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Analysis on Partial Replacement of Coarse Aggregate by Jhama Brick in Concrete

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Abstract:
The use of concrete is truly large and day by day the cost of the conventional material cost is also rising. So, it is beneficial to use the optional materials for making the concrete. The project focuses on coarse aggregate in concrete. In this project work, the study has been done on the replacement of coarse aggregate with demolished brick aggregate known as jhama brick. The optional source is jhama brick as a coarse aggregate. Jhama brick produced due to over burning. The brick has irregular shape and it is also used as coarse aggregate in some places where the stone aggregate is not effortlessly available or if available its cost is high. These rejected bricks can also be an implicit source of coarse aggregate. It's partly or completely a replacement of the conventional material. We replaced the coarse aggregate in ratios of 15%, 25% and 35% in M25 grade of concrete. A complete thirty-eight numbers of concrete samples are cast with and while not crushed jhama bricks. Tests are conducted on fresh and hardened cement concrete, for example, compressive strength test, split tensile tests and flexural test at 7 days and 28 days of curing period. The 25% replacement of jhama brick is considered as the best because of strength and economy, hence we use it in enough loaded structures the result shows that the aggregate that concrete derived from jhama brick aggregate attained lower strength than the regular concrete.

Index Terms: Jhama brick, Compressive strength test, Split tensile test and Flexural strength

1. INTRODUCTION

Concrete is one of the most extensively used construction materials in ultramodern days. The raw materials from which it's prepared; cement and aggregates, affect both the quality and cost of construction. Aggregates are generally cheaper than cement and constitute over 70% of the volume of concrete. It has attained the status of the most favoured material in ultramodern constructions. Whenever there's a demand for Strength, Fire resistance, and endurance, concrete is always preferred and considered the best material. The availability and nearness of aggregate to the construction locality also affect the cost of construction. Bricks are adaptable and durable edifice and construction materials, with good load-bearing properties. Various studies have been carried out on the porosity, permeability, and absorption of bricks. It's reported that the properties of concrete which use crushed bricks as a natural coarse aggregate partial substitute. An experimental study has also been done to achieve progressive strength concrete using crushed brick aggregate. It has been found that even recycled brick can also be a substitute for coarse aggregate in concrete. It has shown that concrete can be successfully produced by using recycled aggregates that have been produced from obliteration and construction waste. In numerous countries, the need for locally manufactured building materials can hardly be overemphasized because there's an imbalance between the demands for housing and pricey conventional building materials coupled with the reduction of traditional building materials. To address this situation, attention has been concentrated on low-cost volition building
materials. This material was prioritized because, in brick making, a large number of bricks are repudiated due to nonconformity the deformed form of brick produced due to high-temperature control in the kiln. These rejected bricks can also be an implicit source of coarse aggregate. According to the general description, concrete is a composite material so by taking advantage of the situation for the people, this paper presents the exploration that's carried out on the concrete when natural coarse aggregate is partly replaced by jhama brick aggregate.
The ambitions of the study are-
To determine the optimum dosage of jhama bricks as partial replacement of coarse aggregate independently
1. To know about a mix proportioning process to manufacture jhama brick-based concrete.
2. To study and determine the effect of salient parameters that affect the properties of jhama brick-based concrete.
3. To study the engineering properties of jhama brick-based concrete.

2. LITERATURE REVIEW

AKSHAY N. KADU (2020)

In this research, it is observed that workability decreases with increasing percentage replacement of coarse aggregate. The Compaction factor observed as 0.91, 0.901, 0.89, 0.86, and 0.84 with the ratio of percentage replacement of coarse aggregate by over brunt brick & demolish brick bat in concrete. The compressive strength of over brunt & demolish brick concrete increases the strength by partial replacement of over brunt & demolish brick to coarse aggregate ratios 15% and 30% increases over the conventional concrete about 2.55%, 3.8% for 7 days, 0.68%, 2.47% for 14 days and 1.51%, 3%, for 28 days.

