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Experimental Study on Recycling of Brick Waste in Concrete as Coarse Aggregate

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Abstract
Several million tons of solid waste are produced each year due to construction and demolition activities worldwide, and brick waste is one of the widest wastes. Recently, a growing number of studies have been conducted on using recycling brick waste (RBW) to produce environmentally friendly concrete. It involves a compressive strength test to compare RBA concrete and conventional concrete. Trial mixes of RBA concrete were prepared by replacing with 20%, 40%, & 60% crushed bricks by volume. M20 grade of RBA concretes were prepared and tested to compare the compressive strength. The test results showed that it is possible to produce RBA concrete with 40 % replacement.

Keywords: RBW, RBA, Aggregate, Replacement, Compressive strength, M20

1. Introduction

Concrete is second widely used construction material in the world. It mainly consists of Coarse Aggregate, Fine Aggregate, Cement and Water. The Coarse Aggregate consumes 70-80% of the volume of the concrete. The primary sources of coarse aggregate are getting diminished due to various reasons such as excessive consumption, technological and industrial development, erosion, excessive mining, etc. In addition of recycling and reuse of construction material waste is an interesting option to save waste disposal sites and conservation of natural resources. Brick is highly available construction material, sometimes it is traditionally used as aggregate.

The conventional aggregates used in concrete are obtained from crushing rocks which consumes very huge quantum of energy and produce a significant amount of greenhouses gases and release it in environment. Also, the transportation of coarse aggregate from where they are sourced to construction sites has been found to result in significant carbon dioxide emission to the environment. The increasing use of concrete has also been found to result in extensive strain on the sources of these aggregates and a consequential deformation of the environment due to the excessive exploration. Brick wastes are being accumulated at certain places which cause the environmental and land fill problems. The most efficient method of managing the construction and demolition waste is recycling and reusing of these products in an effective and economic way. The total quantum of waste from construction industry is estimated to be 12 to 14.7million tons per annum out of which 7-8 million tons are concrete and brick waste.

2. Literature Review

1) **Naraindas Bheel, K Rajesh Kuma, Ashok Kumar,Rehana Bhagam, Adeyemi Adesina , ShankerLal Meghwar and Noor Ahmed Memon**

"Innovative use of brick wastes as coarse aggregate in concrete " Coarse aggregates occupy the largest volume in concrete which is one of the most widely used construction material as per industry surveys. The depleting supply of coarse aggregate coupled with the high greenhouse gasses emissions from its processing and transportation has resulted in a need to find alternatives that can be utilized as coarse aggregate. Of such materials that are available in abundance locally in Pakistan are brick wastes that are generated from the construction and demolition processes. In order to evaluate the feasibility of using brick wastes as coarse aggregate in producing concrete, this study was undertaken. Six concrete mixtures were made by incorporating brick wastes as a replacement for the natural coarse aggregates and the corresponding properties evaluated. The properties evaluated are the slump, density, compressive strength and flexural strength. Results from this study indicated that the use of brick wastes as coarse aggregates in concrete resulted in a decrease in the slump and mechanical properties. However, concrete mixtures incorporating brick wastes up to 100% replacement of natural coarse aggregate exhibited flexural and compressive strength higher than 2 MPa and 10 MPa respectively. Nonetheless, the incorporation of brick wastes as coarse aggregate resulted in a decrease in density due to its lower bulk density in comparison to that of the natural coarse aggregate.

2) **Rekha Kasi, Potharaju Malasani**

"Usage of Recycled Brick as Coarse Aggregate in Concrete" This paper presents the comparative analysis of different properties of both the Recycled Brick Aggregate (RBA) and Granite Aggregate (GA). The results indicate that the crushed clay bricks are suitable to replace the granite aggregate in concrete production. Trial mixes of RBA concrete were prepared by replacing the GA with 25%, 50%, 75% and 100% crushed clay bricks by volume. M20 grade of both GA and RBA concretes were prepared and tested to compare the compressive strength. The test results showed that it is possible to produce RBA concrete with characteristics similar to those of GA concrete with 25% replacement

