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Experimental Investigation on Partial Replacement of Fine Aggregate Using Crushed Spent Fire Bricks

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ABSTRACT: *Fine aggregate is a widely used construction material all over the world. Various researches have been done for the replacement of the construction materials for efficient purposes of which crushed spent fire bricks is one of them. This project explains about the replacement of fine aggregates by partially crushed spent fire bricks. Therefore varying percentage of fine aggregates by crushed spent fire bricks with varying percentage of 10%, 15%, 20% & 25% and optimum percentage of replacements is made and strength and workability parameters are studied. The workability of concrete gets decreased with the addition of the crushed spent bricks. From the test results, crushed spent fire bricks replaced for fine aggregates give a maximum strength at 20% when compared to conventional concrete. Then the optimum percentage of replacement of fine aggregates by crushed spent fire bricks are used in combination as partial replacement in concrete and the optimum percentage of the combination is obtained.*
Keywords: *Fine aggregate, crushed spent fire brick, split tensile test and partial replacement.*

I. INTRODUCTION

In the construction industry the widely used material is concrete. Fine aggregate is one of the important constituent in it. Bricks being an integral part of the wall can be used as recyclable construction material. Fire bricks are the products which are manufactured from refractory grog, plastic and non-plastic clays of high purity. The different raw materials are properly homogenized and pressed in high capacity presses to get the desired shape and size. Finally these are fired in oil-fired kiln at a temperature of 1300^0c. Due to the exposure to continuous high temperature for a period of 10 to 15 days, some physical and mechanical properties are changed. They were physically cleaned and mechanically crushed to a size gradation conforming to fine aggregates.

II. LITERATURE REVIEW

Mohammad Abdur Rashid et al. (2012), investigated about the effect of replacing natural coarse aggregate by brick aggregate on the properties of concrete. The properties of concrete obtained replacing stone aggregate as partially or fully by crushed clay bricks. This study was volumetric replacement such as 0%, 25%, 50%, 75% and 100% of stone aggregate as brick aggregate. The use of brick aggregate as a replacement of stone aggregate resulted reductions in unit weight, compressive strength, and modulus of elasticity of concrete by about 14.5%, 33%, and 28% respectively. The reduction in tensile strength of mixed aggregate concrete is found to be less significant up to 50% replacement of stone aggregate by brick aggregate.

Jafar Bolouri Bazaz et al. (2006), studied about the performance of concrete produced with crushed bricks as the coarse & fine aggregate this experimental was discussed about the physical characteristics of crushed clinker bricks, compressive and tensile strength of bricks concretethe primary test results indicate that the quality of such bricks is low in comparison with natural rocks. The strength and durability of concrete is depends on the porosity, specific gravity, soundness, freezing & thawing resistance, compressive strength. In this project, the properties of concrete made with three types of crushed brick aggregate in terms of size and material. The first type is, a combination of fine and coarse crushed brick aggregate based on ASTM recommendation. The second type is, a combination of fine and coarse crushed brick aggregate based on ASTM recommendation and the third type was using fine crushed brick aggregate to produce fine aggregate concrete. From the results, they concluded that, compressive strength of concrete made with crushed bricks is relatively high in comparison with ordinary concrete.

Keerthinarayana and Srinivasan (2010),investigated about the strength and durability of concrete by partial replacement of fine aggregate using crushed spent fire bricks. The fire bricks were observed through the high power lenses, CSFB particles were of irregular shapes with sharp edges, which are same as that of natural sand texture. From the initial test, both CSFB and sand appeared to have almost same specific gravity, water absorption and fineness modulus. On an overall, the CSFB satisfies the zone II gradation for not only to partially replace the sand, but for good concrete and unit weight of CSFB is higher than that of river sand aggregate in dense condition which, in turn, contributes to the increase in the unit weight of concrete containing CSFB as a fine aggregate. From the obtained results we observe that the maximum strength is achieved by 25% of CSFB replacement in concrete. The 30% of CSFB replacement in concrete indicates there is no strength gaining after increasing the proportion. They concluded that compressive, split tensile and modulus of elasticity of partial replacement of CSFB aggregate concrete is marginally higher than that of the river sand aggregate concrete at age of 7 days, 14 days and 28 days respectively.

