

# Replacement of Coarse Aggregate by Demolished Brick Waste in Concrete

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## Abstract

In this present work the study on replacement of coarse aggregate by demolished brick aggregate. Coarse aggregate can be defined as inert granular materials such as gravel, crushed stone and sand. Coarse aggregate is one of the essential ingredients apart of water and cement in concrete production. The only variable considered in this study was the volumetric replacement (0%, 25%, 50%, 75%, and 100%) of stone aggregate by brick aggregate. The use of brick aggregate as a replacement of stone aggregate resulted reductions in unit weight, compressive strength of concrete. Different relations for determination of compressive strength, splitting tensile strength of mix-aggregate concrete have been tentatively proposed. The 25% replacement of RCBA is considered as the best in view of strength and economy, hence we use it in moderately loaded structures. 50% replacement of RCBA can be used wherever load coming chances are less. Can be rectified, but few of them can be overcome by improving management responsibilities.

**Keywords: RCBA, Compressive Strength, Split Tensile Strength**

## I. INTRODUCTION

In this journal we are going to study on replacement of coarse aggregate by demolished brick. Coarse aggregate can be defined as inert granular materials such as gravel, crushed stone and sand. Coarse aggregate is one of the essential ingredients apart of water and cement in concrete production. It consists about 60 to 75 percent of total concrete production. Coarse aggregate comes from particles greater than 4.75 mm but commonly in a range between 9.5 mm to 37.5 mm. Therefore, the selection of coarse aggregate is vital for a good concrete mix such as it need to be clean, tough, and strong particles that free room absorbing chemicals. Furthermore, coarse aggregate also is significant due to its properties will affect the modulus of elasticity.



Fig. 1: Demolished brick

## II. SIGNIFICANCE OF STUDY

Determining the suitability of brick waste as alternative coarse aggregate in concrete is very important for these researches convince people that brick waste material can be reused in the construction process. The analysis of the test is required to identify the result whether it is satisfactory the requirement or not. This is due to result from the test will show that whether brick waste can achieve the minimum required for compressive strength test and even higher. The compressive strength will be present for age 7 and 28 days, respectively. The test to identify physical and mechanical properties of brick waste concrete is vital to improvisation the

properties of coarse aggregate by brick waste alternative in concrete production. By carrying on the flexural strength test, the ability of concrete to resist distortion under load can be set. We can conclude that how many in per cent brick waste is needed to make its properties in brick concrete strong and can achieve the resistance to deformation load.

### III. OBJECTIVES OF THE PRESENT STUDY

- 1) To determine the suitability of brick waste as replacement of coarse aggregate in concrete production.
- 2) To investigate the mechanical and physical properties of brick waste concrete
- 3) To compare the performance between concrete with brick waste as coarse aggregate partial replacement and conventional concrete (control concrete).
- 4) To study the feasible of waste brick from demolished building as a coarse aggregate replacement material.
- 5) To determine the effect of waste brick aggregate as coarse aggregate replacement material in variable percentage by weight of aggregate in fresh properties of concrete.

### IV. MATERIALS AND METHODOLOGY

#### A. Materials Used

There are various studies that have been conducted on concrete diversifying the sources of materials. Furthermore, there are various types of aggregates that has been set consist of industrial waste, construction waste such as crush brick, brick waste, concrete side, and more.

##### 1) Concrete:

Concrete is a composition of material from coarse granular material such as coarse and fine aggregate mixing in a hard matrix of material that is cemented that fills the space of aggregate particles with an additive and bind them together (Saidi, 2007). It has been known widely in function for building foundations, architectural structures, walls, pavements and most of it in the construction industry. It is important to identify the amount of each material mixing in production of concrete.

##### a) Cement:

Cement is a material that has a cohesive and adhesion properties that enable binding chunks of rock into one cohesive body. There are dissimilar cases of cement made at factory for specific purposes and to conform to the specific demands. When the void between the aggregates is minimized, then the need for cement to fill the empty space can be reduced to maintain the workability and the strength of concrete. And so, the optimal mixing ratio of aggregates will produce a concrete with minimal quantity of cement contain. Therefore, the lower water and cement quantity of water and cement ratio (w/c) constant, would result a more durable concrete.

