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The Performance Characteristics of Concrete with Over Burnt Bricks as Partial Replacement of Coarse Aggregate

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Abstract
To contradict the demand of natural stone aggregates this research aims to utilize the Over Burnt Clay Bricks (OBCB) as alternative to coarse aggregates. In this study the possibility of utilizing crushed over burnt clay bricks as a replacement of coarse aggregates in M30grade concrete. Trial mixes were prepared using crushed over burnt clay bricks as coarse aggregate at various replacement levels. Experimental investigation was carried to enumerate the mechanical properties of the concrete by testing the workability, water absorption and density. The test results showed that concrete made by over burnt clay bricks in concrete as 50% replacement of coarse aggregate, gives the higher compressive strength of 46.27MPa.
Keywords: Coarse aggregates, Concrete, Over Burnt Clay Bricks, Silica fume.

I.INTRODUCTION

Concrete is one of the most often used building materials worldwide, it also consumes a significant amount of natural resources. About 70% of the volume of concrete was made up of coarse aggregate, which is likewise becoming less readily available and more expensive. The ability to construct concrete in harsh environments is one of its main advantages. The objective is to mix these ingredients precisely so that the finished concrete will set and harden to create a sturdy and long-lasting product. It should also be simple to transport, stand, assemble, and finish. Conversely, there is a growing body of research examining the use of construction and demolition waste and other industrial wastes as substitute materials for natural aggregates in the production of concrete that is more environmentally friendly(Chen et al, 2003).Gaining a significant amount of land can be facilitated by creating a sustainable building material (brick) out of construction and demolition (C&D) waste by diverting C&D trash from the primary waste stream (Agarwal 2017). In recent years, the over burnt brick wastes (OBBW) were replaced with coarse aggregate in concrete. This OBBW maintains the strength and characteristic performance to the concrete the main advantage over using OBBW in concrete will reduce the weight of the concrete. (Bidve and Shete 2019).In situations where the pressure is not too high, the aggregate of overheated bricks is beneficial for both fortified and bare concrete constructions. In order to prevent the absorption of mixing water-which is necessary for cement hydration, concrete setting, and durability-the aggregate of the bricks should be filled with water before use. Compared to a brick combination, the aggregate of crushed stone absorbs noise and is more fire resistant. In concrete, extremely hot bricks are a component of a solid natural mixture (Apebo et al 2014).

II.AIM OF THE RESEARCH:

1. To create a method for proportioning mixtures in order to produce concrete using over burnt clay bricks as replacement of coarse aggregate.
2. To determine and investigate the key factors influencing the characteristics of over burnt clay bricks as coarse aggregate in concrete.
3. To investigate the immediate engineering characteristics of both freshly mixed and dried concrete made

from over burnt clay bricks as replacement of coarse aggregate.

III. MATERIALS AND METHODS

Cement:

A fine, gray powder is cement. To make concrete, it is combined with water and additional ingredients like crushed stone, gravel, and sand. As the concrete dries, the cement and water combine to create a paste that holds the other components together. To prepare all of the concrete cubes, Ordinary Portland cement with a 28-day compressive strength of 46 MPa (ASTM 1994) was utilized. The impact of changing the types of coarse aggregate in concrete is examined using a single type of cement. In this study Zuari OPC 43grade cement was used and their property is given in Table 1.

Table 1 Properties of cement

S.No.	Characteristics	Values
1	Normal consistency	33%
2	Initial Setting Time	46min
3	Final Setting Time	545min
4	Specific gravity	2.67
5	Fineness	4.06

Fine Aggregate:

Fine Aggregate that complied with Indian Standard Specifications IS: 383-1970 was purchased locally and used for the experimental program. To get rid of any particles larger than 4.75 mm, the sand was first put through a 4.75 mm sieve. Dust was then removed by washing. Properties of fine aggregate is presented in Table 2.