Tiara Darshita et al. (June 2014),studied about the strength and workability of different grades of concrete by partial replacement of fine aggregate by crushed brick and recycled glass powder. In this project sand can be replaced by 10, 20 & 30% of brick powder and also sand replaced by glass powder range was 10, 15& 20% in M20, M25&M30 mix ratio. The optimum replacement of glass and brick was found to be 15% and 20% respectively at which the strength of concrete at 3 days, 7 days & 28 days were found to be higher than those of concrete prepared without replacement of sand for all mix. In fire bricks replacement was decrease compressive strength in 10% fine aggregate replacement and increase strength in 20% in M20 mix. The Slump value was decrease when CFBP increase in the concrete and the slump value was increase when glass powder increase.

III. MATERIAL PROPERTIES

The properties of materials such as fine aggregate, coarse aggregate, cement, glass powder and crushed spent fire bricks found in laboratory for checking their suitability in concrete and making of concrete. All the results were conducted as per Indian Standard codes.

3.1 Fine Aggregate

Aggregate which is passed through 4.75 IS Sieve and retained on 75micron (0.075mm) IS Sieve is termed as fine aggregate. The sand used for experimental program was locally procured and conforming to zone II. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm.

The fine aggregates were tested as per Indian Standard Specification IS: 383-1970. Properties of the fine aggregate used in the experimental work are tabulated in Table 1.

Table 1: Properties of Fine Aggregates

S. No.	Characteristics	Value
1.	Type	River sand
2.	Specific gravity	2.6
3.	Moisture content	2.5%
3.	Net water absorption	0.9%
5.	Fineness modulus	3.1
6.	Grading zone	II

3.2. Crushed Spent Fire Bricks

The brick bats crushed in coarse powder form were used as a fine aggregate for making concrete. The crushed spent fire brick which is passed through 4.75mm IS sieve and retained on 75micron (0.075mm) sieve to get the grading of fine aggregate. The crushed spent fire bricks are satisfying the zone II gradation. The results of various tests conducted on crushed spent fire bricks are given in Table 2.

Table 2: Properties of Crushed Spent Fire Bricks

S. No.	Characteristics	Value
1.	Specific gravity	2.66
2.	Net water absorption	0.8%
3.	Fineness modulus	2.98
4.	Grading zone	II

IV. EXPERIMENTAL PROGRAMME

4.1 Split Tensile Strength

One of the most important properties of the hardened concrete is tensile strength. The split tensile strength of concrete is usually found by testing plain concrete cylinders. Cylinders of size 150mm×300mm were casting using M30 grade concrete. Fine aggregate replaced by crushed spent fire bricks at 10%, 15%, 20% and

25% are used for the experiment. During moulding, the cylinders were mechanically vibrated using a table vibrator. After 24 hours, the specimens were removed from the mould and subjected to water curing for 28 days. After curing, the specimens were tested for compressive strength using a calibrated compression testing machine.

Split tensile strength, fcr (N/mm2) $=2P/\pi LD$

Where,

P= ultimate load (N),
L= length of cylinder(mm),
D= diameter of cylinder

Figure 1: Split Tensile Strength Test Setup

V. RESULTS AND DISCUSSION

Table 3: Tensile Strength of Concrete

Fine aggregate replaced by crushed spent fire bricks in %	Specimen description	28th day strength in N/mm2
0%	**A**	**2.9**
	A 1	2.4
	A 2	3.1
	A 3	2.78
10%	B	1.83
	B 1	1.99
	B 2	**2.25**
	B 3	1.82
15%	C	2.49
	C 1	1.3
	C 2	1.54
	C 3	0.98
20%	D	2.89
	D 1	2.05
	D 2	2.13
	D 3	1.75
25%	E	1.658
	E 1	0.95
	E 2	1.1
	E 3	0.67

Tensile strength for 28 days = 2.9 N/mm2

The graphical representation of variation in split tensile strength for the specimens under study is shown in Fig 2. The replacement of fine aggregate by crushed spent fire bricks at 20% gives higher strength compared to the conventional concrete by 1.16%and beyond 20% split tensile strength gets decreased. From the test results, it was observed that the split tensile strength of concrete for 7 and 28 days of specimen D2 (10%crushed spent fire bricks) was low than that of the control specimen.