Nitesh Bhardwaj (2020) In this investigation distinctive cement blends were set up by supplanting sand with jhama brick powder from 10% to 30%. The evaluation of cement utilized in this examination is M25 according to IS arrangement. The fundamental goal behind this work is to utilize squander material for casting concrete specimens and decrease the utilization of normally accessible sand for sustainable and waste management of resources.

N.S. Apebo (2013) In this research cubes of concrete were prepared and tested to study the compressive strength. The result indicates that the concrete having brickbats as aggregates may be termed medium-lightweight concrete having a density between 2000-2200 kg/m3. To produce the same workability, the brick aggregates concrete requires a greater proportion of water than the normal gravel aggregate concrete. Use of broken over burnt bricks as coarse aggregate for structural concrete is recommended when natural aggregate is not easily available, high strength of concrete is not required and the bearing capacity of the soil is low.

Ashit Kumar (2016) In this research, they use Jhama Brick Dust as an alternative material for the fine aggregate. The Jhama Brick Dust a partial replacement of the sand from 0%, 10%, 20%, 30%, 40%, and 50%. The various tests are carried out such as Compressive strength, Flexural Strength, and Split Tensile Test at an age of 7, 14, and 28 days of curing. And the Grade of the concrete is M25 and the mix design is carried out as per IS provision. The main purpose of this research is to use the waste material for making concrete.

Bidve Ganesh Shivkant (2019) This project presents the effects of over burnt brick bat inclusion on the mechanical properties of concrete matrix in wet and hardened state properties. For checking the mechanical properties of over burnt brick bat-based concrete used partially replaced overburnt brick bat with coarse aggregate.

Sonu Kumar Gupta (2020) In this project, they replace the coarse aggregate with jhama class bricks bats up to 20% and 40% for M20 grade concrete. It is observed that workability decreased with the replacement of coarse aggregate. One main thing is that weight of concrete is decreased by the use of jhama brick and the cost of concrete is also decreased due to the use of jhama brick. And in a result, they found that there is no difference in the strength of concrete due to the use of jhama class brick.

Nilesh Kumar (2017) The concrete cube beams and cylinders of M-25, M30, and M-35 grades were thrown in this trail to explore work and try to analyze different properties of concrete with crushed over burnt bricks as an alternative material. They found that the aggregate concrete derived from Over Burnt bricks aggregate attained lower strength than the regular concrete.

3. MATERIALS USED AND PROPRETIES: -

3.1. Material used: -

a) Cement: Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. Ordinary Portland cement having 28 days compressive strength of 53 MPa was used for the preparation of all concrete cubes. By using one type of cement, the effect of varying the types of coarse aggregate in concrete is investigated.

b) Fine Aggregate: The sand used for the experimental program was locally procured and conformed to Indian Standard Specifications IS 383-1970. The sand was first sieved through a 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. The sand used in this experiment was M sand.

c) Coarse Aggregate: The broken 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 a maximum size of 20 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per Indian Standard Specifications IS 383-1970.

d) Jhama Class Brick: The bricks are burnt up to a temperature of 800-900C in the brick kiln. If the temperature in the brick kiln is uncontrolled then the bricks are burnt excessively up to the temperature of 1100-1200C. Due to this, the bricks are sold at a cheaper rate as they become out of shape. Therefore, this type of brick is known as over burnt brick. These bricks are also known as Jhama bricks.

These bricks, however, possess higher strength than the normal burnt clay bricks. They are sometimes found to be stronger than even the first-class brick. Over burnt bricks have high compressive strength between 120 to 150 Kg/cm2. However, they have very poor shape. Brickwork using these bricks utilizes 40% of more mortar than traditional brickwork.

e) Water: Water is used for mixing, and curing purposes should be clean, portable, fresh, and free from any bacteria. Water is a key ingredient in the manufacture of concrete.

3.2. Material Properties: -

A) Cement- Ordinary Portland Cement of Birla Shakti of 53 Grade was used and it was conforming to IS 12269:1987 properties of cement are tabulated in Table 1.

