5 Water
Quality: Should be clean and free from impurities.
Role: Activates the cement and aids in hydration.

2.6 Admixtures (Optional)
Types:
Superplasticizers: Improve workability and reduce water content.

Figure No. 03 Super Plastizer

III . METHODOLOGY

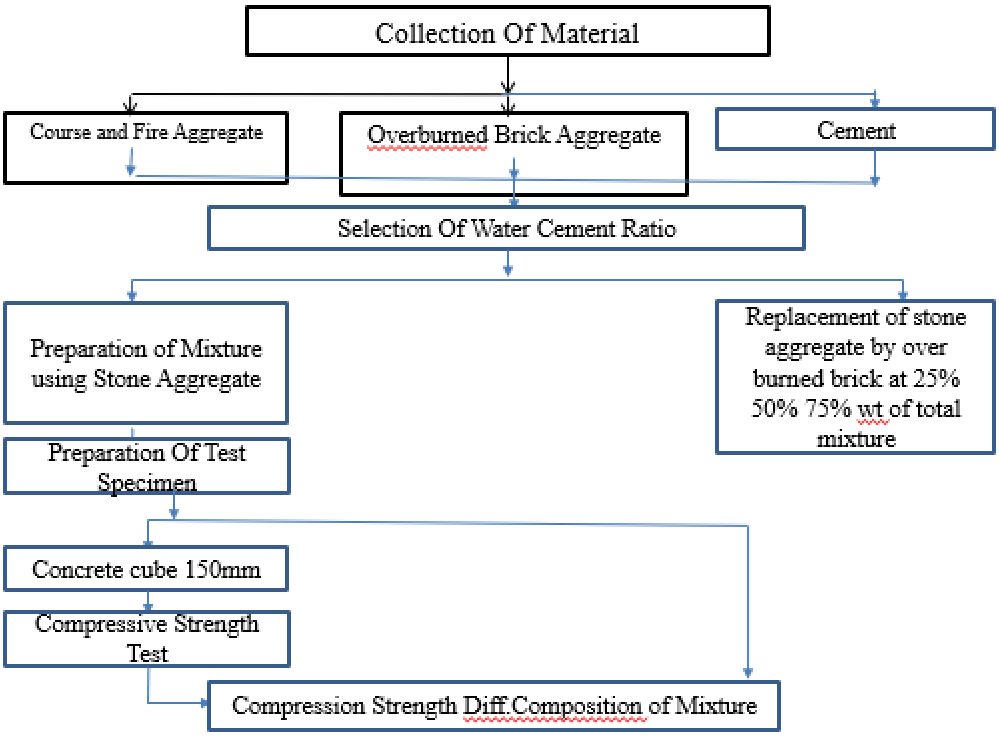


Figure No. 04 block diagram of process

IV . PROCEDURE

1.Collecting the Aggreagates and overburnt brick pieces.

Figure No. 05 Overburnt Brick pieces

Figure No. 06 Aggregates

2. The sample is Sieved by using Mesh.

Figure No. 07 Sieving

3.Mixing of materials .

Figure No.08.Mixing of materials .

V . CONCRETE MIX DESIGN

Ratio For M20 = **1:1.5:3**
50 Kg Bag of Cement.
1 Kg of Cement = 3 Buckets
1 Bucket = 17 Kg

M20 1:1.5:3
50:75:150
50:4.4:8.82
50:5:9_____(Total Bucket)

For 1 Cube
1 Kg Cement
3 Kg Brick Bond
1.5 Kg of 20 mm Aggregate

For 1 Cube
(150 x 150 x 150) With Admixtures
1 bag = 25 L Water

For 1 Kg = 2 L Water Required
Cement: Brick Bond : Fine Aggregate : Admixtures +Water
1 Kg : 3 Kg : 1.5 kg : 16 ml + 2 L Water Or less

VI . EXPERIMENTAL PROGRAM

1.IMPACT AGGREGATE TEST

Figure No. 09 Impact aggregate test

The Aggregate Impact Test is a crucial procedure to evaluate the toughness and resistance of aggregates against impact. Here's a step-by-step overview:

Apparatus:

1. Impact testing machine
2. Aggregate sample (20 mm)
3. Sieves (20 mm)

Procedure:

1. Prepare 5 kg aggregate sample.
2. Oven-dry sample to constant weight.
3. Pass sample through 20 mm sieve.
4. Retain material on 20 mm sieve.
5. Weigh and record initial weight.
6. Place sample in impact testing machine.
7. Apply 15 blows at 135° ± 5°.
8. Sieve sample through 5 mm sieve.
9. Weigh and record final weight.
10. Calculate Aggregate Impact Value (AIV).

2 . AGGREGATE CRUSHING TEST

Figure No. 10 Aggregate Crushing Test

1. Compression testing machine
2. Aggregate sample (20 mm)
3. Mould (150 mm diameter, 100 mm height)
4. Tamping rod
5. IS sieves

Procedure:

1. Prepare 3 kg aggregate sample.
2. Oven-dry sample to constant weight.
3. Fill mould in three layers, compacting each layer.
4. Apply load of 40 tons for 10 minutes.
5. Remove crushed aggregate and sieve.
6. Weigh and record crushed aggregate retained on 2.36 mm IS sieve.
7. Calculate Aggregate Crushing Value (ACV).

