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Investigation on Mechanical Properties Concrete on Partially Replacement of Fine Aggregate with Stone Dust and Coarse Aggregate with Over Burnt Brick

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ABSTRACT

The Republic of India is regarded as one of the world's rising superpowers. This potential is ascribed to a number of factors, the most important of which are its demographic trends and a fast developing economy. As the world's fastest developing economy, China is presently on the cusp of large-scale urbanisation and usage, creating a significant demand for building dwellings and the materials used to construct them. To meet this housing need, the country will need to build 40 to 55 thousand dwellings every day for at least the next seven years. Every human being's fundamental need is for shelter. Carbons are the building blocks of the human body, just as bricks are the building components of a home. India, the world's second largest manufacturer of bricks after China, produces 236 billion bricks every year, utilising enormous amounts of natural resources such as soil, sand, coal, and so on. Traditional red bricks are often manufactured from a mixture of clay and sand, shaped into a rectangular shape, dried, and then fired at a high temperature of 900 to 1200°C in a kiln. The brick business in India, which has over 100,000 kilns, is a major source of pollution. An experimental programme was developed in which one lean concrete mix with no proportion of stone dust and over burned brick aggregate was created, as well as varied combinations of stone dust and over burnt brick aggregate.

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INTRODUCTION

The term "concrete" refers to a mixture of aggregates, most commonly sand, and each gravel or crushed stone, held together by a cement paste binder. Portland cement and admixtures are commonly used in the paste. Concrete is the most widely utilized construction material in the world due to its flexibility, durability, sustainability, and low cost. It is one of the most important and valuable building materials. When all of the ingredients (cement, aggregate, and water) are combined in the proper amounts, the cement and water begin to react with one another, forming a solid mass. Concrete is the name given to a hardened rock-like material. Lime-based concretes, such as Portland cement concrete or concrete manufactured with various hydraulic cements, are the most commonly utilized. However, asphalt concrete, which is commonly used for road surfaces, is a type of concrete in which the cement element is bitumen, and polymer concretes, in which the reinforcing material is a polymer, are occasionally utilized. When aggregate is combined with dry Portland cement and water, a fluid slurry is created that may be easily poured and moulded into shape. Cement reacts chemically with water and other elements to generate a hard matrix that binds the materials together to make a long-lasting stone-like substance with several applications. To improve the physical qualities of the wet mix or the finished product, additives are frequently added to the mix. Reinforced concrete is made by pouring concrete with reinforcing components implanted to enhance tensile strength.

Over-Burnt Brick: A sufficient quantity of clay is present in bricks made by burning moulded soil. Due to an unregulated distribution of temperature in the kiln during manufacture, approximately 13% of bricks are badly over-burned. These over-burned bricks are considered waste because they have no purpose in cement concrete preparation. Furthermore,

it poses a dilemma for brick manufacturers in terms of disposing of waste. Over-burned brick is a useful material for simple concrete work as well as reinforced work with low stresses. To avoid absorption of the mixing water required for hydration of cement and setting and hardening of concrete, brick aggregates should be saturated with water for 24 hours before usage. Crushed stone aggregates are more fire resistant and sound absorbing than brick aggregates: The over burnt bricks are irregular in shape and dark in colour. Because over-burnt bricks have a compacted structure, they are occasionally found to be stronger than first-class bricks when used as aggregate in concrete for foundations, floors, and roadways, among other things.

Stone Dust: Stone dust resembles a coarser, darker form of sand. It is a by-product of running stones in a machine to produce crushed stone. Its specific composition will, of course, be determined by the type of stone that was processed through the machine. The machine has a screen that traps the larger material (i.e., the crushed stone). The smaller material or "screenings" falls through the screen. Depending on the size of the holes in the screen used, it can be so fine in texture that it is basically a powder.

Problem Formulation

An experimental program was planned in which one lean concrete mix which did not include any percentage of stone dust and over burnt brick aggregate with different combinations of stone dust and over burnt brick aggregate were prepared. Cubes cylinder and beam specimens were casted to obtain the different physical properties of concrete mixes with 0%, 15%, 30%, and 45% of crushed glass as to replace some part of fine aggregate and 0%, 25.25%, 35.25%, 45.25% and 55.25% of over burnt brick aggregate (OBBA) as to replace some part of natural coarse aggregates. Suitable quantities of plasticizer and materials are added to improve the workability and stability. The cube specimens cylindrical and beam specimens will be tested after the recommended curing time of curing period of 7 days and 28 days respectively.