3) **Duaa Jabbar Abdullah, Dr. Zena K Abbas, Dr. Suhair kadhem abed**

"Study of Using of Recycled Brick Waste (RBW) to produce Environmental Friendly Concrete" Study of Using of Recycled Brick Waste (RBW) to produce Environmental Friendly Concrete Several million tons of solid waste are produced each year due to construction and demolition activities worldwide, and brick waste is one of the widest wastes. Recently, a growing number of studies have been conducted on using recycling brick waste (RBW) to produce environmentally friendly concrete. The use of brick waste (BW) as potential partial cement or aggregate replacement materials is summarized in this review, where the performance is discussed in the form of the mechanical strength and properties related to the durability of concrete. It was found that, because of the pozzolanic activity of clay brick powder, it can be utilized as a cement substitute in replacement levels up to 10%. Whereas for natural coarse aggregate, recycled aggregate can be used instead of it, but at a limited replacement level. Concrete manufacturing from recycled aggregate can give adequate strength and can be suitable for producing medium or low strength concrete. On the other side, the utilization of fine recycled brick waste as aggregate in concrete manufacturing provides development of the properties of concrete. It develops the durability of concrete in some cases when used with replacement level up to 10% by the weight of fine aggregate…

4) **Farid Debib and Said Kenai**
studied the effect by partially replacing the fine and coarse aggregate with crushed clay brick in concrete. The compressive, flexure and split tensile tests were conducted on concrete at the replacement levels of 25, 50, 75 and 100%. The authors reported a relatively low density for crushed brick concrete than normal concrete. The substitution levels of 25% for coarse aggregate and 50% for fine aggregate were reported from the test results.

5) **Vikash Kumar Gautam, Mr. Devesh Jaysawal**
"Use of over burn crushed Brick as Coarse Aggregate in Concrete mix" The study during this paper is administered to check the practicability of exploitation crushed over burn bricks to alternate the coarse mixture (gravel) in concrete. 2 kinds of concrete intermixture are ready. the primary one may be a mixture of 1:2:4 while not crushed over burn bricks and is employed as a reference mixture. The other is formed of various weight of crushed over burn bricks (as a proportion from the load of the coarse aggregate). a complete of thirty numbers of concrete specimens are casted with and while not crushed over burn bricks and tested below compression and split tension as per relevant to British commonplace specifications. take a look at results indicated that mistreatment crushed bricks reduces the strength of concrete. Also, the proportion of water to cement magnitude relation will increase for constant slump once the proportion of crushed bricks augmented. The results indicate that the crushed over burn brick are appropriate to switch the granite mixture in concrete production. Trial mixes of crushed over burn brick concrete were ready by substitution the Granite Aggregate with 25%, 50%, 75% and 100 percent crushed over burn bricks by volume. M20 grade of each Granite aggregate and crushed over burn brick concretes were ready and tested to match the compressive strength. The take a look at results showed that it's doable to provide crushed over burn brick concrete with characteristics like those of Granite aggregate concrete with 25% replacement.

6)

3. Objectives

- To study the physical properties of brick waste aggregate and coarse aggregate.
- To study the suitability of recycled bricks as a replacement of natural coarse aggregate in concrete.
- To study the behavior of compressive strength
- Make sustainable concrete with more economical for constructions.

4. Material & Test

- **Cement:** Use OPC 53 grade cement
- **Test on cement**

Table 1: Physical characteristic of cement

Fineness of cement	3.00%
Standard consistency of cement	34.66
Initial Setting Time	162 mins
Final Setting Time	291mins
Soundness test of cement	0.3mm
Specific gravity test of cement	3.11

- **Coarse aggregate:** Use 20mm and 10mm coarse aggregate
- **Test on coarse aggregate**

Table 2: Physical characteristic of coarse aggregate

Specific gravity	2.74
Apparent specific gravity	2.83
Water absorption	3.1.21 %

- **Fine Aggregate:** Use crushed sand for project
- **Test on fine aggregate:**

Table 3: Physical characteristic of fine aggregate

Specific gravity	2.8
Apparent specific gravity	3.11
Water absorption	2.8%

- **RBA:** The RBA is then coated with cement slurry to reduce its water absorption before using them in concrete
- **Test on RBA:**

Table 4: Physical characteristic of RBA

Specific gravity	2.71
Apparent specific gravity	1.77
Water absorption	0.2 %

5. Concrete mix used in investigation

M20 Concrete mix was designed in accordance with IS 10262:2012. RBA concrete was produced by replacing with 0%, 20%, 40% and 60% volume of RBA.

