EFFECTIVE UTILSATION OF CRUSHED OVER BURNT BRICK AS COARSE AGGREGATE IN CONCRETE HOLLOW BLOCKS

[1]Ishfaq Ahmed Lone, [2] Tapeshwar kalra
[1]PG Scholar ,Department of Civil Engineering Surya Educational Charitable Trust Rajpura, India
[2]Asst. Professor ,Department of Civil Engineering Surya Educational Charitable Trust Rajpura, India

Abstract: Concrete hollow block is one of the most important developments in concrete masonry and it is widely used for both load bearing and non-load bearing masonry construction. It is made of cement and sand mix or concrete mix with dense or lightweight aggregates. The study has been carried out at 0%,20%, 40%,60%,70%, 80% and 100% replacement levels of normal crushed stone aggregate with crushed over burnt brick aggregate by Arbitrary standards method. Cube specimens of sizes 150mm with different percentages by weight of normal stone aggregate to over burnt brick aggregate were casted and tested after 7 & 28 days. On the other hand concrete hollow block specimens of size 200×200×150mm were tested only after 28 days, as per IS standards. For the purpose of current study, batching operation by weight approach (Arbitrary standards method) has been adopted. Nominal mix of 1:8 (1 cement: 8 combined aggregates) or 1: 4: 4 has been investigated with water/cement ratio of 0.55. The constituents used in the mix were Pozzolona Portland Cement (PPC) with 25% fly ash, fine aggregate (natural sand), coarse aggregates (locally available crushed stone aggregates 10 mm maximum size) and (crushed over burnt brick aggregate of 10 mm maximum size), and potable water as per IS 456-2000.Comparative study among various parameters like strengths of mixes, prepared at different replacement levels reveled that, crushed over burnt brick aggregates can be confidently used upto 69% replacement level of normal crushed stone aggregate with crushed over burnt brick aggregate, without compromising with the minimum required desired strength as per codal provisions. The main objective of the study is to explore and assess the possibility of use of crushed over burnt brick aggregate (industrial waste) as an alternative for the both costly and conventional stone aggregate in concrete hollow blocks (masonry in fills) to reduce their production cost, construction cost, and in addition dead weight of a building structure.

Keywords— **Cube, Hollow blocks, water cement ratio, aggregates, Compressive strength, burnt brick aggregate, concrete.**

I. INTRODUCTION

Concrete hollow block is one of the most important developments in concrete masonry and it is widely used for both load bearing and non-load bearing masonry construction. It is made of cement and sand mix or concrete mix with dense or lightweight aggregates. It is an effective means of utilizing wastes generated by stone crushers, quarrying and stone processing units and other industries. The technology has high potential in areas where raw materials are easily available. The Concrete Block Technology package is a highly profitable business for micro and small scale building material producers and construction companies.

A. Appearance

Concrete blocks have a light grey concrete colour, and on close inspection may show a granular texture depending on the type of aggregate used. Machine production provides even finish which offers savings on further cement plaster etc. Concrete blocks can be surface engineered by using pieces of stone or ceramic waste on their face.

B. Thermal properties

Concrete blocks have an excellent thermal property, comparable to other masonry units. The cavities in the blocks provide better thermal protection and also do not need external or internal plastering. The performance of these blocks increases with the increase in the number of hollow cores, which may or may not be filled in with some insulating materials.

C. Sound insulation

Concrete hollow blocks provide an acceptable degree of sound insulation. Insulation of concrete hollow blocks can further be improved by filling the cavities with an insulating material.

II LITERATURE REVIEW

Michael L. Whelan (1992) proposed a modified concrete masonry unit cross-section that along with different procedures for installation, resulted in productivity improvements without losses in structural strength, system durability, or aesthetic appearance. The masonry units are modified to allow for an interlocking arrangement. The proposed placement procedure was based on extruding mortar material into the joints after placement of the units. He expected that significant improvements in productivity would result from the proposed system appears valid.