Objective of the Study

- To examine the compressive strength by replacing fine aggregate by stone dust and coarse aggregate by over burnt brick aggregate.
- To examine the split tensile strength by replacing fine aggregate with stone dust and coarse aggregate by over burnt brick aggregate.
- To examine the flexural by replacing fine aggregate by stone dust and coarse aggregate by over burnt brick aggregate.
- To make concrete economical use more and more waste products for utility in construction.

Experimental Methodology

An experimental program was planned to investigate strength properties of concrete with stone dust as partial replacement of fine aggregates and over burnt brick aggregate partial replacement of natural coarse aggregates. Concrete mix samples containing percentage replacement by stone dust as 0%, 25.25%, 35.25%, 45.25% and 55.25% and percentage replacement of over burnt brick as 0%, 15%, 30% and 40% were used in this study. The concrete mixes for the investigation of different percentages of concrete using stone dust and over burnt brick were designated as MU01, MU02, MU03, MU04, MU05, MU06, MU07, MU08, MU09, MU10, MU11, MU12, MU13, MU14, MU15 and MU16. The experimental study was divided into the following stages:

1. Properties of material used in the study.
2. Mix Design according to IS 10262-2009.
3. Workability test of concrete mixes.
4. Casting and curing of specimens.
5. Strength tests on specimens.

Properties of Material

The test specimens were prepared using cement, normal fine aggregate (NFA), normal coarse aggregate (NCA), stone dust, over burnt brick aggregate (OBBA), Plasticizer (Sikament 4101NS) and water. The materials in general, conformed to the specifications laid down in the relevant Indian standard codes. The materials used for making concrete mix specimens were having the following characteristics:

Sr. No.	Properties	Observations
1	Bulk density	1450 kg/m^3
2	Specific gravity	3.15
3	Initial setting time	30 min
4	Final setting time	600 min
5	Standard Consistency	5-7%
6	Fineness (90 micron IS Sieve)	5%
7	28-days compressive strength	42.17Mpa

Table 1: Physical properties of cement

I.S. Sieve (mm)	Weight Retained(gm)	% Retained	Cumulated% Retained (x)	Cumulative % Passing (100-x)	Requirement as per I.S 383-1970
					ZONE II
10 mm	0	0	0	100	100
4.75 mm	31	6.2	6.2	93.8	90-100
2.36 mm	34	6.8	13.0	87.0	75-100
1.8 mm	54	10.8	23.8	76.2	55-90
0.600 mm	226	45.2	69.0	31.0	25-50
0.300mm	95	19.0	88.0	12.0	10-25
0.150 mm	45	9.0	97.0	3.0	0-10
pan	15	3.0			

Table 2: Fineness modulus of natural fine aggregates

I.S. Sieve (mm)	Weight Retained(gm)	% Retained	Cumulated% Retained (x)	Cumulative % Passing (100-x)	Requirement as per I.S 383-1970
					ZONE II
10 mm	0	0	0	100	100
4.75 mm	28	5.6	5.6	94.4	90-100
2.36 mm	31	6.2	11.8	88.2	75-100
1.8 mm	61	12.2	24.0	76.0	55-90
0.600 mm	206	41.2	65.2	34.8	25-50
0.300mm	117	23.4	88.6	11.4	10-25
0.150 mm	36	7.2	95.8	4.2	0-10
pan	21	4.2			

Table 3: Fineness modulus of Stone dust

I.S. Sieve (mm)	Weight Retained(gm)	% Retained	Cumulated% Retained (x)	Cumulative % Passing (100-x)	Requirement as per I.S 383-1970
40mm	0	0	0	100	100
20 mm	172	8.6	8.6	91.4	85-100
10 mm	1091	54.55	63.15	36.85	25-50
4.75 mm	653	32.65	95.80	4.20	0-10
pan	84	4.20			