Table.1 Test on Cement

Sr. no.	Properties	Test results
1	Specific gravity	3.15
2	Initial setting time	45 min
3	Final setting Time	482 min
4	soundness	1.92 mm

B) Fine Aggregate- Fine aggregate includes the particles that all pass through the 4.75 mm sieve and retain in the 0.075 mm sieve. Locally available manufacture sand i.e.M-sand will be used as fine aggregate. The sand will first be sieved through a 4.75 mm sieve to remove any particles greater than 4.75 mm and then washed to remove the dust. Properties of fine aggregate are tabulated in Table 2

Table.2 Test on Fine Aggregate

Sr. no.	Properties	Test results
1	Specific gravity	2.74
2	Fineness modulus	2.85
3	Grading zone	II
4	density	717 kg/m^3

C)Coarse Aggregate- Locally available coarse aggregate having a nominal size of 20 mm was used. The aggregates were washed to remove dust and dirt. Physical properties of coarse aggregate are tabulated in Table 3

Table.3 Test on Coarse Aggregate

Sr. no.	Properties	Test results
1	Size	20 mm
2	Specific gravity	2.74
3	Fineness modulus	6.9
4	Shape	angular
5	Density	1171 kg/m^3

D)Jhama Brick- The Jhama brick broken into pieces called as brick bats. These brick bats are mixed with cement slurry after 7days and 28 days curing used as an aggregate in concrete. Physical properties of Jhama brick are tabulated in Table 4

Table.4 Test on Jhama Brick

Sr no	Properties	Test results
1	Size	20 mm
2	Specific gravity	2.4
3	Shape	angular

4. METHODOLOGY: -

General: - Required materials was collected and preliminary tests were done on materials to construct mix design of M25 grade like, water absorption and specific gravity on sand, aggregate and jhama bricks, sieve analysis on sand and aggregate etc.

A. Mix Design-Concrete of grade M25 was prepared for this mix design. The mix design guidelines were carried out as per the IS10262:2009. The proportion for M25 grade was taken as 1:1.9:3.1 by weight and their water cement ratio as 0.50.

B. Proportioning, Mixing and Casting of Sample-The guidelines were as per the IS code specification for proportioning and proper attention and care had been taken while mixing and casting the samples. All materials were batched with proper care and mixing was done in laboratory by concrete mixing machine. After mixing all the materials properly, water was added. The cubes, beams and cylinders were casted as per the requirements of testing and table vibrators were used for compaction purpose. The molds were levelled with the help of shovel and after 24 hours of casting, they were demolded and kept in curing tank up to the date of testing.

C. Specimen Details- 6 cubes, 2 beams and 2 cylinders were prepared for one mix. Dimension of cube, beam and cylinder casted within the experiment was (15cm X 15cm X 15cm), (70cm X 15cm X 15cm) and (30cm x 15cm) respectively. Molds were conforming to the IS specification. Three sample of cubes were prepared for each test.

D. Curing: - All the molds were cured by immersing in a curing tank in the lab for 7 days and 28 days. The specimens were brought out from water roughly 24 hours before testing and kept at room temperature till testing later on following test were performed on cube, beam and cylinder respectively and results were recorded.

a. Compressive Strength Test
b. Flexural Strength Test
c. Split Tensile Strength Test

