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Experimental Study on Partial Replacement of Coarse Aggregate with Over Burnt Bricks in Pervious Concrete

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Abstract – *The research focuses on using overburnt brick aggregate as a sustainable and cost-effective alternative material for pavement construction. This study looks at pervious concrete, which is recognized for its ecologically benign and hydrologically sustainable properties. Several design parameters, including as aggregate gradation, water-cement ratio, and fine aggregate percentage, are investigated to determine their influence on the mechanical strength and pore characteristics of pervious concrete mixes. Prediction equations are constructed based on statistical analysis of experimental data to estimate the porosity, permeability, and compressive strength of these mixtures. This study advances the understanding and utilization of overburnt brick aggregate as a sustainable choice in construction, notably for pavement systems. The data given here provide important information for developing and implementing pervious concrete mixture*

Key Words: **Pervious Concrete, Over Burnt Bricks, Compressive Test**

1.INTRODUCTION

Concrete, a frequently used artificial material in building, is made up of cement, sand, coarse aggregate, and water. Due to the escalating cost of cement and sand, it is necessary to investigate less expensive alternatives. This research will look at the impacts of partially substituting cement and sand with waste products like fly ash and stone dust. The study aims to achieve equivalent performance in terms of overall building quality with these substitutes. Finding sustainable alternatives becomes increasingly important as natural resources decrease and CO2 levels grow. River sand, a key component of concrete strength, is being replaced with stone dust, and fly ash is being utilized in place of cement. Varying quantities of fly ash and stone dust are tested to see how they affect flexural and compressive strength. By deploying new materials as partial replacements in concrete buildings, the research hopes to contribute to environmental preservation and cost reduction in construction.

2. Material properties

Pervious concrete is a porous type of concrete designed for water permeability. It comprises overburnt bricks, fly ash, cement, coarse aggregate, fine aggregate, and water. Overburnt bricks replace some coarse aggregate, providing voids for water flow. Fly ash enhances strength and permeability. Cement acts as a binding agent, while coarse aggregate consists of larger particles and fine aggregate consists of smaller particles, improving strength and workability. Water hydrates the cement, forming a solid structure. Pervious concrete benefits stormwater management, reduces runoff, and promotes groundwater recharge. It finds applications in parking lots, sidewalks, and green infrastructure.

2.1 Cement

Cement is a binding agent that holds the concrete mixture together. It reacts with water to form a paste that hardens over time, providing strength to the pervious concrete.

2.2 Fine Aggregate

Fine aggregate consists of smaller particles, such as sand. It helps fill the gaps between the larger particles, improving the overall strength and workability of the pervious concrete mixture.

2.3 Coarse Aggregate

Coarse aggregate consists of larger particles, such as crushed stone or gravel. In pervious concrete, overburnt bricks are sometimes used as a partial replacement for coarse aggregate to create voids and promote water infiltration.

2.4 Fly Ash

Fly ash is a byproduct of coal combustion in power plants. It is commonly used as a supplementary cementitious material in concrete production. In pervious concrete, fly ash is often added to the cement mixture to enhance its strength, durability, and permeability.

2.5 Over Burnt Bricks

These are bricks that have been subjected to high temperatures during the manufacturing process, resulting in a darker color and increased porosity. They are used as a partial replacement for traditional coarse aggregate in

pervious concrete, providing void spaces for water to pass through.

2.6 Water

Water is a crucial component in the concrete mix, enabling the cement to hydrate and form a solid structure. In pervious concrete, the water-to-cement ratio is carefully controlled to ensure proper hydration while maintaining the desired permeability.

3. Experimental Work

This experimental work focuses on creating pervious concrete by incorporating overburnt bricks and 10% fine aggregate, with the aim of evaluating its compressive strength. The procedure involves mixing the 15% overburnt bricks with fly ash, cement, coarse aggregate, and water, while adding 10% -15% fine aggregate. The mixture is carefully proportioned and thoroughly blended to achieve a uniform consistency. The pervious concrete is then cast into specimens and subjected to a controlled curing process. After the curing period, the compressive strength of the specimens is measured using standard testing methods. The results of this study will provide valuable insights into the feasibility and performance of pervious concrete with overburnt bricks and 10% and 15% fine aggregate, aiding its potential application in construction projects.

For this experiment, a total of 60 cubes were casted, with three cubes being prepared for each mix proportion from the five categories specified in the table provided. This approach ensures an adequate sample size to analyze and evaluate the performance of different combinations within each category.

Table 1Mix Proportion of Material

Aggregate Garde	Fine Aggregate %	Water Cement Ratio
A1	10	0.30
		0.32
	15	0.30
		0.32
A2	10	0.30
		0.32
	15	0.30
		0.32
A3	10	0.30
		0.32
	15	0.30
		0.32
A4	10	0.30
		0.32
	15	0.30
		0.32
A5	10	0.30
		0.32
	15	0.30
		0.32

4. Results

The cubes have been successfully casted and are now prepared for analysis. These cubes serve as representative samples of the concrete mixture used in the experiment. They have undergone the necessary curing period to develop their strength and other relevant properties

Fig -1 pervious concrete

4.1 Compressive Strength test

In total 60 cube has been casted of 150x150x150 mm. Where 3 cube has mix of only cement, sand and aggregate. Other 3 has mix of cement with fly ash and 3 cube has mix of cement with cattle manure ash. And remaining cube has mix of cement with cattle manure ash and fly ash.

Table 2 Compressive strength result (Mpa)

A1			
10%	6.67	6.66	6.67
15%	7.15	7.1	7.18

Table 3 Compressive strength result (Mpa)

A2			
10%	7.11	7.05	7.18
15%	9.81	9.77	9.81

Table 4 Compressive strength result (Mpa)

A3			
10%	6.67	6.66	6.67
15%	7.15	7.1	7.18

Table 5 Compressive strength result (Mpa)

A4			
10%	6.67	6.66	6.67
15%	7.15	7.1	7.18

Table 6 Compressive strength result (Mpa)

A5			
10%	6.67	6.66	6.67
15%	7.15	7.1	7.18

3. CONCLUSIONS

This experimental study concludes that:

- The water-cement ratio, a crucial design parameter impacting mix workability, should be selected within the specified range (0.3-0.32) to achieve a medium workable mix, as extreme values can compromise the strength of the porous matrix.
- The gradation of aggregates impacts the mechanical and pore properties of pervious concrete. Smaller size aggregates enhance strength but reduce porosity, while single-graded aggregates offer higher porosity but lower strength compared to dense-graded mixes.
- In summary, for pavement works in low-traffic areas, pervious concrete provides an efficient and eco-friendly solution that effectively manages stormwater while maintaining the required structural integrity. It offers a sustainable and durable pavement surface that promotes environmental preservation and supports long-term water management goals.
- Using over burnt brick aggregate in pervious concrete can offer cost advantages by utilizing locally available and recycled materials, reducing transportation costs, and minimizing the need for extensive drainage infrastructure

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