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USE OF JHAMA BRICK DUST AS AN ALTERNATIVE MATERIAL FOR FINE AGGREGATE IN CONCRETE

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ABSTRACT

The concrete is very useful material and now a day it is not only used in the building construction work but it is also useful for the construction of the bridges, roads, dams, and other important structures. The concrete is a composite material and conventional concrete is made of cement, fine aggregate, coarse aggregate and water. The concrete can be use in any desire shapes. So that it is versatile material in field of construction. Since the use of concrete is very large and day by day the cost of the conventional material cost is also rises. So it is advantageous to use the alternative materials for making the concrete. The alternative material can be used as partial or fully replacement of the conventional material. In this research we use the Jhama Brick Dust as an alternative material for the fine aggregate. Here we use the Jhama Brick Dust as partial replacement of the sand from 0%, 10%, 20%, 30%, 40%, and 50%. The various tests are carried out such as Compressive , Strength, Flexure Strength and Split Tensile Test at an age of 7, 14 and 28 days of curing. Here 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 the concrete.

Keywords: Compressive Test, Fine Aggregate, Jhama Brick, Flexure Test, Split Tensile Test.

I. INTRODUCTION

The concrete is commonly used construction material due to its ease of availability, mouldability, rigidity and durability. It consists of cement as binding material, fine aggregate, coarse aggregate and required quantity of water. Sand is used as fine aggregate. Due to rapid growth of the construction activity the availability of the naturally available material getting exhausted. Hence conservation of the naturally available material is very important. Since the construction activities cannot be diminished. There is only way to search the alternative material which replaced partially or fully naturally available material. Jhama Brick Dust is such an alternative material which can be effectively being used in construction as partial replacement of natural sand. This is a waste product obtain while processing Jhama Brick Aggregate. Jhama Brick Aggregate is used where the stone is not available or it is costly. Various studies were carried out in which the Jhama Brick pieces are used as coarse aggregate. This brick is also known as 4^{th} class brick. In this research we have replaced the sand up to 50% at an interval of 10% by using the Jhama brick dust. The main aim of this work is to use the waste material and save the naturally available material. This work is helpful where the sand is not easily available or if available its cost is high. All materials are used in this work are locally available.

II. MATERIALS SPECIFICATION

2.1 Cement

Cement plays a vital role in the manufacturing of concrete it binds the fine aggregate and coarse aggregate together. In this work locally available cement is used which is Portland Pozzolana Cement (fly ash based) brand name is Lafarge confirming to the IS: 1489 (Part-I) – 1991 having the specific gravity 3.14 and normal consistency 32%.

2.2 Fine Aggregate

The fine aggregate used in this research work is from the locally available from Banka District, Bihar and confirming to the zone II of IS: 383-1970. This fine aggregate has the specific gravity 2.67 and fineness modulus is 2.89. Which is shown in table 1.

2.3 Coarse Aggregate

In this research work we use the coarse aggregate of two different sizes 20 mm and 10 mm. The coarse aggregate were collected from local market which is from Pakur District, Jharkhand. The coarse aggregate is free from any impurities and having the specific gravity 2.72 for both of the sizes. The sieve analysis was carried out for both the sizes which are given in the table below. The 20 mm and 10 mm aggregates were mixed in the ratio of 60:40. The coarse aggregates were confirming to IS 383:1970. The fineness modulus of 20 mm aggregate is 6.97 and for 10 mm aggregate are 6.31. Which are shown in table 2 and 3 respectively.

2.4 Jhama Brick Dust

Bricks are a versatile and durable building and construction material with good load bearing properties. The bricks are burnt up to temperature of 800-900 degree centigrade in the brick kiln. If the temperature in the brick kiln is uncontrolled then the bricks are burnt excessively up to the temperature 1100-1200 degree centigrade. Due to this the bricks are sold at 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. Jhama brick is produced due to over burning. This brick has irregular size and shape and it is also used as coarse aggregate in some places where the stone aggregate is not easily available or if available their cost is high. Jhama Brick Dusts are produced while this brick is processing as coarse aggregate. In this research work it taken from the local Brick making plant from Prunea District, Bihar. The Jhama Brick Dusts are free from any impurities and their sieve analysis is carried out which is given in the table 4.

