Suitability of Crushed Over Burnt Bricks as Coarse Aggregate

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Abstract— **concrete is a versatile engineering material consisting of cementing substance, aggregates, water and often controlled amount of entrained air. It is initially a plastic, workable mixture which can be molded into a wide variety of shapes when wet. The strength is developed from the hydration due to the reaction between cement and water. The products, mainly calcium silicate, calcium aluminates and calcium hydroxide are relatively insoluble which bind the aggregate in a hardened matrix. The primary goal of the research is to investigate and evaluate the feasibility of employing crushed over burned brick aggregate as an alternative to costly traditional stone aggregate in concrete in order to minimize production costs, construction costs, and dead weight of a building structure. The research was conducted to study the suitability of crushed over burnt bricks as alternative coarse aggregates for concrete production. Tests were carried out to determine the physical properties of the crushed over burnt bricks aggregates. Values of 0%, 25% 50%, 75% and 100% were obtained for aggregate crushing value, aggregate impact value and aggregate water absorption respectively**

Keyword: Coarse-aggregates, Concrete, Crushed over burnt bricks, Suitability, ANSYS

1. INTRODUCTION

Cement, water, coarse and finely ground, and mortar are added to make concrete (if needed). The great advantage of concrete is that it can be built to withstand extreme conditions. The goal is to assemble these components in precise proportions to produce concrete that is easy to transport, stand, assemble, and finish, and that will set and harden to produce a solid and durable product. The amount of each component (cement, water, and aggregates) affects the properties of the solid concrete. Concrete mixes are intended to produce concrete that can be easily installed at very low cost. In order to produce strong and durable concrete, the concrete must work and harden if it is plastic, then set and firm. The design of the mix should take into account the location where the concrete will be used, such as exposure to seawater, trucks, vehicles, forklifts, pedestrians, or hot and cold temperatures. Concrete is made up of Cement, Water, Solid and Fine Joints, and composite materials. The proportions of each component in the mixture influence the final properties of the solid concrete. Weight is a very accurate measure of weight. Volume measurement is not so bad, yet it is enough for small projects. Concrete is a flexible engineering material made up of cement, scales, water, and a controlled part of the air inlet. It has risen to the point of being in demand in modern architecture. Concrete is always selected and considered suitable wherever energy, fire resistance, and durability are required. When wet, it becomes plastic, a functional substance that can be molded into a variety of shapes. The mixture between cement and water produces hydration, which leads to the formation of energy. The raw materials used to make it, cement and mortar, have an impact on both quality and construction costs. Aggregates are usually less expensive than cement and cost more than 70% of the concrete volume. Construction costs are also affected by the availability and proximity of the total construction site. The immature materials used to make cement, sand, and composites have an impact on both quality and construction costs. Aggregates are usually less expensive than cement and cost more than 70% of the concrete volume. Construction costs are also affected by the availability and proximity of the total construction site. However, when quantity is scarce and there is an urgent need to conserve natural resources for long-term growth and to conserve resources for the benefit of future generations, this involves the use of some of the rigid components provided locally. The bat or brick kiln found in the making of bricks is one of the rough collections.

Heat-treated concrete such as rough clusters have applications such as lightweight concrete, lightweight mixtures, load reduction for buildings with large structural features, PCC function, and floors. Burnt bricks cannot be used in road construction if they fail impact and abrasion tests.

1.1. Over Burnt Brick Aggregate

The aggregate of overheated bricks is a useful asset for bare concrete works and fortified works where the pressure is not too high. Prior to use, the aggregate of the bricks should be filled with water to avoid the absorption of mixing water, which is required for the cement hydration and the setting and durability of the concrete. The aggregate of crushed stone is more resistant to fire and absorbs noise than a combination of bricks. Extremely hot bricks are used in concrete as part of a solid natural mixture. The practical and mechanical features of the Over Burn Brick design were used to achieve this goal. The type of waste bricks included in this study are found during the construction of various buildings in the large Kolhapur area, and this type is tested to determine its mechanical properties before being hired. Conventional concrete models are cast and tested to match their results with traditional mixtures. A mixture of burnt bricks for waste construction.

2. ANALYTICAL TESTING RESULTS

2.1 Mix Design

The main goal of concrete mixing design is to determine the best concentrations of the various concrete materials, resulting in new concrete with desirable performance and strong concrete with the required compression strength and durability. Mixtures should also meet the additional condition of using the least amount of cement possible so that the cost of concrete is kept to a minimum.

The following basic data are required to be satisfied for the design of concrete mix.