Table 2 Properties of Fine Aggregate

S.No.	Characteristics	Values
1	Specific gravity	2.67
2	Water Absorption	1.05%
3	Fineness Modulus	2.58
4	Grading Zone	II

Coarse Aggregate:

The broken stone is utilized as a coarse aggregate. The maximum size of the coarse aggregate is determined by the nature of the work. In our work, we used coarse aggregate that was readily available locally and had a maximum size of 20 mm. After being cleaned to get rid of dirt and dust, the aggregates were dried until they were surface dry. In accordance with Indian Standard Specifications IS: 383-270, the aggregates were tested.

Crushed Over Burnt Clay Bricks:

Bricks are an excellent load-bearing material that is both adaptable and strong for use in construction. Numerous studies on the porosity, permeability, and absorption of brick have been conducted. Traditional clay bricks are made by hand in a wooden mould using clay and a specific amount of sand. After that, the damp bricks are taken to the brick kiln to be burned after being first allowed to dry in the sun and air. In the brick kiln, the bricks are burned to a temperature of 800-900C. The temperature in the brick kiln can rise to 1100–1200C if the temperature is allowed to get out of control. As a result, bricks that are in poor condition are sold for less money. Consequently, this kind of brick is crushed over burnt clay bricks as shown in Fig.1.

Fig.1 Crushed Over Burnt Clay Bricks

Characteristics comparison between Coarse Aggregate (CA) and Over Burnt Clay Bricks is presented in Table 3.

Table 3 Comparison between Coarse Aggregate and Over Burnt Clay Bricks

S.No.	Characteristics	CA	OBCB
1	Impact Value of Aggregate	10.65	28.23%
2	Crushing Value of Aggregate	18.32	30.86%
3	Specific Gravity of Aggregate	2.79	2.64
4	Density of Aggregate	1589kg/m^3	1678kg/m^3
5	Water Absorption of Aggregate	0.99%	6.02%

Mix Ratio:

The concrete mix design recommendation for IS-10262:2009 was followed in the preparation of the concrete mix. A mix proportioning ratio of 1:1.39:3.43 was established with target strength of 38.25 MPa. The water-to-cement (w/c) ratio was 0.40 in each instance. and obtained the following material quantity for this mix ratio is presented in Table 4.

Table 4. Quantity of Material per Cubic Meter of Concrete.

S.No.	Material	Proportion by Weight	Weight in kg/m^3
1	Cement	1	368
2	F.A	1.39	512
3	C.A	3.43	1264
4	W/C	0.4	147lit
5	SP	0.82	0.06 ml

Test Procedure:

For concrete with crushed over burnt clay bricks as coarse aggregate the following test were conducted for this experimental work,

(i) Workability test
(ii) Compressive Strength Test
(iii) Flexural Strength Test
(iv) Mass Density Test

IV.RESULTS AND DISCUSSIONS

(i)Workability test

The Compaction Factor Test was utilized to determine the workability of over burnt clay bricks as coarse aggregate in concrete, as it provides more information than the Slump Test. Since the test is dynamic, it is better suited for concrete mixtures than static tests. The test results are presented in Table 5 and Fig. 2.