Table 1. Sieve Analysis for Fine Aggregate

Sieve Size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Percentage Weight Retained	% Passing
4.75 mm	-	-	-	100
2.36 mm	60	60	6.0	94.0
1.18 mm	230	290	29.0	71.0
600 µ	345	635	63.5	36.5
300 µ	280	915	91.5	8.5
150 µ	77	992	99.2	0.8
Pan	3	995	100	0
Total = 1 Kg	Fineness Modulus = 289.2/100 = 2.89			

Table 2. Sieve Analysis for Coarse Aggregate (20 mm size)

Sieve Size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Percentage Weight Retained	% Passing
40 mm	-	-	-	100
20 mm	430	430	8.6	91.4
10 mm	4023	4453	89.06	10.94
4.75 mm	539	4992	100	-
2.36 mm	0	4992	100	-
1.18 mm	0	4992	100	-
600 µ	0	4992	100	-
300 µ	0	4992	100	-
150 µ	0	4992	100	-
Total = 5 Kg	Fineness Modulus = 697.66/100 = 6.97			

Table 3. Sieve Analysis for Coarse Aggregate (10 mm size)

Sieve Size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Percentage Weight Retained	% Passing
20 mm	-	-	-	100
10 mm	2589	2589	51.78	48.22
4.75 mm	1410	3999	79.89	20.11
2.36 mm	991	4990	100	-
1.18 mm	0	4990	100	-
600 µ	0	4990	100	-
300 µ	0	4990	100	-
150 µ	0	4990	100	-
Total = 5 Kg	Fineness Modulus = 631.67/100 = 6.31			

2.5 Water

The clean portable water is used in this work which is free from any suspended impurities and it is suitable for the drinking purpose.

Table 4. Sieve Analysis for Jhama Brick Dust

Sieve Size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Percentage Weight Retained	% Passing
4.75 mm	-	-	-	100
2.36 mm	68	68	6.8	93.2
1.18 mm	256	324	32.4	67.6
600 µ	326	650	65.0	35
300 µ	274	924	92.4	7.6
150 µ	68	992	99.2	0.8
Pan	2	994	100	0
Total = 1 Kg	Fineness Modulus = 295.8/100 = 2.95			

III. EXPERIMENTAL POCEDURE

3.1 Mix Design

In this work we have select the M25 grade of concrete. The mix design is carried out as per the IS 10262:2009. The three trails have been prepared and finally we find the proportion for M25 grade is 1:1.40:3.05 by weight and their water cement ratio is 0.45.

3.2 Proportioning, Mixing and Casting of sample

The proportioning were done as per the IS provision and proper care has taken while mixing and casting the sample. All materials were weighted properly and mixed in the laboratory concrete mixing machine. The water is added when all the materials are properly mixed. The cubes, beams and cylinder were casted and using the table vibrator for compacting the sample. The moulds were leveled properly and after 24 hours of casting it is kept in curing tank till the date of testing the sample. The samples were tested at 7, 14 and 28 days.

3.3 Compressive Strength Test

For compressive strength test the cubes were prepared of sizes 150 x150 x 150 mm. The moulds are confirming to the IS specification. For each tests three samples were prepared and their average value is taken. The cubes were tested in the compression testing machine and loads were applied at the rate of 140Kg/cm^2 per minute till the specimens fails. The loads at failure is divided by the area of cross section gives the compressive strength of the cubes.