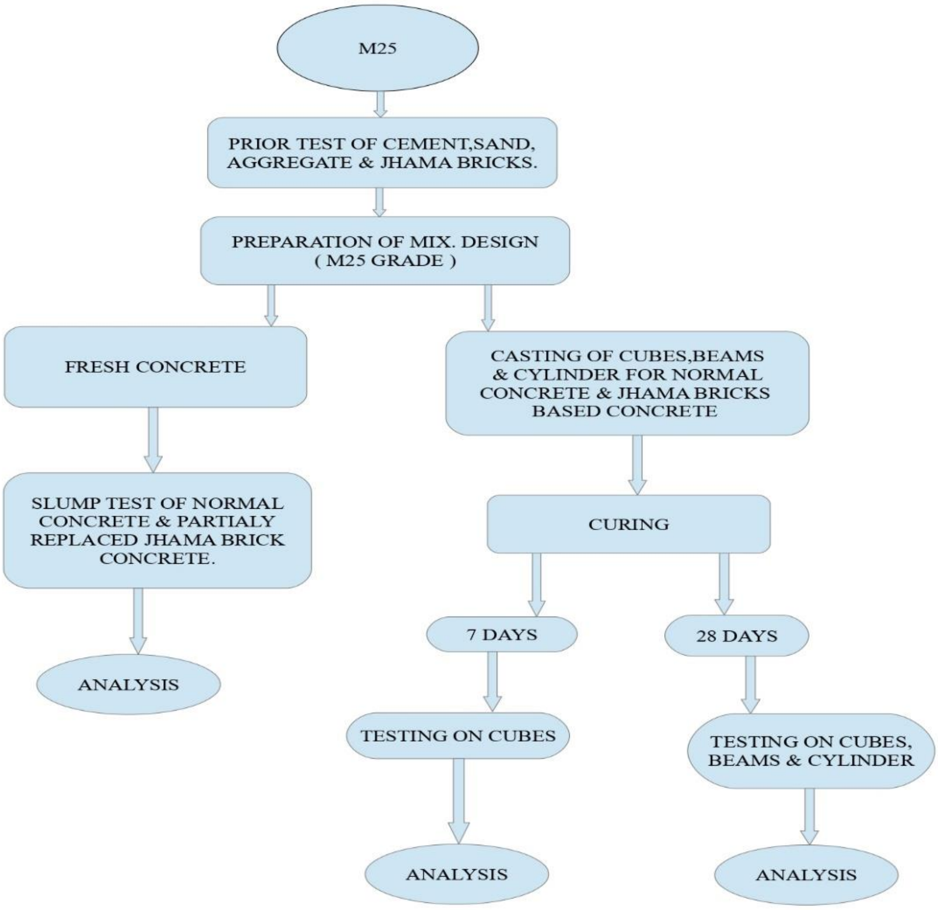

Fig.1 Methodology flow chart

5. RESULTS AND DISCUSSION: -

5.1Compressive Strength of cube: -

Compressive strength of cubes 150X150X150(mm) for M-25 in (MPa).

Compressive strength test results at 7 days and 28 days are attached in Table.5 along with their graphical representation.

Table .5 Average strength of cube of 7 days and 28 days

S. No.	% of jhama brick	compressive strength in N/mm^2	
		7 days	28 days
1	0%	23.32	26.15
2	15%	20.57	27.17
3	25%	18.89	25.43
4	35%	14.53	23.72