##### b) Coarse aggregate:

Coarse aggregate can be defined as inert granular materials such as gravel, crushed stone and sand. Coarse aggregate is one of the essential ingredients apart of water and cement in concrete production. It consists about 60 to 75 percent of total concrete production. Coarse aggregate comes from particles greater than 4.75mm but commonly in a range between 9.5mm to 37.5mm.

##### c) Fine aggregate

Locally available river sand conforming to Grading zone IV of IS: 383 –1970. Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.

##### d) Recycled aggregates:

The recycled aggregate are collected from the source demolished structures. The concrete debris were collected locally from different sources and broken into the pieces of approximately 80 mm size with the help of hammer. The foreign matters were sorted out from the pieces. Further, those pieces were mechanically sieved through sieve of 4.75 mm to remove the finer particles. The recycled coarse aggregates were washed to remove dirt, dust etc. and collected for use in concrete mix.



Fig. 2: Cement



Fig. 3: Coarse Aggregate



Fig. 4: Fine Aggregate



Fig. 5: Recycled Coarse Aggregate

## B. Methodology

### 1) Mix Design

Mix design is a process of selecting suitable ingredients for the concrete and determining their proportion which would produce, as economically as possible, as concrete that satisfies the job requirement. The proportioning of the ingredients of concrete is an important phase of concrete technology as it ensures quality and economy, in pursuit of the goal of obtaining concrete with desired performance characteristics.

Table - 4.1  
Detailed Description of Concrete Mix

MIX NAME	RCBA-0	RCBA-25	RCBA-50	RCBA-75	RCBA-100
% OF REPLACING BRICK AGGREGATE	0%	25%	50%	75%	100%

Table - 4.2  
Mix Proportion

Cement	Fine aggregate	Coarse aggregate:	Water/Cement Ratio
1	1.44	2.9	0.53

## V. RESULTS AND DISCUSSION

### A. Tests on Materials:

#### 1) Cement

In this present work JK of cement of 43 grade ordinary Portland cement. Testing of cement was performed as per IS: 8112-1989.

Table - 5.1  
Detailed Description of Test on Cement

Particulars	Test method	Experimental Outcome	Standard as per IS:8112-1989
Specific Gravity	Density bottle method	3.10	3.0-3.15
Setting time (minutes)	Vicat's apparatus		
Initial setting time	Needle is 1 mm square section	52 minutes	Which isn't lower than 30 min
Final setting time	Needle is 1mm square section with 5mm dia attached	240minutes	Which is isn't more than 600 min
Fineness of cement	Fineness by sieving	5.33%	<10%

#### 2) Coarse Aggregates:

Locally available crushed granite coarse aggregate has been used. The present work having maximum size 20mm coarse aggregate used. Accordingly, tests have been carried out as per procedure given in IS 2386 (PART3)-1963

Table - 5.2  
Detailed Description of Test on Coarse Aggregate

Physical Properties	Coarse Aggregate test result
Specific Gravity	2.63
Impact test	6.9%
Water Absorption	0.26%
Angularity Number	9.84

#### 3) Fine Aggregates:

Locally available river sand has been used. The present work having maximum size 4.75mm fine aggregate used. Accordingly, tests have been carried out as per procedure given in IS 2386 (PART3)-1963

Table - 5.3

Detailed Description of Test on Fine Aggregate

Physical Property	Fine Aggregate test result
Specific Gravity of Sand	2.60
FM	2.01
Grading Zone	IV
Water Absorption	1%

4) Recycled Brick Aggregate:

The recycled aggregate are collected from the source demolished structures. The concrete debris were collected locally from different sources and broken into the pieces of approximately 80 mm size with the help of hammer

Table - 5.4

Detailed Description of Test on Brick Aggregate

Physical Properties	Coarse Aggregate test result
Specific Gravity	2.2
Impact test	6.9%
Water Absorption	0.26%
Angularity Number	9.84

**B. Compressive Strength Test Results**

Following table gives the compressive strength test results of concrete produced by replacing the C.A. by RCBA.