3.4 Flexure Strength Test

For the flexure strength test the beam were prepared of size 150 x 150x 700 mm. The moulds are confirming the IS provision. For each test three samples are casted in the laboratory. The average values of the three samples are taken as flexure strength. The value of flexure strength is about 10-20 % of the average compressive strength depending upon the size and volume of coarse aggregate used. For compacting the sample the tamping rod of 16 mm diameter is used and applies 25 blows. The flexure strength tests were carried out at 7, 14 and 28 days.

3.5 Split Tensile Test

We all know that the concrete is weak in tension. The tensile strength is one of the important properties of the concrete. For the tensile test the cylinder of 15 cm diameter and 30 cm length is casted in the cylindrical mould of same size. For each tests three samples were casted in the laboratory and it is compacted by using 16 mm diameter rod giving 25 blows. The split tensile tests were carried out at 7, 14 and 28 days.

3.4 Designation of the Samples

The samples were designated by using certain code as given in the table below. The sample name and their materials composing as per the given in the table.

Table 5. Designation of samples

Designation	Grade	Type	Cement %	Coarse Aggregate %		Sand %	Jhama Brick Dust %
				20 mm	10 mm		
A-0	M 25	Cube	100	60	40	100	0
A-10	M 25	Cube	100	60	40	90	10
A-20	M 25	Cube	100	60	40	80	20
A-30	M 25	Cube	100	60	40	70	30
A-40	M 25	Cube	100	60	40	60	40
A-50	M 25	Cube	100	60	40	50	50
B-0	M 25	Beam	100	60	40	100	0
B-10	M 25	Beam	100	60	40	90	10
B-20	M 25	Beam	100	60	40	80	20
B-30	M 25	Beam	100	60	40	70	30
B-40	M 25	Beam	100	60	40	60	40
B-50	M 25	Beam	100	60	40	50	50
C-0	M 25	Cylinder	100	60	40	100	0
C-10	M 25	Cylinder	100	60	40	90	10
C-20	M 25	Cylinder	100	60	40	80	20
C-30	M 25	Cylinder	100	60	40	70	30
C-40	M 25	Cylinder	100	60	40	60	40
C-50	M 25	Cylinder	100	60	40	50	50

IV. RESULT AND DISCUSSION

4.1 Compressive Strength

The result of the compressive strength with partial replacement of the Jhama brick dust for 7, 14 and 28 days are shown in table 6 and their graphical representation in the figure 1.

Table 6. Compressive Strength of Different Mix

Designation	Compressive Strength in N/mm^2			% Sand	% Jhama Brick Dust
	7 Days	14 Days	28 Days		
A-0	20.6	25.4	31.82	100	0
A-10	20.5	24.15	32.60	90	10
A-20	20.72	23.20	33.40	80	20
A-30	20.81	25.48	33.36	70	30
A-40	20.86	26.10	34.20	60	40
A-50	21.42	27.20	33.10	50	50