Fahmy and Ghoneim (1997) have developed a 3-D nonlinear finite element model to study the complex behavior of ungrouted and grouted concrete block masonry under axial compression. The model detects crack initiation and traces crack propagation in the masonry assemblage. They studied the effect of strengths of block, mortar and grout on the prism strength and modulus of elasticity. They also tested block specimens under axial compression to determine the stress-strain relationship and the unit compressive strength were compared with those obtained from a finite element model of the block unit. Good agreement was observed between the various experimental values and finite element results.

Aggrawal and Kedia (1998) studied the uses of fly ash in concrete hollow blocks . The fly ash concrete hollow blocks were found lighter in weight, less porous, which gives better resistance to chemical attack, and have better fire resistance and the compressive strength decreases with the increase in fly ash to coarse aggregate ratio. The desirable strength can be achieved by selecting fly ash to coarse aggregate ratio between 0.7 and 0.8 and cement content between 7.5% and 10%.

Ramamurty (2001) conducted experimental investigations on the compression behavior of three-course high concrete hollow block masonry prisms using one type of block geometry. He presented a table of masonry compressive strengths for different block-mortar strength combinations

Fada Casi (2004) studied the geometric design of cores in concrete hollow blocks for optimum weight". In his study he found that the blocks with large size cores have the lightest weights. In general as the number of cores increases the weight of masonry unit also increases. He also found that the concrete hollow block with two-cores is the optimum shape for blocks to be light weight

Falah M. Wegian (2007) studied two techniques for concrete hollow blocks section conventional wire meshes and steel bars. A comparison was made of their structural behavior with that of normal reinforced concrete beam section. The comparison were based on response both prior and afterwards they were repaired with glass fibre reinforced polymer (GFRP). The specimens were subjected to concentrated loading till initial failure. The specimens were repaired after failure and loaded once again till another failure was reported.

III. MATERIALS USED

A. Over burnt brick aggregate.

Over burnt brick aggregate can be considered as a good material suitable for plain concrete works as well as for reinforced works where stresses are not very high. Brick aggregate should be saturated with water before use to avoid absorption of the mixing water which is necessary for the hydration of cement and for the setting and hardening of the concrete. Brick aggregate is more fire resistant and sound absorbent than crushed stone aggregate.

Fig.2.1 Typical shapes of Over Burnt Aggregate

TABLE: 2.1 Properties of coarse aggregate.

Properties	Over burnt brick aggregate	Normal stone aggregate
Maximum aggregate size (mm)	10 mm	10 mm
Specific gravity	1.78	2.05
Water absorption (%)	4.50	1.00
Bulk density (Kg/m^3)	1161.3	1587.1
Percentage void (%)	33.64	22.58