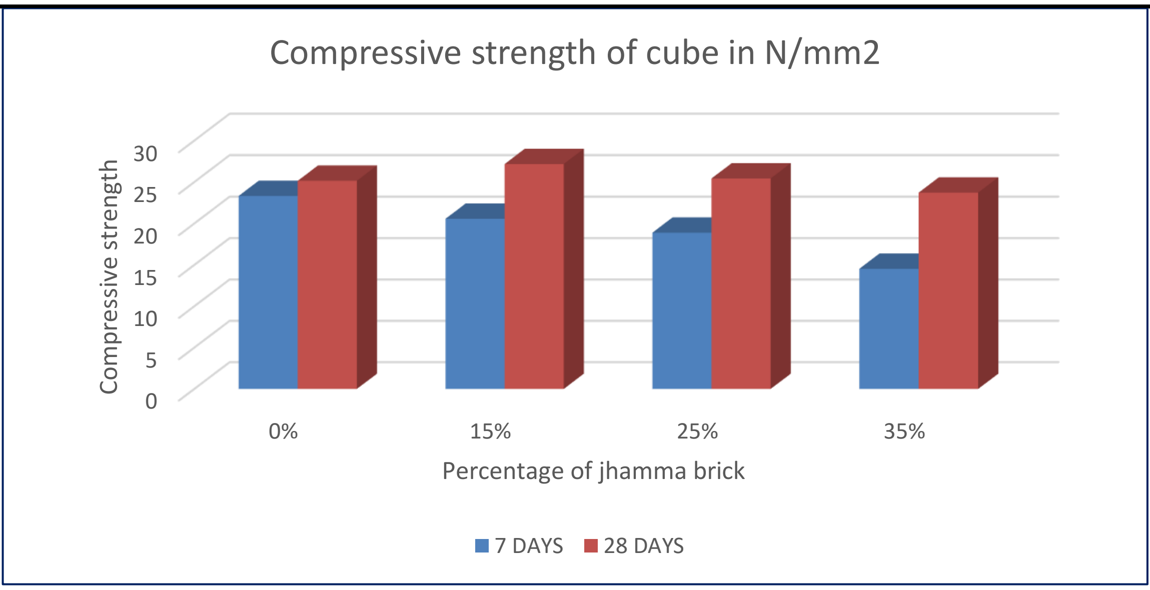

Figure.2 Compressive test result

Fig.3 Compressive test on Cube

At 7 days, strength is increased by 14% and 5% in 15% and 25% jhama brick replacement compared to reference concrete while it is decreased by 19% in 35% jhama brick replacement with respect to reference concrete.
At 28 days, strength is increased by 8% and 2% in 15% and 25% jhama brick replacement compared to reference concrete while it is decreased by 5% in 35% jhama brick replacement with respect to reference concrete.
Referring to the Bar chart, we can see that 15% and 25% replacement have reached the target strength. Mix with 25% jhama brick replaced concrete is giving more strength than other percentage replaced concrete and reference concrete at all ages of curing.

5.2 Split tensile strength on cylinder: -

Split tensile strength of cylinder of 300X150(mm) for M-25 in (MPa).

Split tensile strength test results at 28 days are attached in Table.6 along with their graphical representation.

Table.6 Average strength of cylinder on 28 days

s. no.	% of jhama brick	Tensile strength in N/mm² 28 days
1	0%	2.58
2	15%	2.73
3	25%	2.56
4	35%	2.11

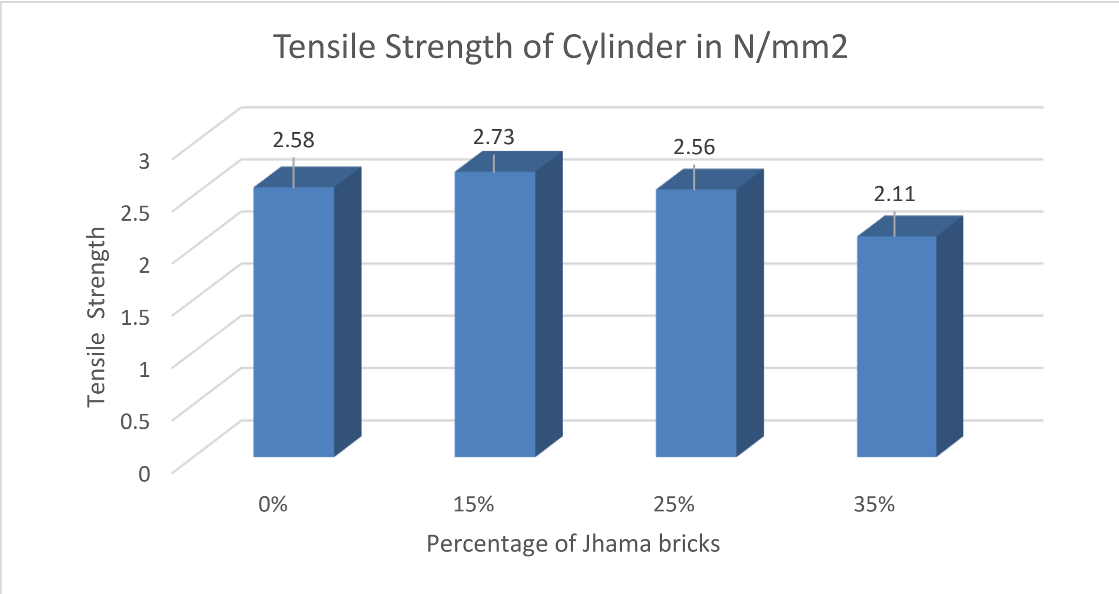

Fig.4 Split tensile test result

Fig.5 Split tensile test on Cylinder

At 28 days, strength is increased by 9% and 3% in 15% and 25% jhama brick replacement compared to reference concrete while it is decreased by 15% in 35% jhama brick replacement with respect to reference concrete.
Referring to the Bar chart, we can see that 15% and 25% replacement have reached the target strength. Mix with 25% jhama brick replaced concrete is giving more strength than other percentage replaced concrete and reference concrete at all ages of curing.