1. Characteristic compressive strength of concrete at 28 days.
2. Degree of workability.
3. Limitations on the water cement ratio and the minimum cement content to ensure adequate durability as per IS: 456 – 2000 [80].
4. Type and maximum size of aggregate to be used.
5. Standard deviation of compressive strength of concrete.
6. Degree of quality control.
7. Type of exposure
8. Specific gravity of cement, fine and coarse aggregate.
9. Fineness modulus of fine and coarse aggregate

Design steps

I. From known characteristic compressive strength, the target mean strength is to be estimated by using the formula, Ft = Fck + S×t, Where ‘S’ is Standard Deviation and ‘t’ is a coefficient

II. The water cement ratio selected as per Table-5, IS: 456-2000 [80] based on the exposure condition.

III. The water content is selected from Table-2, IS: 10262-2009 [64] based on the maximum nominal size of aggregates

IV. After, calculating water content, cement content is calculated from the water- cement ratio and water content

V. Proportion of volume of coarse and fine aggregate

Volume of coarse aggregate corresponding to nominal maximum size of aggregates and fine aggregate confining to the specific zone as per IS: 383 - 1970 is calculated from Table-3, IS: 10262:2009.

VI. Calculation of Mix proportions

- Volume of the concrete (a) = 1m^3
- Volume of cement (b) = mass of the cement/specific gravity of the cement) x (1/1000)
- Volume of water(c) = (mass of water/specific gravity of water) x (1/1000)
- Volume of all in aggregate (d) = [a - (b + c)]
- Mass of coarse aggregate = *d* x volume of coarse aggregate x specific gravity of coarse aggregate x 1000
- Mass of fine aggregate = *d* x volume of fine aggregate x specific gravity of fine aggregate x 1000

Table 1 Mix proportions of all Mixes

Grade of concrete	Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (Lt)
M20	347	550	1120	180

Fig 1 Crushed Over Burnt Bricks

Fig 2 Crushed Over Burnt Bricks

Table 2.Cube/ Cylinder/ Test Analysis In Lab

Percentage replacement of BBA (%)		0	10	25	50	Total Cubes Cast
No. of cubes cast	M20	2	2	2	2	10
No. of Cylinder	M20	2	2	2	2	10
No. of Beam	M20	2	2	2	2	10

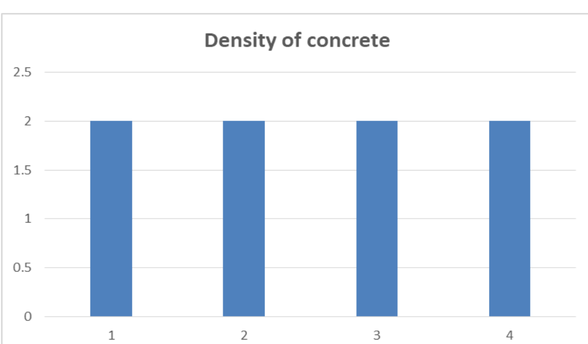
2.2 Density of concrete

Concentration of concrete, also known as the weight of a cubic meter of concrete, is necessary to determine the strength of the concrete in advance. As the concrete density decreases, so do the voids and, consequently, the strength. Immediately after mixing the layers, the scale is filled with freshly mixed concrete.

Density = Weight of the Measure/Volume of the measure

Table 2 Results For Density of concrete

Percentage Replacement	0%	10%	25%	50%
M20 (Kg/m^2)	2515	2400	2255	2142



Graph 1 Density of concrete

The density of grade BBA M20 decreases with the increase in percentage replacement of recycled brick aggregate as the recycled brick is light in weight than granite aggregate. Hence BBA concrete can be considered as light weight concrete which results in smaller dead loads.

2.3 Compressive strength of concrete

The concrete was filled into the mould in layers approximately of 5cm thick. Each layer was compacted by vibrating with a vibrating table till the desired compaction was achieved.

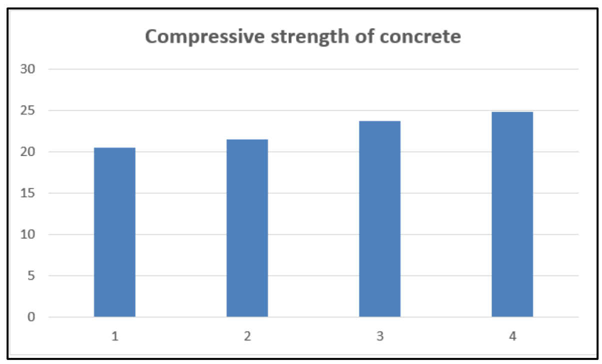
$$Fck = P/A$$

Where, P = Maximum load applied on the specimen

A = area of cross-section of the specimen on which the load is applied.