Table 5 Compaction Factor Test Results

Replacement in %	0%	25%	50%	75%	100%
Compaction Factor	0.90	0.88	0.86	0.85	0.82

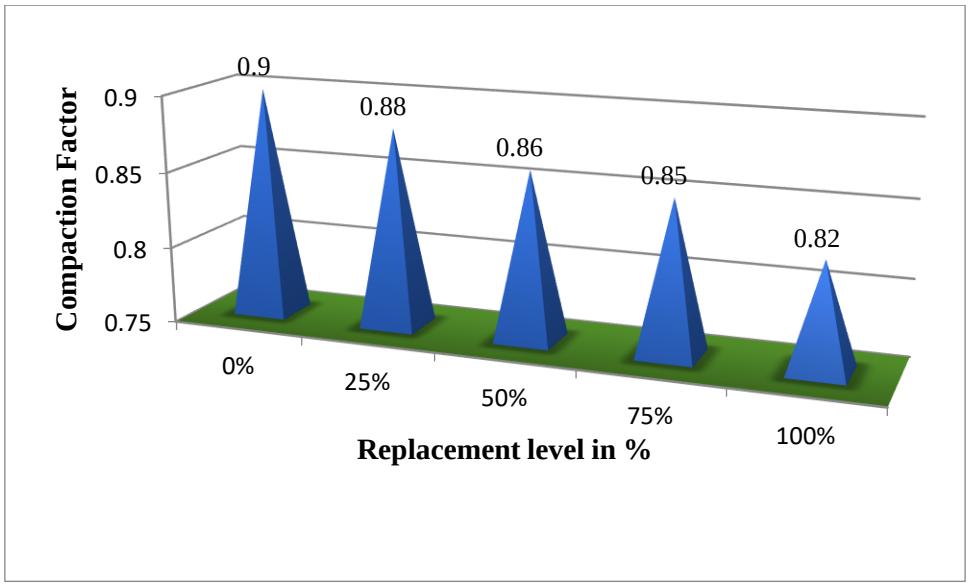

Fig. 2 Compaction Factor Test Results for all Replacement levels

(ii)Compressive Strength Test

Table 6 presents the compressive strength attained by various replacement levels of coarse aggregates by Over Burnt Clay Bricks and Fig.2 clearly indicates that the enhancement of compressive strength after 28 days for 25% and 50% was 30.32% and 35.45% when compared to that of conventional concrete (0% replacement level). On other hand the compressive strength decreases to 16.01% and 9.01% for 75% and 100% replacement level when compared to that of conventional concrete.

Table 6 Compressive Strength Test Results

S.No.	Replacement in %	Compressive Strength in N/mm^2	
		7 Days	28 Days
1	0	25.63	34.16
2	25	32.25	44.52
3	50	30.98	46.27
4	75	29.37	39.63
5	100	27.19	37.24

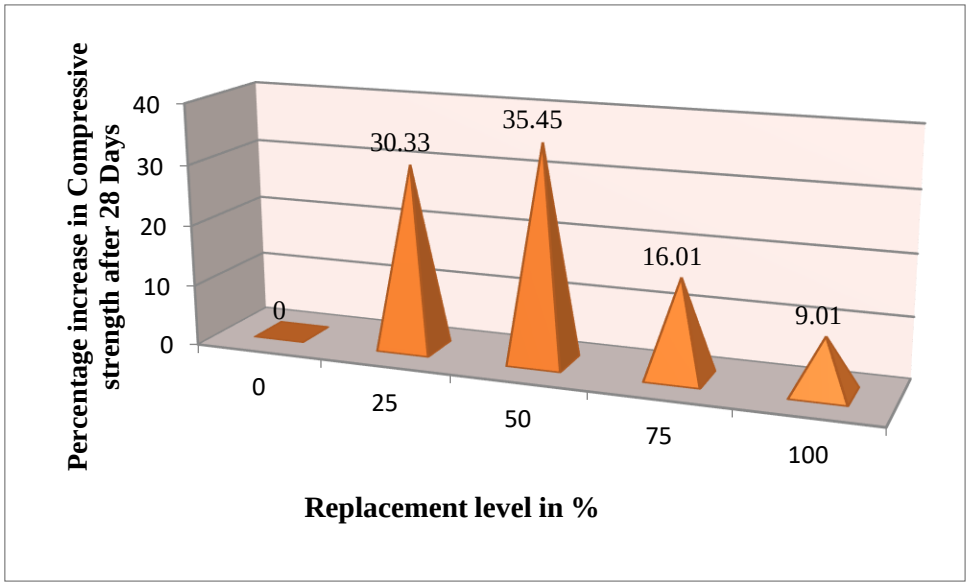

Fig. 3 Percentage Increase in Compressive strength after 28 days

(iii) Flexural Strength Test

Table 7 shows the flexural strength attained by various replacement levels of coarse aggregates by Over Burnt Clay Bricks and Fig. 4 shows the percentage increase in flexural strength after 28 days. The 50% replacement level exhibits an increase of 9.34% in flexural strength when compared to that of conventional concrete.

