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# Comparative Study of Concrete with Partial Replacement of Fine Aggregate with Brick Ballast Using M30 Grade

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***Abstract: Fine aggregate like sand is a material used for Various concrete construction in the world.There are lot of constructions done by partial replacements either fine or coarse aggregate with cement but i have done my research on partial replacement of sand by Brick Ballast .This project explains about the replacement of fine aggregates by partially brick ballast. I have done partial replacements by brick ballast with various percentages as 0%, 5%, 10%, 15%, 20%, 25% & 30% 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 brick ballast. From the test results, brick ballast replaced for fine aggregates give a maximum strength at 30% when compared to conventional concrete. So we use optimum percentage of brick ballast in order to get the maximum strength as required for the construction.***

***Keywords –Brick Ballast, Compressive Strength, Flexural Strength, Split Tensile Strength,***

## I. INTRODUCTION

In the construction industry the widely used material is concreteand is second to water as the most utilized substance on the planet.Fine aggregate is one of the important constituent in it.The demand for aggregate is enormous in liberalization, privatization and globalization, and in the construction of important infrastructure projects like Expressways, Airports, nuclear plants etc. The increased extraction of coarse and fine aggregate from the natural resources is required to meet this high demand. The increasing use of natural fine aggregate creates an ecological imbalance. Thus, partial replacement of fine aggregate is vital in construction industries. Most of the aggregate used are naturally occurring aggregates. On the other hand, the modern technological society is generating substantially high amounts of solid wastes both in municipal and industrial sectors; posing an engineering task for effective disposal. Hence, partial or full replacement of fine aggregate by other compatible materials like sintered fly ash, quarry dust, glass powder, brick ballast etc. is needed in view of conserving the ecological balance.

In region such as Bangladesh and West Bengal (India), where natural aggregate deposits are scarce, brick ballast is used as an alternative source of aggregate. Brick ballast is used in the construction of rigid pavement, small to medium span bridges, culverts and buildings up to six stories. Brick ballast are easily available in the region and are much cheaper than the crushed stone aggregate. In spite of its extensive use and the apparent satisfactory performance of structure built by concrete using brick aggregate, no systematic investigation ofmix design of brick aggregate concrete has been conducted and properly documented.

## II. LITERATURE REVIEW

**Devenny and Khalaf( 1999)** studied that the earliest use of crushed brick in cementitious materials using Portland cement occurred in Germany in 1860.

**Koyuncu H (2004)** studied on use of recycled aggregate from the ceramic industry waste in the construction of land fill, sub based course on secondary road, concrete block and manufacture of concrete.

**MariaenricaFrigione (2010)** had conducted an investigation on using recycled PET bottles as fine aggregate in concrete and concluded the workability, compressive strength, split tensile strength is slightly lower than reference concrete and moderately higher ductility.

## III. MATERIALS AND PROPERTIES

### Cement

Elephant OPC 53 grade cement is used in this study. It is tested for physical properties as per IS : 12269:1981.

Physical Requirements for ordinary Portland cement of 53-Grade

| Characteristic | Requirement | Test Method |
|---|---|---|
| Fineness (Min) | 225 $m^2$ /Kg | IS 4031 (Part 2) |
| Soundness | Not more than 10mm | IS 4031 (Part 3) |
| Initial Setting Time | Not less than 30 minutes | IS 4031 (Part 5) |
| Final Setting Time | Not more than 600 minutes | IS 4031 (Part 5) |
| Normal Consistency | 5-7 mm | IS 4031 (Part 4) |
| Specific Gravity | 3.15 | - |

### FineAggregates

The sand used for the work was locally procured and conformed to Indian Standard Specifications. The sand was sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. The various other tests conducted are specific density, bulk density, fineness modulus, water absorption and sieve analysis. The results are given below in Table 3.5 and 3.6. The fine aggregated belonged to grading zone II. This Aggregate has absorption of 1.23%. The Bulk Specific Gravity of the fine aggregate was 2.60 while its SSD Specific Gravity was 2.6.

### AGGREGATE (COARSE AGGREGATE)

The material which is retained on IS sieve no. 4.75 is termed as a coarse aggregate. The crushed stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested. The results of various tests conducted on coarse aggregate are given blow.