3. COMPRESSIVE STRENGTH TEST

Figure No. 11. Compressive Strength Test

The Compressive Strength Test of Aggregate follows ASTM C131 and AASHTO T 104 standards. Here's a step-by-step procedure:

Apparatus:

1. Compression testing machine (min. 100 kN capacity)
2. Cylindrical mold (150 mm diameter, 150 mm height)
3. Tamping rod
4. Aggregate sample (14-10 mm)
5. Cement (optional)

Procedure:

1. Prepare 3-5 kg aggregate sample.
2. Mix aggregate with cement (1:2 ratio) for mortar.
3. Compact mixture in mold using tamping rod.
4. Apply 3 layers, compacting each layer.
5. Finish surface with trowel or float.
6. Cure specimen in moist air (23°C, 100% RH) for 24 hours.
7. Remove specimen from mold.
8. Test compressive strength at 7 or 28 days.

Testing:

1. Place specimen in compression machine.
2. Apply load at 0.5-1.5 MPa/s rate.
3. Record maximum load (P).
4. Calculate Compressive Strength.

VII . EXPERIMENTAL PROGRAM

1.IMPACT AGGREAGATE TEST

W1	858 gm
W2	1.039 gm
W3	856 gm
W4	559 gm

W5 = (W4/W3) x 100
= 6.410 %
Exceptionally Strong.

2. AGGREGATE CRUSHING TEST

Aggregate Crushing Value	10 %
Brick Crushing Value	12.26 %

3. COMPRESSIVE STRENGTH TEST

Sample No	Dimension (mm)			% of Stone	% of Brick Bond	Days Of Curing	Area (mm2)	Max. Load (KN)	Strength (N/mm2)
	L	H	W						
1	150	150	150	25%	75%	7 Days	22500	330	14.66
1.1	150	150	150	25%	75%	14 Days	22500	373	16.55
1.2	150	150	150	25%	75%	21 Days	22500	405	18

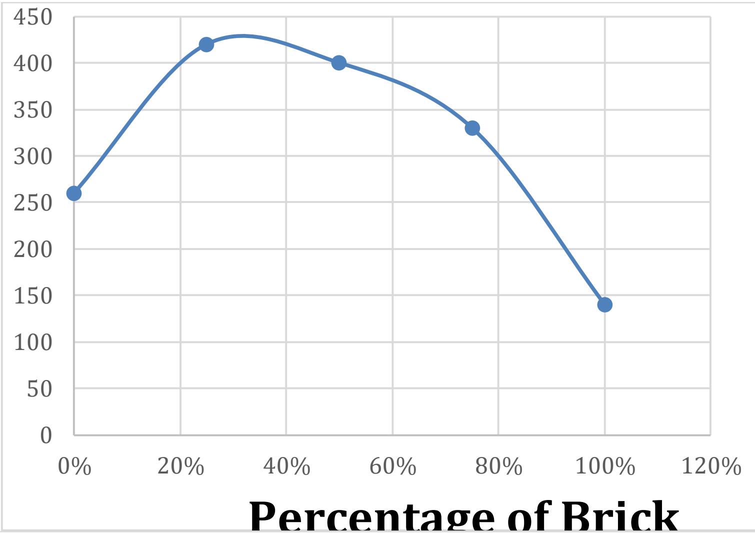
Sample No	Dimension (mm)			% of Stone	% of Brick Bond	Days Of Curing	Area (mm2)	Max. Load (KN)	Strength (N/mm2)
	L	H	W						
2	150	150	150	50%	50%	7 Days	22500	300	13.33
2.1	150	150	150	50%	50%	14 Days	22500	337	15
2.2	150	150	150	50%	50%	21 Days	22500	374	16.66

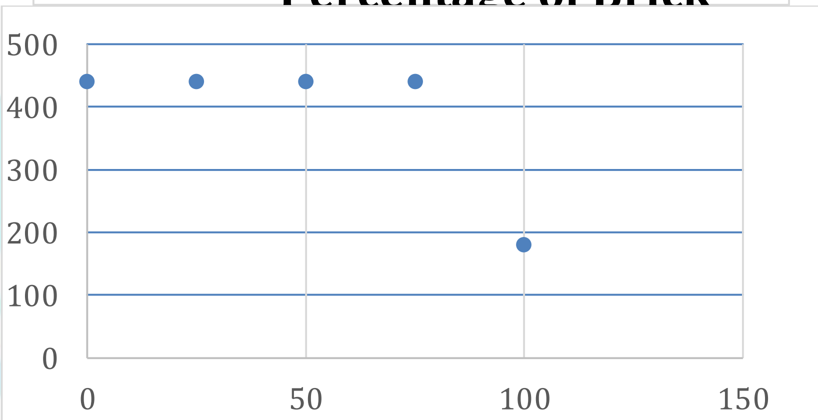
Sample No	Dimension (mm)			% of Stone	% of Brick Bond	Days Of Curing	Area (mm2)	Max. Load (KN)	Strength (N/mm2)
	L	H	W						
3	150	150	150	75%	25%	7 Days	22500	420	18
3.1	150	150	150	75%	25%	14 Days	22500	440	19.55
3.2	150	150	150	75%	25%	21 Days	22500	490	21.05