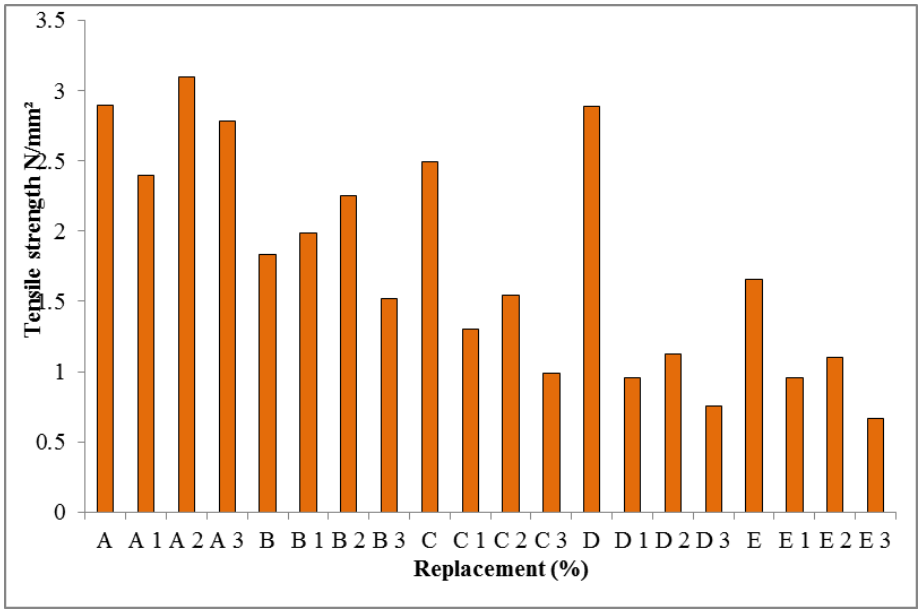

Figure2: Split Tensile Strength of Concrete

VI. CONCLUSION

In this project replacement of fine aggregate by crushed spent fire brick was used.The following conclusions are made from the experimental works carried out:

- It is concluded that when a crushed spent fire brick is used as a replacement of natural fine aggregate, there is an increase in strength.
- The workability of concrete decreases with replacement of fine aggregate by crushed spent fire brick.
- The optimum percentage for fine aggregate replaced with crushed fire bricks achieved at 20%.

REFERENCES

[1]. Abdus Salam M., KowsurHasan M., Mohammad Abdur Rashid and Sukanta Kumar Shill F. (2012), 'Effect of Replacing Natural Coarse Aggregate by Brick Aggregate on the Properties of Concrete' DUET Journal, vol -, Issue 3, pp.17-21.

[2]. Jafar Bolouri Bazaz., Mahmood Khayati S. and Navid Akrami D. (2006), 'Performance of Concrete Produced with Crushed Bricks as the Coarse & Fine Aggregate' The Geological Society of London, IAEG2006, pp. 616 - 622.

[3]. Keerthinarayana S. and Srinivasan R. (2010), 'Study on Strength and Durability of Concrete by Partial Replacement of Fine Aggregate using Crushed Spent Fire Bricks' Journal of construction and building materials vol-1, pp. 18-23.

[4]. Patel Anoop and Tiara Darshita (June 2014), 'Study of Strength and Workability of Different Grades of Concrete by Partial Replacement of Fine Aggregate by Crushed Brick and Recycled Glass Powder' International Journal of science and Research, vol-3 Issue 6, pp. 141-145.

[5]. IS 456:2000, 'Plain & Reinforced concrete-code of practice', Bureau of Indian Standards, New Delhi.

[6]. IS 383 (1970) 'Indian Standard Code of Coarse and Fine Aggregate from Natural Sources for Concrete', Bureau of Indian Standards, New Delhi.

[7]. IS 10262:2009, 'Guidelines for Concrete Mix Proportioning', Bureau of Indian Standards, New Delhi.