Physical Properties of coarse aggregates

| Characteristics | Value |
|---|---|
| Type | Crushed |
| Specific Gravity | 2.884 |
| Total Water Absorption | 0.97% |
| Fineness Modulus | 6.96 |

Mechanical Properties of Aggragate

| Property | Value |
|---|---|
| Elongation Index | 13 % (should not be more than 15 %) |
| Flakiness Index | 12 % (should not be more than 15 %) |
| Specific Gravity of Aggregate Slag Aggregate | G = 2.98 |
| Aggregate impact value | 4.5 % (should not be more than 30 %) |
| Crushing value | 19.11 % (should not be more than 45 %) |
| Dry Loose Bulk Density | 1.52 Kg/lt |
| Water Absorption | 1.0 % (should not be more than 2 %) |
| Abrasion Value | 14 % (should not be more than 30 %) |

**Brick Ballast**

Brick ballast is a waste product obtained from different brick kilns and tile factories. Now day's construction work is on large scale so demand of brick also increases so due to this brick kiln industries all over the world also increased. There are numerous brick kiln which have grown over the decades in an unplanned way in different part of Lucknow. Tons of waste products like Brick ballast or broken pieces or flakes of bricks (brick bat) come out from these kilns and factories. So far, such materials have been used just for filling low lying areas or are dumped as waste material.Brick ballast is made of first class well burnt or slightly over-burnt brick-bats to 40 mm gauge for foundations and floor concrete and 25 mm gauge for roof concrete. No under-burnt or "jhama" bricks (over-burnt porous) should be used. About 390 to 420 9-inch bricks and 420 to 440 Indian Standard Modular (IS) bricks make one cu. m of brick ballast. 280 to 351 9-inch bricks and 300 to 370 IS bricks made one cu. m of brick-bats. About 125 cu. m of brick-bats make 100 Cu. m of brick ballast.

**Properties of Brick Ballast**

| Sr. No. | Characteristics | Volume |
|---|---|---|
| 1. | Specific gravity | 2.67 |
| 2. | Net water absorption | 0.8% |
| 3. | Fineness modulus | 2.99 |
| 4. | Grading zone | II |

**Water**

Water plays a very important role in concrete construction. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling is necessary. Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent tap water is used forcasting.

**DESGINMIX**

Mass of Cement in kg/$m^3$ - 380

Mass of Water in kg/$m^3$ - 160

Mass of Fine Aggregate in kg/$m^3$ - 711

Mass of Coarse Aggregate in kg/$m^3$ - 1283

Mass of 20 mm in kg/$m^3$ - 924

Mass of 10 mm in kg/$m^3$ - 359

Mass of Admixture in kg/$m^3$ - 1.90

Water Cement Ratio - 0.42

## TEST RESULTS AND DISCUSSION

The test results of slump, compressive strength, split tensile strength and flexural strength obtained from the experimental study are given in the form of graph and made discussion also.

### A. Slump test

Slump test is conducted on fresh concrete of different mix proportions. The obtained slump value for normal concrete is 59 mm. This indicates medium workability.

Fig.1 shows the variation of slump value of concrete using Brick Ballast. From the graph it is observed that in concrete, percentage of Brick Ballast increases, it decreases the workability.

| Mixture | Measured Slump (mm) |
|---|---|
| **Brick Ballast 0%** | **59** |
| **Brick Ballast 5%** | **60** |
| **Brick Ballast 10%** | **55** |
| **Brick Ballast 15%** | **53** |
| **Brick Ballast 20%** | **51** |
| **Brick Ballast 25%** | **49** |
| **Brick Ballast 30%** | **48** |

### B. Compressive strength

Concrete cubes of size 150 mm X 150 mm X 150 mm were prepared and the specimen is cured, it is tested for compressive strength. The maximum load at failure reading was taken.