Table 3 Compressive strength of concrete

Percentage Replacement	0%	10%	25%	50%
M20 (N/mm^2)	20.5	21.53	23.68	24.86



Graph 2 Density of concrete

The percentage in Compressive strength increases with increase BBA in grade of concrete. BBA 50% grade concrete showed highest Compressive strength than BBA 0% grade concrete.

2.4 Split Tensile Strength

For tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank wherein they were allowed to cure for 7, 14 days. These specimens were tested under compression testing machine. In each category, three cylinders were tested and their average value is reported.

Tensile strength was calculated as follows as split tensile strength:

Tensile strength (MPa) = $2P / \pi DL$

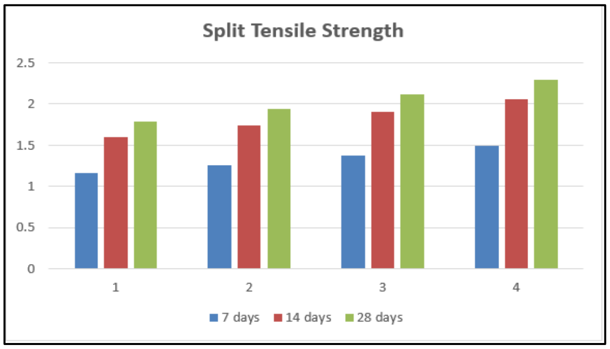
Where, P = failure load,

D = diameter of cylinder,

L = length of cylinder

Table 3 Split Tensile Strength

BBA %	7 days	14 days	28 days
0	1.16	1.60	1.78
10	1.26	1.74	1.94
25	1.37	1.90	2.11
50	1.49	2.06	2.29



Graph 3 Split Tensile Strength

Above Results show that there is a marginal increase in Split Tensile Strength in replacement of BBA ate the 25% and 50% of at the age of 7, 14, 28 days.

2.5 Flexural Strength

For flexural strength test beam specimens of dimension 100x100x500 mm are casted. The specimens are detached from the moulds after 24 hours of casting and are placed in curing tank for 7 and 14 days of curing

Flexural strength was calculated as follows as:

Flexural Strength = PL/bd2

Where, P = Failure Load

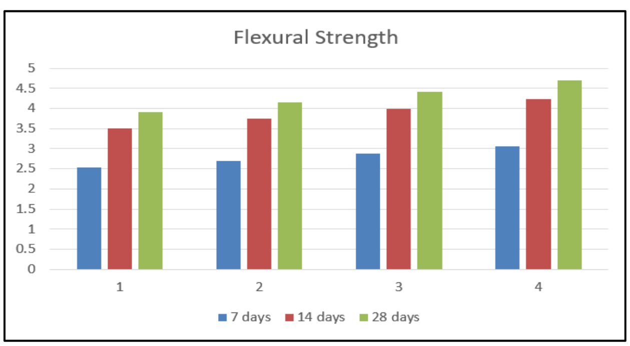
L = C/C Distance between Support

B = Width of Specimen

D = depth of specimen

Table 4 Flexural Strength

BBA %	7 days	14 days	28 days
0	2.54	3.51	3.90
10	2.70	3.74	4.15
25	2.87	3.98	4.42
50	3.06	4.23	4.70



Graph 4 Flexural Strength

Above Results show that there is a marginal increase in Flexural Strength in replacement of BBA ate the 25% and 50% of at the age of 7, 14, 28 days.

5. CONCLUSION

Concrete is being used more and more in today's society to fulfil the rapid rise of infrastructure needs. This fast use of concrete in the construction industry has resulted in a severe problem of resource depletion, such as sand, coarse aggregate, and so on. Furthermore, the concrete is vulnerable to fire accidents owing to a variety of factors such as natural catastrophes, power supply short circuits, gas leaks, and so on, resulting in concrete deterioration. A systematic review of the literature revealed that detailed research on the behaviour of recycled brick aggregate concrete at higher temperatures is essentially non-existent, leaving confusion about its applicability. As a result, the current study is being conducted to better understand the behaviour of recycled brick aggregate concrete when subjected to high pressures and temperatures.

Burn brick aggregate (BBA) concrete was made by replacing the granite aggregate with 0, 10, 25, and 50% by weight certified recycled brick aggregate. The density and compressive strength of fresh and hardened recycled brick aggregate concrete were studied at room temperature in order to optimize the percentage replacement of recycled brick aggregate in order to achieve the desired M20 grade BBA concrete in the form of density and compressive strength tests. For analytical findings, we examined Cubes, cylinder and beams for density, compressive strength, Split Tensile Strength and Flexural Strength concluded that the BBA replacement 25% and 50% have more economic results, thus we may advise aggregate repayment to BBA up to 50% in concrete.

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