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EFFECT OF PARTIAL REPLACEMENT OF COARSE AGGREGATE BY JHAMA CLASS BRICK IN CONCRETE

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Abstract— Concrete is considered the world's most used construction material. Typical concrete mixtures are comprised of water, sand, cement and an aggregate of rock. This project focuses on the coarse aggregate in concrete. The other material will be used to replace the coarse aggregate of rock in typical concrete. This will include burn brick or Zama brick. This material was chosen because of their availability. The burn brick is available from brick manufacturing area. Also in brick-making, a large number of bricks are rejected due to nonconformity with the required specifications. One such major nonconformity is the distorted form of brick produced due to the uneven temperature control in the kiln. These rejected bricks can also be a potential source of coarse aggregate. This would not only make good use of the otherwise waste material but would also help alleviate disposal problems. This project presents the effects of Jhama Class Brick inclusion on the mechanical properties of concrete matrix in wet and hardened state properties. For checking mechanical properties of Jhama Class Brick bat based concrete used partially replacement Jhama class brick to coarse aggregate ratios 20%, 40%, 60% and 80% in M40 grade of concrete. It is observed that workability decreased with replacement of coarse aggregate. The Compaction factor observed as 0.92, 0.899, 0.88, 0.87 and 0.85 with varying percentage replacement of coarse aggregate by Jhama class brick bat as 0%, 20%, 40%, 60% and 80% respectively. The compressive strength of Jhama Class Brick bat based concrete used with partially replacement Jhama class brick to coarse aggregate ratios 20%, 40%, increased over conventional concrete about 6.08%, 10.02% for 3 days and 9.23%, 12.08% for 7 days and 10.02%, 11.95% for 28 days. If further increased in the percentage of replacement up to 60% and 80%, the strength was decreased by 3.73% and 8.16% respectively for 3 days and 5.69%, 9.25% for 7 days and 2.72%, 6.87% for 28 days cured cube specimen respectively. The Split Tensile and Flexural Strength of this concrete increases with 5.26%, 8.68%, and 2.74%, 4.76% respectively over plain concrete for the replacement 20% and 40% and decreased with 3.94%, 12.1% and 3.16%, 7.5% for the replacement 60% and 80%.

Keywords— Jhama class brick, Kiln, Compressive strength, Plasticizer, Jhama class Brick bat based concrete.

INTRODUCTION

Concrete is produced by mixing cement, sand, coarse aggregate and water to produced material that can be molded into almost any shape. The major volume concrete is filled with aggregate. The inclusion of aggregate in concrete reduces its drying shrinkage properties and improves many other properties such as compressive strength etc. But it is costly to transport, so local sources are needed to reduce the cost of transport, but due to geographical constraints this is not available at all places, therefore it necessitates finding other sources and alternative from local sources.

The many materials are used as a alternative source for natural coarse aggregate such as recycled low quality crushed brick, recycled coarse aggregate, coconut shell, recycled plastic aggregate, well burnt brick etc. For this work select a jhama class brick as a alternative source for course aggregate. This material was chosen because in brick making, a large number of bricks are rejected due to non conformity is the distorted form of brick produced due to high temperature control in the kiln. These rejected bricks can also be potential source of coarse aggregate. According to general definition concrete is a composite material so by taking advantage of the situation for the people, this paper presents the research that is carried out on the concrete when natural coarse aggregate is partially replaced by Jhama Class brick aggregate.

The aims of the study are:-

1. To develop a mixture proportioning process to manufacture Jhama class brick based concrete.

2. To identify and study the effect of salient parameters that affects the properties of Jhama class brick based concrete.

3. To study the short-term engineering properties of fresh and hardened Jhama class brick based concrete.

MATERIAL USED:-

A) Materials:-

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 46 MPa (ASTM 1994) was used for preparation of all concrete cubes. By using one type of cement, the effect of varying the types of coarse aggregate in concrete is investigated.