Table 4: Fineness modulus of coarse aggregates

I.S. Sieve (mm)	Weight Retained(gm)	% Retained	Cumulated% Retained (x)	Cumulative % Passing (100-x)	Requirement as per I.S 383-1970
40mm	0	0	0	100	100
20 mm	162	8.10	8.10	91.9	85-100
10 mm	1087	54.35	62.45	37.55	25-50
4.75 mm	670	33.50	95.95	4.05	0-10
pan	81	4.05			

Table 5: Fineness modulus of over burnt brick aggregates

Mix design

The proportioning of raw materials in concrete is very important as it ensures quality and durability of concrete. The basic mix design adopted for M 25 in present study was in accordance with IS: 10262-2009. The porosity and water absorption of over-burnt bricks is more than that of the natural aggregates. Due to high porosity and water absorption, the bricks were placed in water for 24 hours.

Results

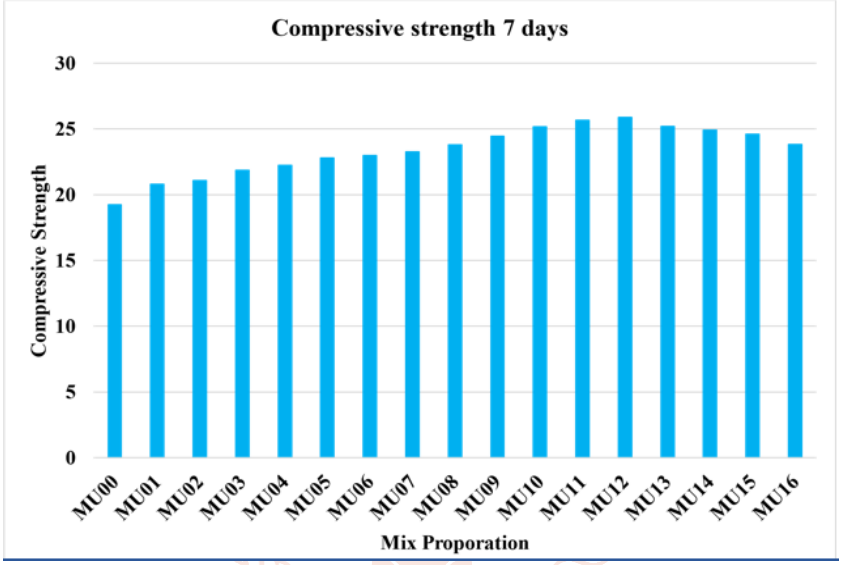

Figure 1: Compressive Strength after 7 days

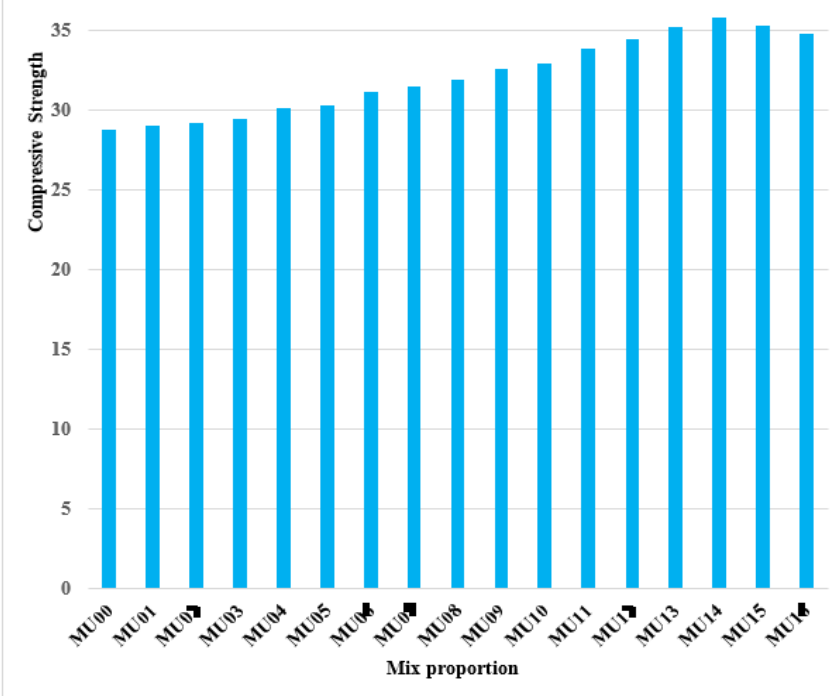

Figure 2: Compressive strength after 28 days

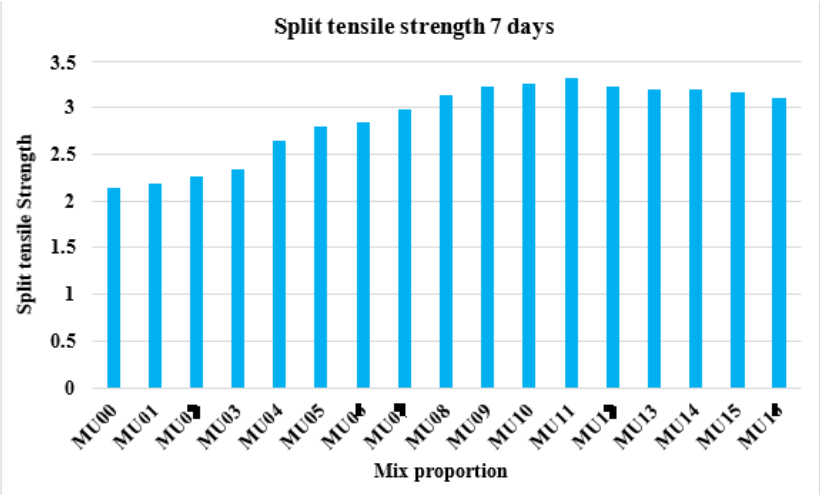

Figure 3: Split strength after 7 days

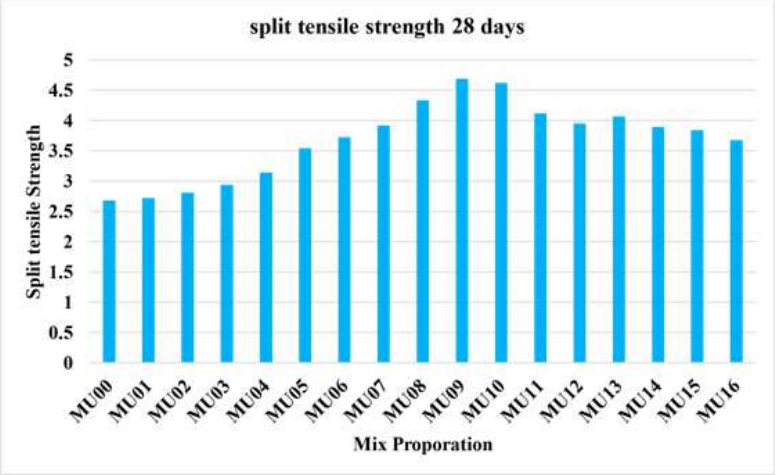

Figure 4: Split strength after 28 days

Conclusion

The conclusions that may be drawn from the results of investigation are:

- Strength concrete was achieved which is 25.87 N/mm^2 after 7 days of curing and the mix name was MU12.