Aggregate crushing value (%)	35.75	25.50
Fineness modulus	3.338	3.407

Fig: 2.2 Particle size distribution curve of Over Burnt Aggregate

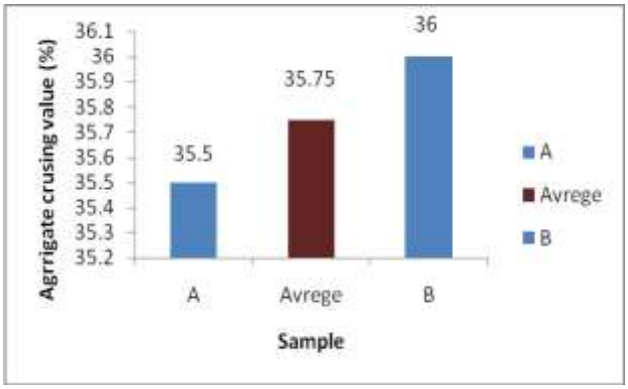

Fig: 2.3 Aggregate crushing value of Over Burnt Aggregate

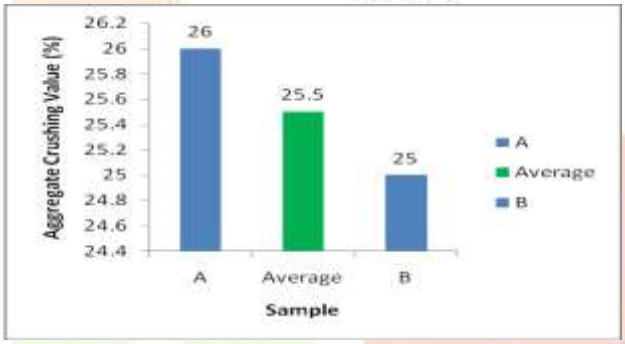

Fig: 2.3 Aggregate crushing value of normal stone aggregate

B. Fine aggregate

Natural sand conforming to Zone I with fineness modulus of 3.016 has been used in the present study. The maximum size of sand was taken to be 4.75 mm. The testing of sand has been done as per IS-2386 (part I) 1963. Fineness modulus of sand = 3.016 (Coarse sand)

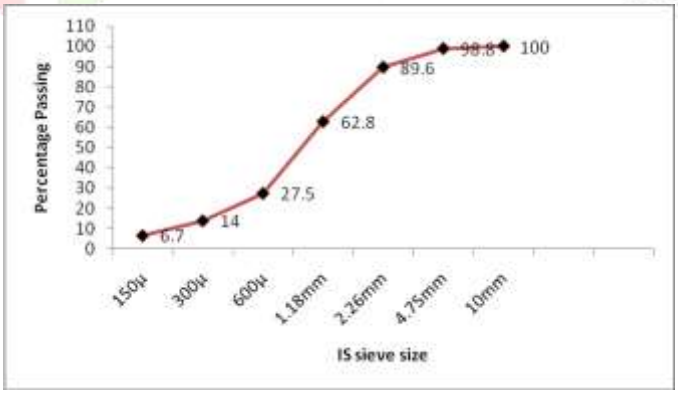

Fig 2.4 particle size distribution curve of fine aggregate

C. Cement

Portland Pozzolana cement conforming to Indian Standard: 1489(part I)-1991 has been used in the study. The various physical and mechanical properties investigated in the study are presented in table 2.2.

TABLE 2.2: properties of cement

Fineness (%)		2.56
Standard consistency (%)		34
Initial setting time (min.)		190
Final setting time (min.)		275
Average expansion (mm)		0.75
Compressive Strength (N/mm²)	3 day	23.89
	7 day	31.82
	28 day	43.26

D. Water

Tap water, potable without any salts or chemicals was used in the study.

IV. TEST PROGRAM

- To explore and assess the possibility of using crushed Over burnt brick aggregate as an alternative for the normal crushed stone aggregate in concrete masonry unit (concrete hollow blocks) to reduce, the production cost of the unit, construction cost, and in addition, dead weight of a building structure.
- To study the physical and mechanical properties of the OVER BURNT BRICK AGGREGATE concrete hollow block as per the specifications given by IS- codes of practice.
- To carry out comparative study among strength, Economy.

V. COMPRESSIVE STRENGTH TEST

All batches described above in the experimental program were prepared, cured, and tested for compressive strength after 7 and 28 day. Standard 150 x 150 x 150 mm cubes & hollow block specimens of size 200×200×150mm cubes were used for compressive strength. hollow block specimens of size 200×200×150mm were tested only after 28 days. As shown in Figure 1, three identical specimens were crushed at 7 days and three identical specimens were crushed at 28 days. The compressive strength was calculated by dividing the failure load by average cross sectional area.

Fig.3.1 concrete hollow blocks with Different percentage of OBA

Fig.3.2 concrete cube specimens with and without replacement level

Fig.3.3 Test setup of cube specimen

From the experimental observations, concrete hollow block with 60% OVER BURNT BRICK AGGREGATE gives the 28-day block strength of 1.87 N/mm^2 The strength of OVER BURNT BRICK AGGREGATE concrete hollow block is inversely proportional to the percentage replacement of normal stone aggregate (P ά 1/RNORMAL STONE AGGREGATE).