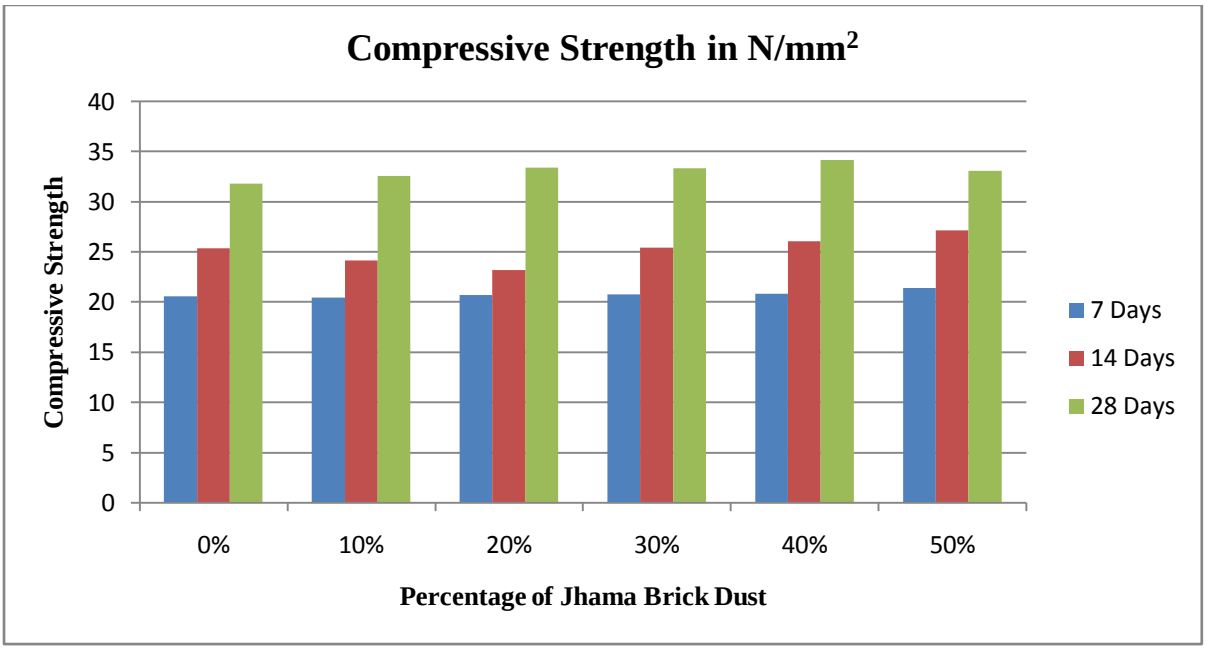

Fig.1. Compressive Strength of Different Mix

4.2 Flexure Strength Test

The flexure strength of the different mix is shown in the table 7 with different doses of the Jhama Brick Dust. And their graphical representation is shown in the figure2.

Table 7. Flexure Strength of Different Mix

Designation	Flexure Strength in N/mm^2			% Sand	% Jhama Brick Dust
	7 Days	14 Days	28 Days		
B-0	3.62	3.78	4.46	100	0
B-10	3.61	3.62	4.32	90	10
B-20	3.42	3.61	4.73	80	20
B-30	3.20	3.50	3.71	70	30
B-40	3.05	3.36	3.68	60	40
B-50	2.91	3.06	3.26	50	50

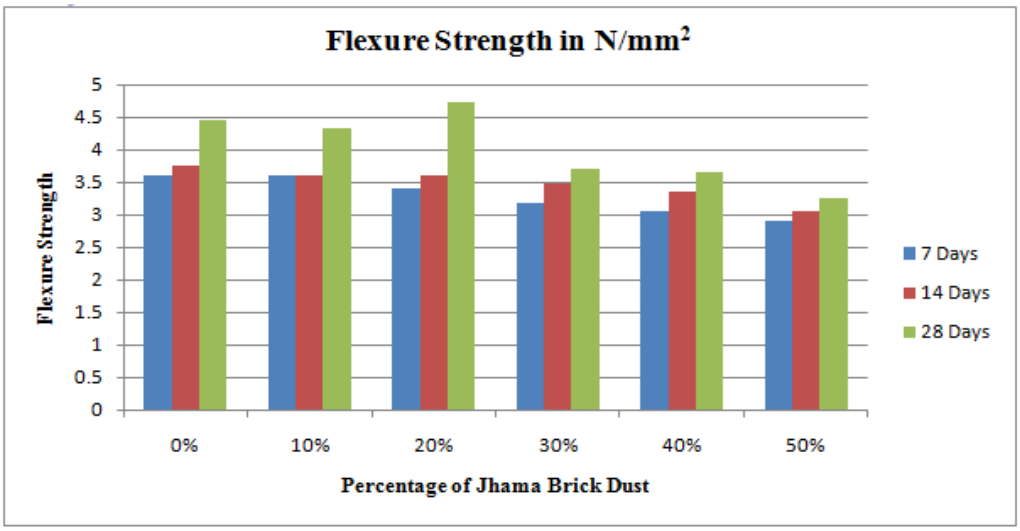

Fig.2. Flexure Strength of Different Mix

4.3 Split Tensile Test

The Split Tensile Strength is shown in the table 8 with different percentage of the Jhama Brick Dust and their graphical representation in the figure3.