Table 7 Flexural Strength Test Results

S.No.	Replacement in %	Flexural Strength in N/mm^2
		28 Days
1	0	5.14
2	25	5.37
3	50	5.62
4	75	5.21
5	100	5.03

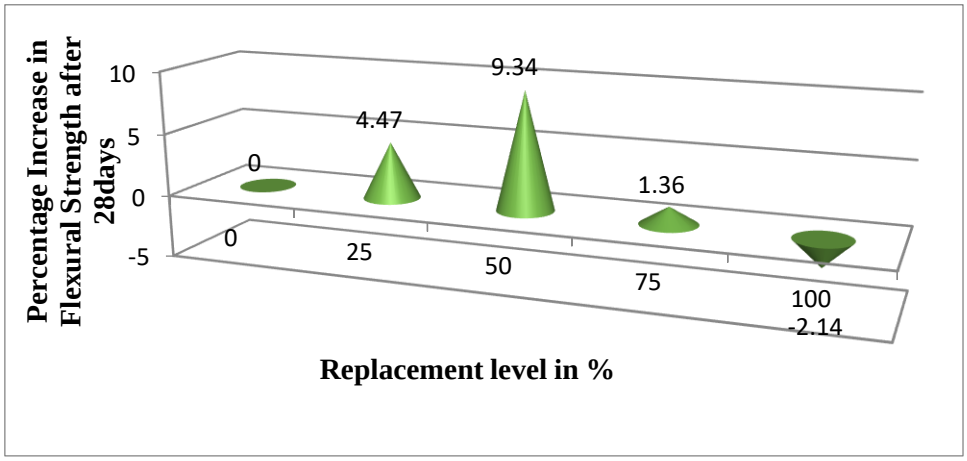

Fig. 4 Percentage Increase in Flexural strength after 28 days

(iv) Mass Density Test

The test results of mass density test is presented in the Table 7 and in Fig.5

Table 7 Mass Density Test Results

S.No.	Replacement in %	Unit Weight in kg/m^3
1	0	1589
2	25	1572
3	50	1598
4	75	1624
5	100	1678

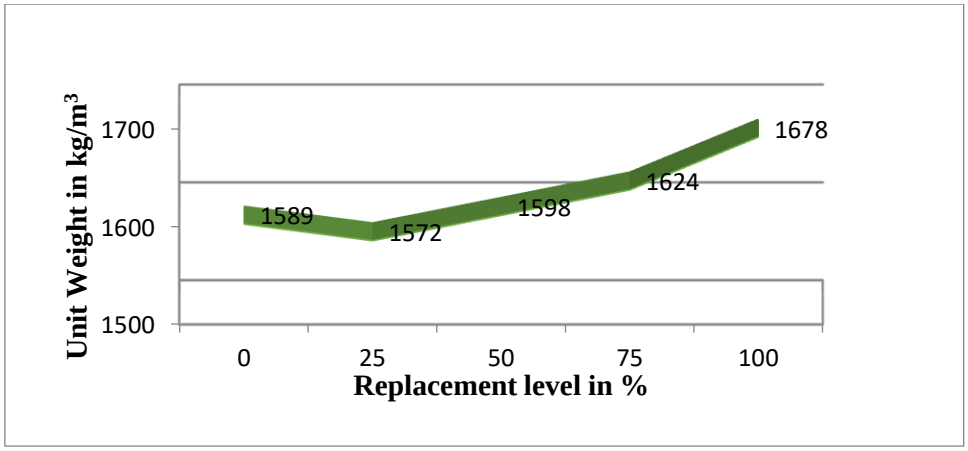

Fig. 5 Mass Density Test Results for all Replacement levels

V.CONCLUSIONS

The following conclusions were made in light of the experimental investigation's outcome.The compaction factor decreased as the percentage of over burnt clay bricks in concrete increases and increased in comparison with the conventional concrete. The density got a decreased value of 1598kg/m^3 for 50% replacement level and then after it increases. Concrete made by over burnt clay bricks in concrete as replacement of coarse aggregate, the enhancement of compressive strength after 28 days for 25% and 50% was 30.32% and 35.45% when compared to that of conventional concrete. At 50% replacement level the concrete exhibits an increase of 9.34% in flexural strength when compared to that of conventional concrete.

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