Table - 5.5

Average Strength of cubes for 7 & 28 days

% of RCBA	Average Compressive Strength (Mpa)
	Cubes
0%	24.55
25%	25.36
50%	15.12
75%	11.46
100%	6.96

% of RCBA	Average Compressive Strength (Mpa)
	Cubes
0%	31.20
25%	29.92
50%	20.93
75%	18.20
100%	10.96

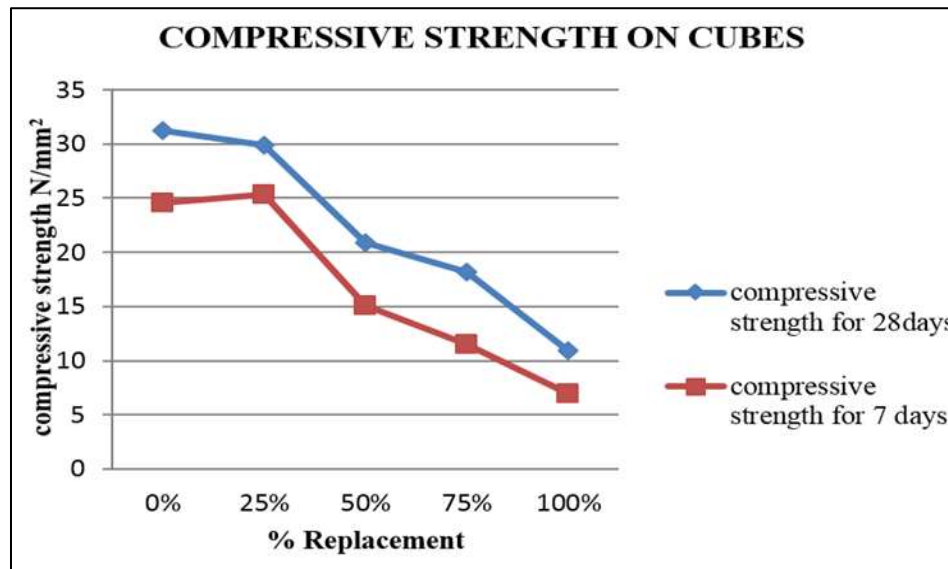


Fig. 6: Compressive Strength Result

**C. Split Tensile Strength Test Results**

Following table gives the split tensile strength test results of concrete produced by replacing the C.A. by RCBA.

Table - 5.6  
Average Strength of cylinders for 7 & 28 days

% of RCBA	Average Split Tensile strength (Mpa)
	Cylinders
0%	8.97
25%	10.46
50%	7.95
75%	6.14
100%	3.56

% of RCBA	Average Split Tensile strength (Mpa)
	Cylinders
0%	12.18
25%	14.52
50%	10.46
75%	7.78
100%	5.31