Table 8. Split Tensile Test of Different Mix

Designation	Split Tensile Strength in N/mm²			% Sand	% Jhama Brick Dust
	7 Days	14 Days	28 Days		
C-0	2.12	2.27	3.02	100	0
C-10	2.16	2.20	3.09	90	10
C-20	2.11	2.15	3.16	80	20
C-30	2.18	2.30	3.06	70	30
C-40	2.21	2.56	3.26	60	40
C-50	2.30	2.62	3.81	50	50

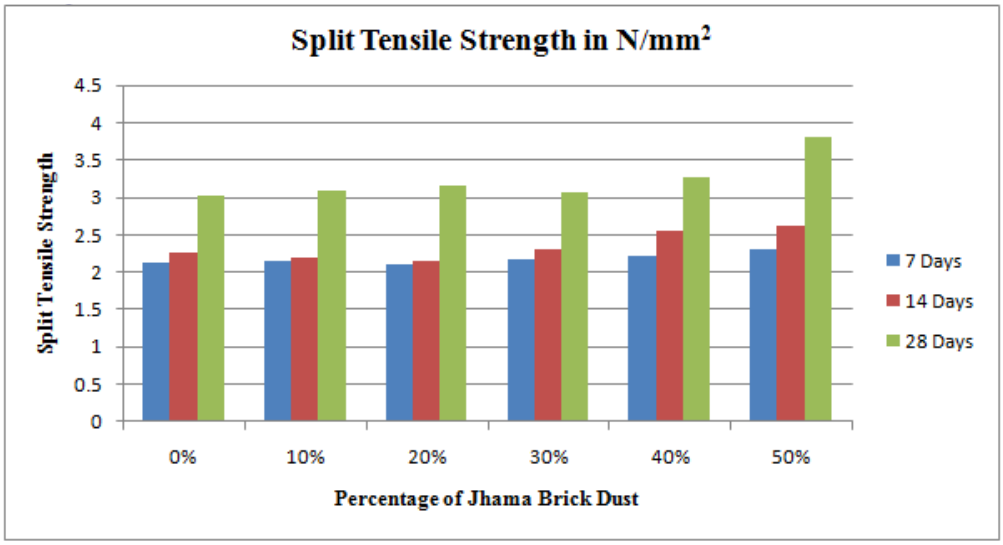

Fig.3. Split Tensile Strength of Different Mix

V. CONCLUSION

From the present study we obtained the following results.

1. The compressive strength at 7 days by replacing sand by Jhama Brick Dust increase up to 4%. But at higher age the compressive strength at 28 days increases up to 7% as compared to the conventional concrete. Hence compressive strength cannot increases to too much but it is large saving in costly sand.
2. The flexure strength is decrease by increasing the percentage increase of Jhama Brick Dust. Hence it is not used where the flexure strength is an important property.
3. The flexure strength of the concrete by replacing 20% sand by Jhama brick dust is increases 6% as compared to the conventional concrete.
4. The split tensile strength of the concrete increases not too much at early age but at 28 days by replacing sand 50% by Jhama Brick Dust it increase the split tensile strength up to 21% as compared to the conventional concrete.
5. Since in this work we use the waste material hence it is used for the low cost housing technology.
6. The materials are locally available hence this concrete is prepared at every time.

VI. FURTHER SCOPE OF THE WORK

1. The study can be carry out by increasing the percentage of Jhama Brick Dust up to 100%.
2. The work can be carry out by using the different grade of the concrete.
3. The study can be carry out by study the density of the concrete.
4. The permeability, humidity and water absorption test of the concrete can also be studied.

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