5.3 Flexure strength of beam: -

Flexure strength of Beams 700X150X150(mm) for M-25 in (MPa).

Flexural strength test results at 28 days are attached in Table.7 along with their graphical representation.

Table.7 Average strength of beam on 28 days

s. no.	% of jhama brick	Flexure strength in N/mm^2
		28 days
1	0%	3.48
2	15%	3.92
3	25%	3.4
4	35%	3.31

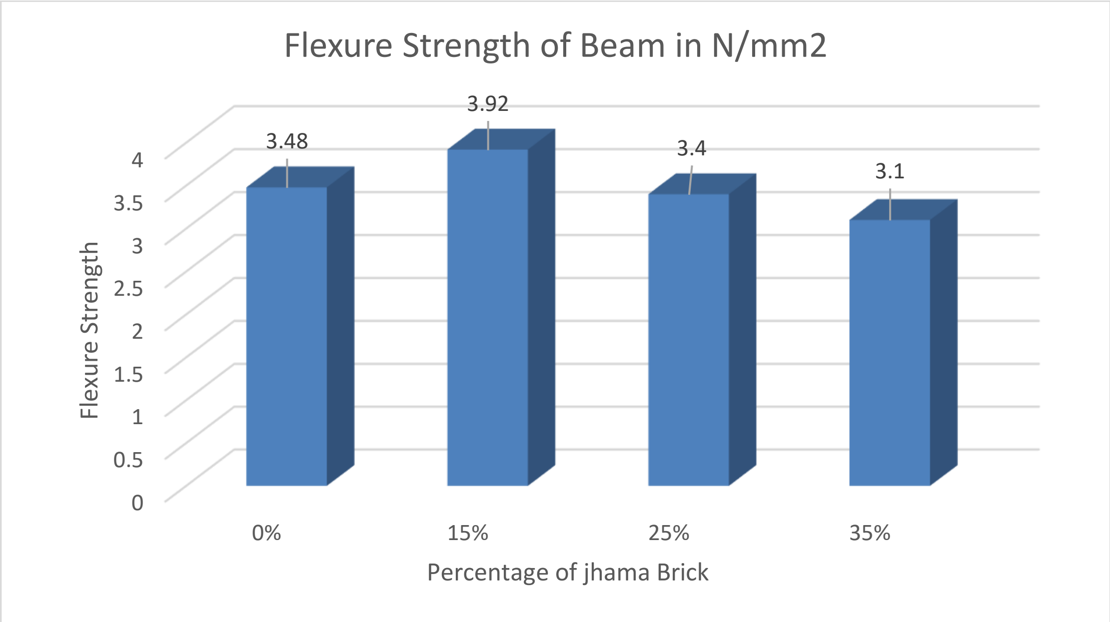

Fig.6 Flexural strength result

Fig.7 Flexural Strength Test on Beam

At 28 days, strength is increased by 23%, 6% and 3.5% in 15%, 25% and 35% jhama brick replacement compared to reference concrete.

Referring to the Bar chart, we can see that all mixes of M25 have reached the target strength. Mix with 25% jhama brick replaced concrete is giving more strength than other percentage replaced concrete and reference concrete at all ages of curing.

6.CONCLUSION: -

The following inferences are drawn based on the experimental investigation of the strength and workability of concrete with partial replacement of coarse aggregates by brick ballast.

1) The 15% replacement of jhama brick is considered the best because of strength and economy, hence we use it in loaded structures

2) Up to 15% of coarse aggregates may be replaced with brick ballasts.

3) The 25% replacement of jhama brick is considered as good replacement because of strength and economy, hence we use it in moderately loaded structures.

4)This study has found that crushed bricks will be used satisfactorily as a coarse combination for creating concrete of adequate strength characteristics.

5)Before the recommendation for use in the field, several tests should be conducted for the concrete with replaced coarse aggregates of different proportions.

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