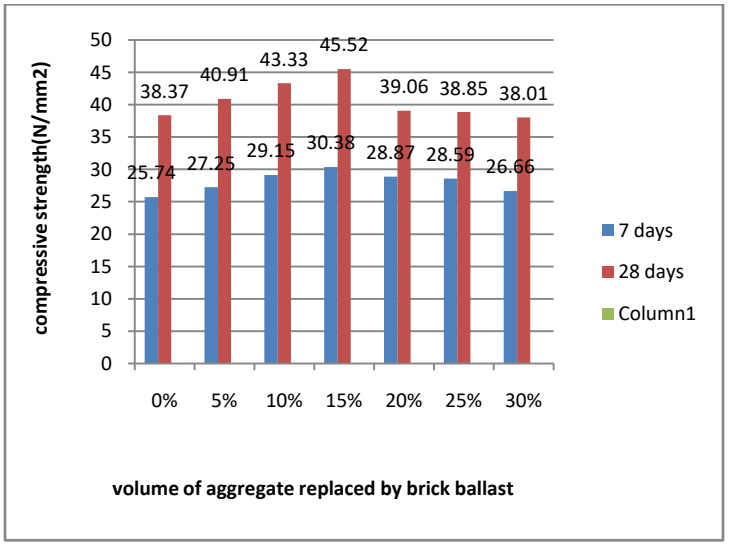


**Fig.1 Compressive strength of concrete using brick ballast at 7th& 28th day**

Fig.1 shows the compressive strength of concrete using brick ballast at 7th and 28th day. It was observed that the strength of concrete increases with the increase in the quantity of brick ballast as replacement to natural aggregates. Up to 15% replacement of fine aggregate by brick ballast, the compressive strength of concrete of all concrete mix increases but beyond 15% decrease in the strength is observed.

C. Split tensile strength

Concrete cylinders of diameter 150 mm and height 300mm were casted and the specimen is cured, it is tested for split tensile on 7th and 28th day. The maximum load at failure reading was taken.

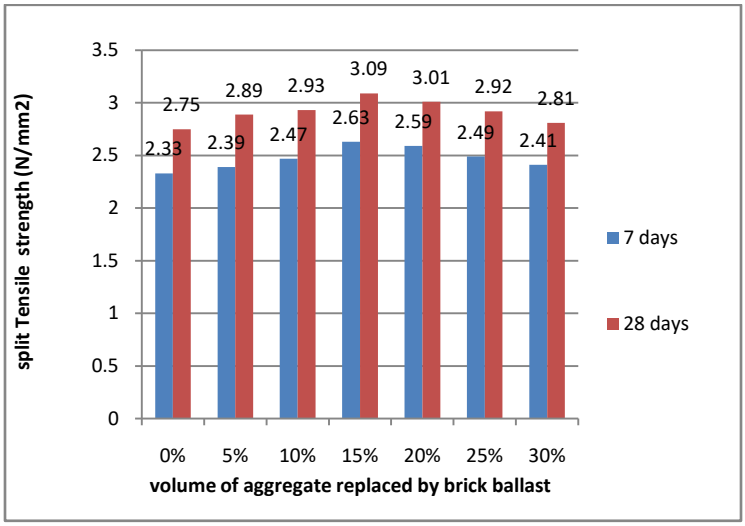


**Fig.2 Split tensile strength of concrete using brick ballast at 7th and 28th day.**

D.Flexural strength

The flexural strength test for beam specimen having the size of 100 x 100 x 500 mm was casted and cured at 7th and 28 days. It was kept horizontally between the loading surfaces of a universal testing machine and the load was applied until failure of the beam. The failure load was noted and shorter length from crack to support strength was measured.

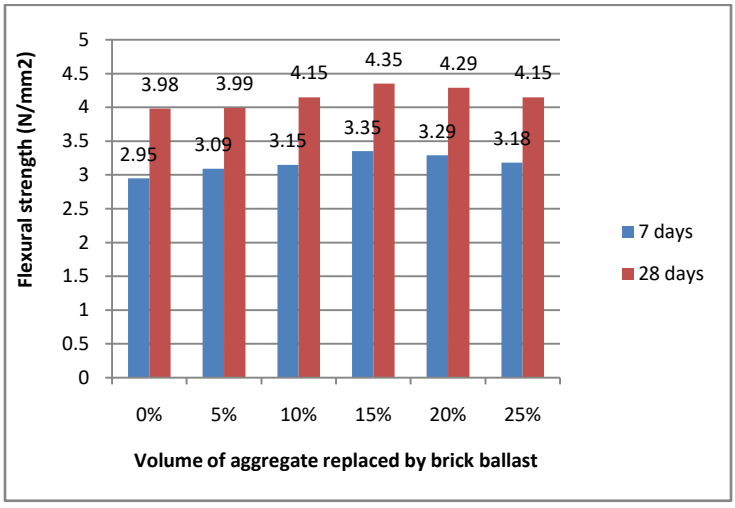


**Fig.3 Flexural strength of concrete using steel slag at 7th 28th day**

## CONCLUSION

1. The optimum value of compressive strength, flexural strength, split tensile strength can be achieved by 30% replacement of brick ballast.

2. The workability of concrete decreases with replacement of fine aggregate by brick ballast.

3. It is concluded that when a brick ballast is used as a replacement of natural fine aggregate, there is an increase in strength.

4. This experimental study has proved to be better way to disposal of brick ballast.

5. The cost of ballast is almost 50% of that of natural aggregate it is a waste product obtained from different brick kilns and tile factories. Also it could be easily used as coarse and fine aggregate in all plain concreteapplications.

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