TABLE : 3.1 - Compressive strength test results for cube samples 150mm x 150mmx150mm & hollow block specimens of size 200×200×150mm

Mix	CUBE SAMPLES				HOLLOW BLOCK SPECIMENS	
	Compressive strength N/mm²		Average compressive strength N/mm²		Compressive strength N/mm²	Average compressive strength N/mm²
	7DAYS	28 DAYS	7 DAYS	28 DAYS	28 DAYS	28DAYS
0%	9.89	17.7	9.74	17.66	3.96	3.98
	9.74	17.6			4.26	
	9.61	17.61			3.93	
20%	8.79	17.15	8.82	16.94	3.68	3.5
	8.80	16.90			3.48	
	8.90	16.78			3.46	
40%	7.98	15.64	7.86	15.64	3.09	2.95
	7.71	15.72			2.98	
	7.95	15.51			2.91	
60%	7.51	15.19	7.33	15.07	1.93	1.93
	7.15	14.97			1.89	
	7.33	15.17			2.09	
70%	7.06	14.92	7.12	14.75	1.61	1.47
	7.15	14.32			1.40	
	7.15	14.75			1.38	
80%	7.02	14.38	6.84	14.08	1.10	1.12
	6.80	14.15			1.20	
	6.70	13.98			1.09	
100%	6.31	12.80	6.18	12.81	0.88	0.82
	6.17	12.98			0.86	
	6.08	12.71			0.79	

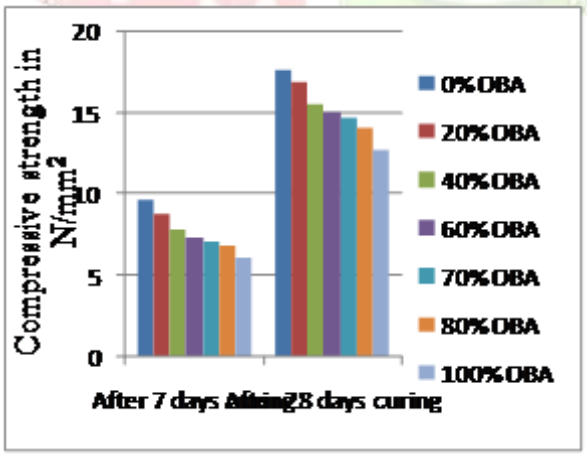

Fig.3.4 Comparison of 7 & 28 days compressive strength of cube specimens at different OBA levels.

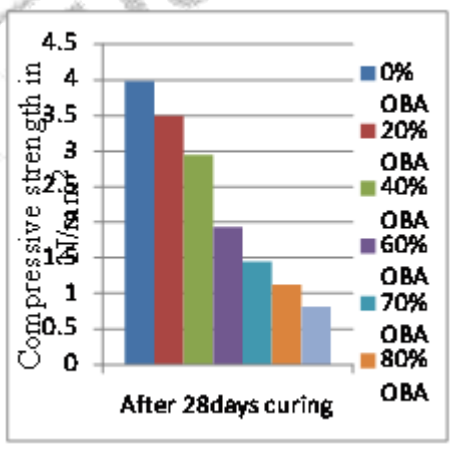

Fig.3.5 Comparison of 28 days compressive strength of Hollow Block specimens at different OBA levels.

V. CONCLUSIONS

In general, over burnt brick aggregate has good potential as coarse aggregate in the production of concrete hollow blocks. The following observations and conclusions can be made on the basis of the current study.

- The crushing value of Over burnt brick aggregate is 10.25% higher than normal stone aggregate of 10mm maximum size but it is within the limits specified by IS codes of practice.

- From the experimental observations, concrete hollow block with 60% over burnt brick aggregate gives the 28-day block strength of 1.87 n/mm^2 and with 70% over burnt brick aggregate gives 1.44 n/mm^2. however, from the regression the required block strength of 1.5n/mm^2 is attained at 69% inclusion of over burnt brick aggregate.
- The percentage reduction in the production cost of the unit per month per factory at 69% replacement of normal stone aggregate by over burnt brick aggregate is 8.53% hence economical than normal concrete hollow block.
- Besides achieving the above advantages, the suggested block also proves Eco-friendly as it utilizes the industrial waste which creates the large dumping problems.

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