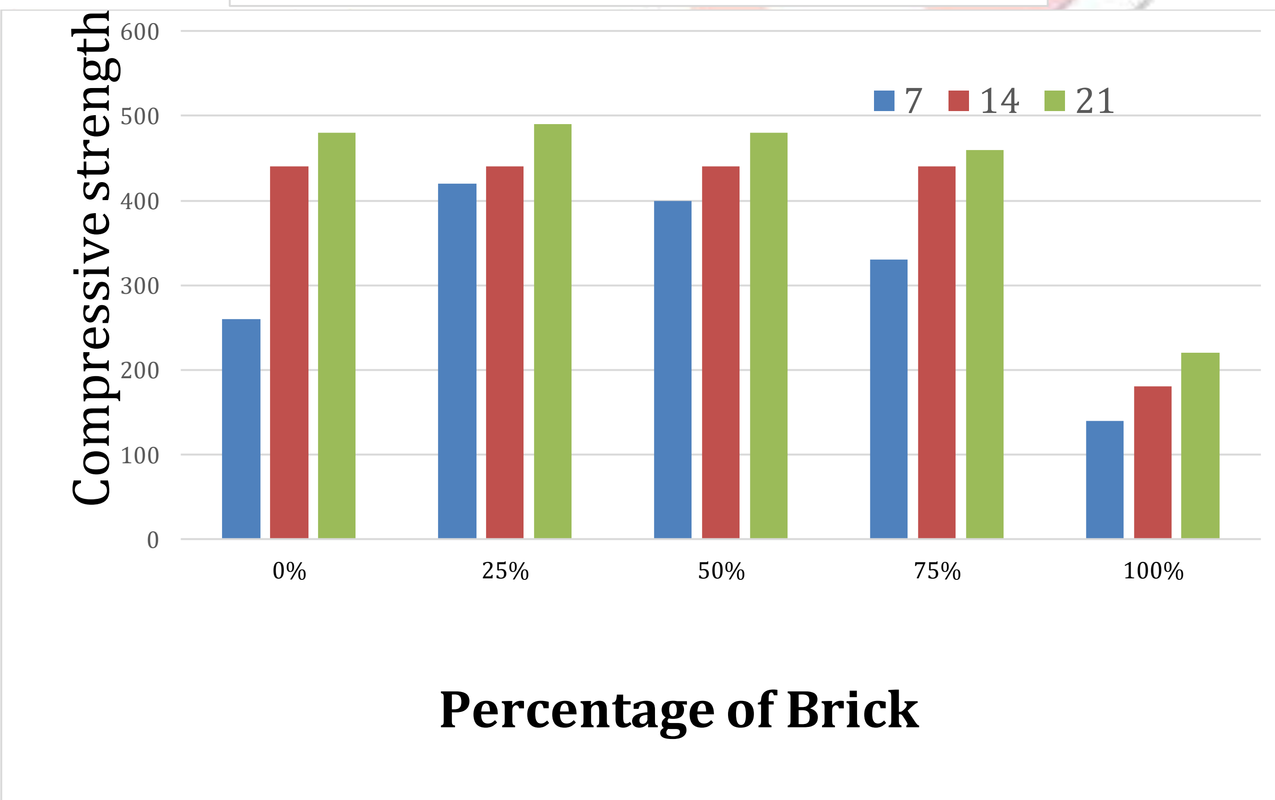
Sample No	Dimension (mm)			% of Brick Bond	Days Of Curing	Area (mm2)	Max. Load (KN)	Strength (N/mm2)
	L	H	W					
4	150	150	150	100 %	7 Days	22500	140	6.22
4.1	150	150	150	100 %	14 Days	22500	180	8
4.2	150	150	150	100 %	21 Days	22500	250	11.11

Sample No	Dimension (mm)			% of Stone	Days Of Curing	Area (mm2)	Max. Load (KN)	Strength (N/mm2)
	L	H	W					
5	150	150	150	100 %	7 Days	22500	450	20
5.1	150	150	150	100 %	14 Days	22500	460	20.44
5.2	150	150	150	100 %	21 Days	22500	480	21.33

VIII GRAPHS


450
400
350
300
250
200
150
100
50
0
0%
20%
40%
60%
80%
100%
120%
Percentage of Brick


500
400
300
200
100
0
0
50
100
150


Compressive strength
600
500
400
300
200
100
0
7
14
21
0%
25%
50%
75%
100%
Percentage of Brick

IX CONCLUSION

1. Addition of 75% Stone Aggregate and 25% Brick Bond ,the compressive strength is 21.05N/mm.
2. Which is the best suitable mix among other combination of mixes.

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