TABLE:-I Properties of cement

Sr. No.	Characteristics	Values obtained	Standard values
1	Normal consistency	33%	
2	Initial Setting Time	48 min	Not less than 30 min.
3	Final Setting Time	240 min.	Not Greater than 600 min.
4	Sp.Gr.	3.09	
5	Fineness	4.8	

b) Fine Aggregate:

The sand used for the experimental programmed was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

TABLE:-II Properties of Fine Aggregate

Sr. No.	Characteristics	Value
1.	Type	Uncrushed
2.	Specific Gravity	2.68
3.	Total Water	1.02%
4.	Fineness Modulus	2.507
5.	Grading Zone	II

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 the 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.

TABLE III: - Properties of Coarse Aggregate

Sr. No.	Characteristics	Value
1.	Type	Crushed
2.	Maximum Size	20 mm
3.	Specific Gravity (20mm)	2.825
4.	Total Water Absorption Absorption (20mm)	0.995%

d) Jhama Class Brick

Bricks are a versatile and durable building and construction material with good load bearing properties. Various researchers have been carried out in porosity, permeability and absorption of brick. The traditional clay bricks are manually produced by pressing clay with certain amount of sand in the wooden mould. Then the wet bricks are first dried in the sun and air and then transported to the brick kiln for subsequent burning process. The bricks are burnt up to 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 1100-1200C. 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.

Fig. No. I:-Jhama Class Brick Materials

These bricks, however, possess higher strength than the normal burnt clay bricks. Therefore one of the cheaper alternative for brick foundation, floors, roads etc. because of the fact that the over burnt bricks have a compact structure and hence 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/cm^2. However they have very poor shape. Brickwork using these bricks utilizes 40% of more mortar than traditional brickwork. However this cost is offset by the price at which over burnt bricks are available. Due to over burnt, the bricks become black and its edges also become curved. It is not used in brick work of building main wall, partition wall and some other purposes.

TABLE IV:-Comparison between Coarse Aggregate and Jhama Brick Aggregate

Properties	Coarse Aggregate	Jhama class brick bats
Aggregate Impact Value	7.24	19.35
Aggregate Crushing Value	16.85	32,2
Specific Gravity	2.83	2.67
Water Absorption	0.995%	11.08%

B) Mix Ratio:-

The mix designed was prepared according to the IS-10262:2009 recommendation for concrete mix design. 1:1.54:2.08 mix proportioning ratio was determined for targeted strength of 48 MPa For all cases 0.38 water/cement (w/c) ratio was used. And got a quantity of material for this mix ratio:-

TABLEV:-Quantity of Material per Cubic Meter of Concrete.

Material	Proportion by Weight	Weight in kg/m^3
Cement	1	375
F.A.	2.26	849.02
C.A.	3.04	1139
W/C	0.38	150 lit.

For 50kg cement, found the quantity of material

TABLE VI:-Quantity of Material per 50 kg Cement

Material	Proportion by Weight	Weight in kg/m^3
Cement	1	50
F.A.	1.54	113
C.A.	2.08	152
W/C	0.38	19 lit.

METHODOLOGY:-

GENERAL:-

This presents the details of development of the process of making Jhama class brick bat based concrete. The materials that are required for making the Jhama class brick bat based concrete, coarse aggregates, sand and the Jhama class brick coarse aggregate as per design of mix proportion M40 are clearly mentioned in a tabular format as per IS 1026-2008.

Preparation, Casting and Curing of Jhama class brick bat based Concrete:-

1. **Mix Preparation:-**

The batching of all the ingredients was performed by weight. The sand was air dried in the laboratory before mixing. First the surface was damped with water then all the aggregates (Natural Coarse Aggregate, Fine Aggregate and Jhama class brick coarse Aggregate) were spread on the surface area till the aggregates. After thorough mixing of aggregates cement was introduced on the ground surface and water were added slowly as per W/C ratio. The concrete was mixed for approximately three minutes after the water was added.

2. **Mix Casting:-**

It is found that the Jhama brick-bats based Concrete is dark in color and is cohesive. The amount of water in the mixture plays an important role on the behavior of fresh concrete. When the mixing time is long, mixtures with high water content bled and segregation of aggregates and the paste occurred. This phenomenon is usually followed by low compressive strength of hardened concrete. From the preliminary work, it was decided to observe the following standard process of mixing in all further studies,

1) Take the suitable proportion of the ingredients of the concrete.

2) Spread the fine aggregate on the ground,

3) After that put the coarse aggregate as well as Jhama brick-bats,

4) After that add the water in suitable quantity.