- When overt burnt brick aggregate was used 45% by weight of coarse aggregate and stone dust 35.25 % by weight of the fine aggregate the optimum strength of compressive strength concrete was achieved which is 35.76 N/mm^2 after 28 days of curing and the mix name was MU14. When overt burnt brick aggregate was used 30% by weight of coarse aggregate and stone dust 45.25 % by weight of the fine aggregate the optimum strength of split tensile strength concrete was achieved which is 3.31 N/mm^2 after 7 days of curing and the mix name was MU11.
- When overt burnt brick aggregate was used 30% by weight of coarse aggregate and stone dust 25.25 % by weight of the fine aggregate the optimum strength of split tensile strength concrete was achieved which 4.69 N/mm^2 after 28 days of curing and the mix name was MU09.
- When overt burnt brick aggregate was used 30% by weight of coarse aggregate and stone dust 55.25 % by weight of the fine aggregate the optimum strength of flexural strength concrete was achieved which 3.71 N/mm^2 after 7 days of curing and the mix name was MU12.
- When overt burnt brick aggregate was used 30% by weight of coarse aggregate and stone dust 45.25 % by weight of the fine aggregate the optimum strength of flexural strength concrete was achieved which 5.21 N/mm^2 after 28days of curing and the mix name was MU11.

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