6. Results and discussions

Compressive strength on M20 grade of concrete made with the different percentages of recycled brick aggregates are performed. For each concrete mix, the compressive strength is determined on twelve 150x150x150 mm cubes at 7, 14 & 28 days of curing.

Table 5: Compressive strength test for 7 days

Percentage Of Replacement	Compressive Strength
0 %	13.63
20%	13.04
40%	12.96
60 %	9.80

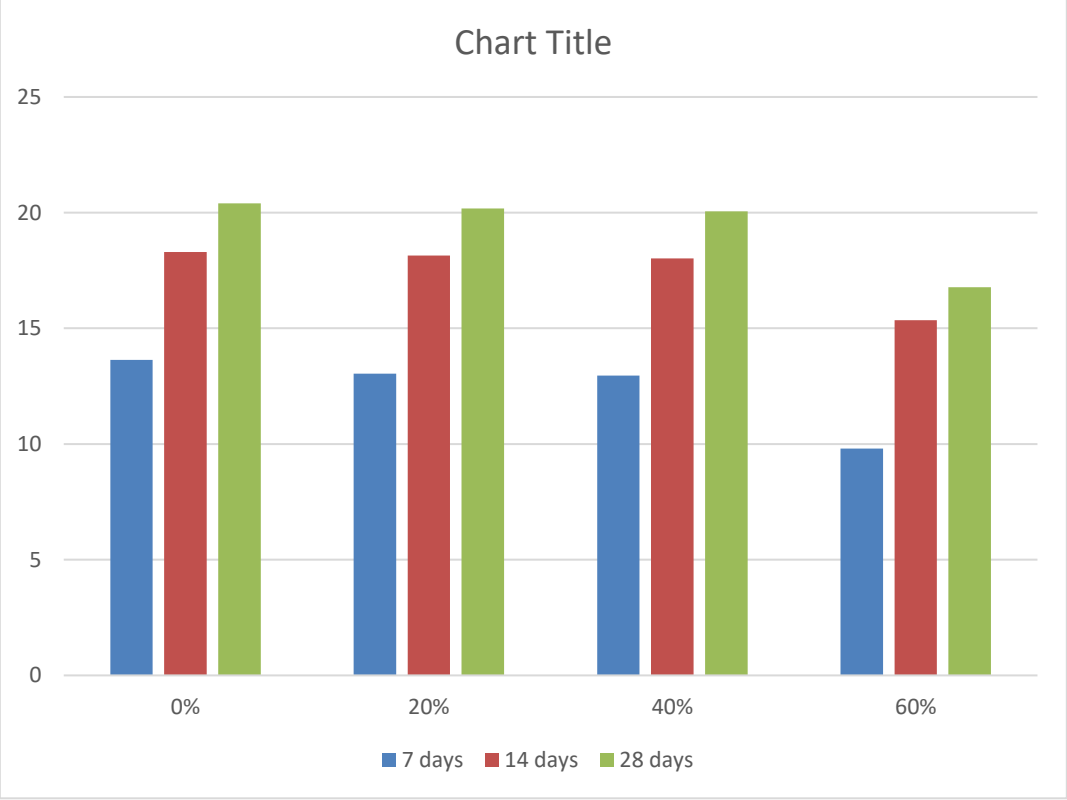
Table 6: Compressive strength test for 14 days

Percentage Of Replacement	Compressive Strength
0%	18.30
20%	18.14
40%	18.02
60%	15.35

Table 7: Compressive strength test for 28 days

Percentage Of Replacement	Compressive strength
0%	20.40
20%	20.18
40%	20.05
60%	16.77

Figure 1: Compressive strength



7. Conclusion

1. The test results showed that it is possible to produce RBA concrete with 40% replacement
2. Due to this study, It is economical
3. Due to this study optimizing the waste by using RBA.

4. Water absorption of recycle brick aggregate is very high But RBA was coated with cement slurry to reduce water absorption
5. Compression strength of RBA concrete decreased with increased in the percentage replacement
6. RBA concrete is used for village road, parking floor, footpath, cycle path.

8. Acknowledgement

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