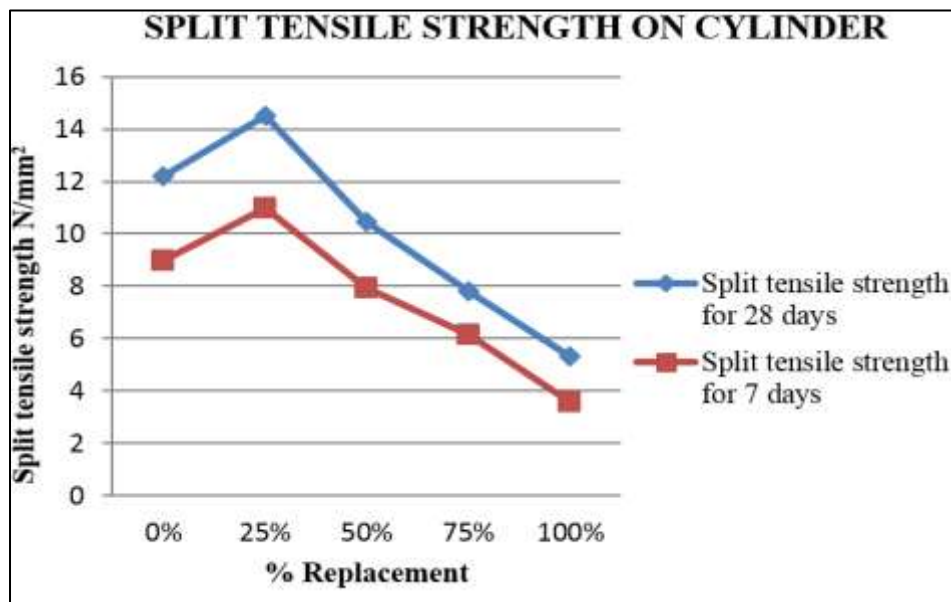


Fig. 7: Split Tensile Strength Result

## VI. CONCLUSIONS

From the present investigation, the following conclusions were drawn.

- The RCBA are considered as comparatively less weight aggregates but not light weight aggregates.
- As increase in the percentage of replacement of RCBA the strength also gets reduces and density also reduces.
- For 25% is found to be better substitute for concrete with respect to strength.
- The 25% replacement of RCBA is considered as the best in view of strength and economy, hence we use it in moderately loaded structures.
- 50% replacement of RCBA can be used wherever load coming chances are less.

## VII.SCOPE FOR FUTURE WORK

This research is focused on some properties and strength behaviour of concrete if demolished waste bricks used as aggregate in construction.

However further studies are required on following issues:

- The effect fine recycled brick aggregate in concrete by various percentages.
- Determine the effect of the RCBA from different ages of buildings.
- The behaviour of RCBA concrete at low temperatures.
- Tests on age of RCBA concrete.

## REFERENCES

- [1] Khalaf F M, et al, "investigated the properties of crushed clay brick concrete subjected to elevated temperatures". ASCE, Vol.18, No.4, pp.518-526, 2006.
- [2] Chi Sun Poon and Dixon Chan. "use of recycled concrete aggregates and crushed clay brick as unbound road sub-base". Vol.15,3 may 2007
- [3] Mohammad AbdurRashida , et al. "Properties of higher strength concrete made with crushed brick as coarse aggregate". IEB, Vol.14, received on 14, 2008.
- [4] Fadia S. et al.(2009) "Use of Crushed Bricks as Coarse Aggregate In Concrete". Tikrit journal of eng, Vol.16, No.3, september 2009.
- [5] JianYanga, et al. "Concrete with recycled concrete aggregate and crushed clay bricks". IJE, VOL.2,13 November 2011
- [6] Yang, J, et al. "Concrete with recycled concrete aggregate and crushed clay brick". IJE, Vol.25(4), April 2011
- [7] Tanvir Hossain, et al. "Pervious concrete using brick chips as coarse aggregate". IEB, 37(1) 43-52, 2011
- [8] Mohammad Abdur Rashid, "Effect of Replacing Natural Coarse Aggregate by Brick Aggregate on the Properties of Concrete". DUET Journals, Vol. 1, Issue 3, June 2012.
- [9] Ali.A.Aliabdo. "Utilization of crushed clay brick in concrete industry". IJCSM, Vol.148:757-769, 2013
- [10] Gopinandan Dey and Joyanta Pal. "Use of Brick Aggregate in Standard Concrete and Its Performance". IACSIT, Vol.5, No.4 August 2013.

### **Reference of Code Practice**

- [11] IS: 456-2000 plain and reinforced concrete code of practice.
- [12] IS: 10262-2009 recommended guidelines for concrete.
- [13] IS: 3495-1 to 4 (1992): Methods of tests of burnt clay.
- [14] IS: 383-1970 recommended guidelines for test on aggregates.
- [15] IS: 8112-1989 recommended guidelines for test on cement.