5) And continue the wet mixing for another four minutes.

Then the fresh prepared mix was casted standard cube moulds, cylinders and beams.

3. **Curing:-**

All the moulds were cured by immersing in a curing tank in the lab. The specimens were brought out from water approximately 24 hours before testing and kept at room temperature till testing.

- **Jhama brick-bats based Concrete**

Following test were conducted for this experimental work,

a) Workability test
b) Compressive Strength Test
c) Split Tensile Strength Test
d) Flexural Strength Test
e) Mass Density Test

RESULTS AND DISCUSSION

a) Workability Test:-

To find the workability of Jhama class brick bat based concrete, used the Compaction Factor Test because the compaction factor test gives more information than the slump test. The test is a dynamic test and thus is more appropriate than static tests for highly thixotropic concrete mixtures.

TABLE VII:-Compaction Factor Test Result

Replacement in %	00	20	40	60	80
Compaction Factor	0.92	0.899	0.88	0.87	0.85

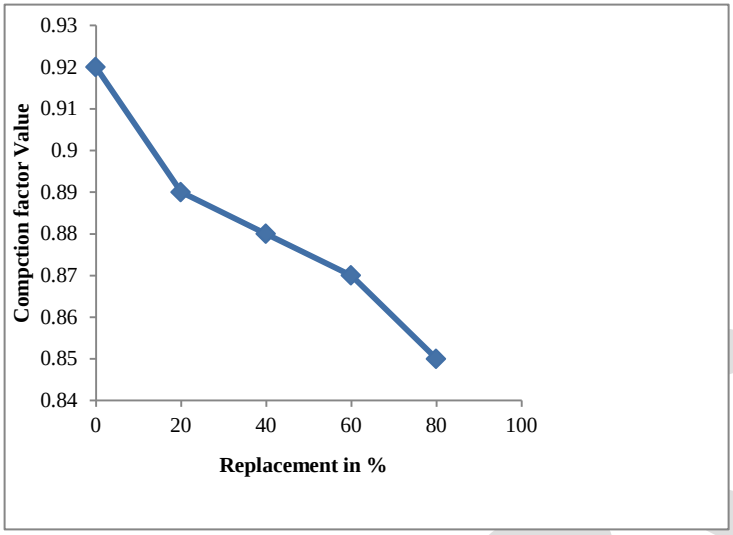


Fig. No. II:-Compaction Factor Vs Replacement

b) Compressive Strength Test:

Table VIII:-Compressive strength test result

Sr. No.	Replacement in %	Compressive Strength in N/mm^2		
		3Days	7 Days	28 days
1	0	13.11	28.31	37.82
2	20	13.9	30.92	41.61
3	40	14.44	31.73	42.34
4	60	12.62	26.71	36.79
5	80	12.04	25.68	35.22

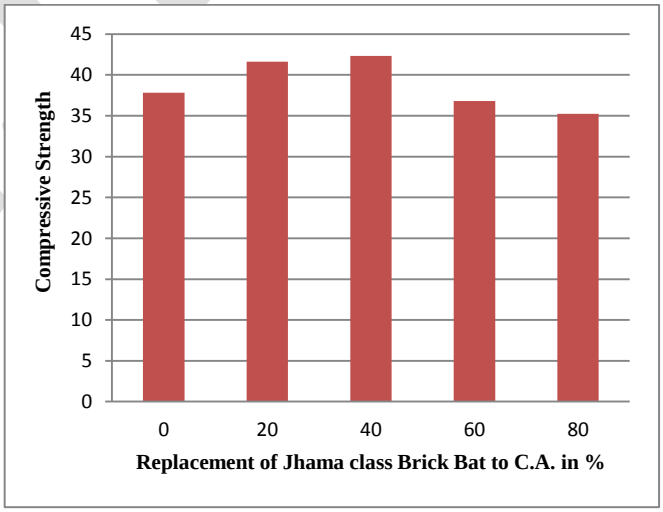


Fig. No. III:-Compressive Strength Test

c) Split Tensile Test:

Table IX:-Split Tensile Test Result

Sr.No.	Replacement in %	Split tensile strength in MPa
		28 Days
1	0	3.8
2	20	4
3	40	4.3
4	60	3.65
5	80	3.24

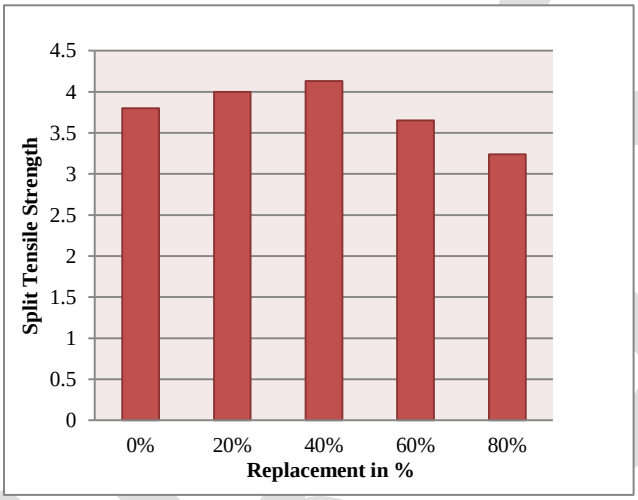


Fig. No. IV: - Split Tensile Strength Test

d) Flexural Strength Test:

Table X:-Flexural Test Result

Sr. No.	Replacement in %	Flexural strength in MPa
		28 Days
1	0	5.06
2	20	5.20
3	40	5.50
4	60	4.89
5	80	4.62

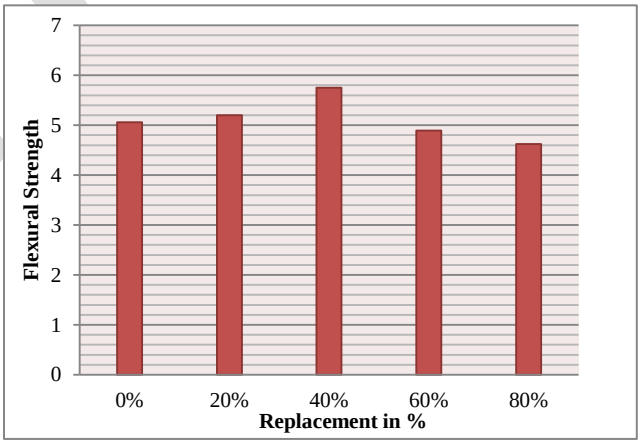
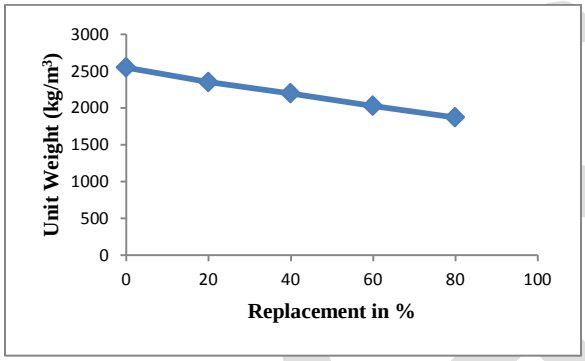


Fig. No. V: - Flexural Strength Test

e) MASS DENSITY TEST:-

Table VIII:-Unit Weight Test Result

Replacement in %	Unit Weight in kg/m^3
0	2548.14
20	2349.62
40	2195.55
60	2026.67
80	1869.62



CONCLUSION:-

On the basis of the result obtained during the experimental investigation, following conclusions were drawn,

1. The compaction factor decreased as the percentage of Jhama class brick increases and increased in comparison with the conventional concrete.
2. The unit weight also decreased as the percentage of Jhama class brick and decreased in comparison with the conventional concrete.
3. Concrete made by using jhama class brick as a coarse aggregate, initially it gives the higher compressive strength for the replacement 20% and 40% after that it was to decrease for 60% and 80%.
4. The compressive strength was found 6.08%, 10.02% higher than that of conventional concrete when the coarse aggregate is replaced by 20% and 40% by Jhama class brick aggregate respectively for the age of concrete 3 days.
5. The compressive strength was found 3.73%, 8.16% lower than that of conventional concrete when the coarse aggregate is replaced by 60% and 80% by Jhama class brick aggregate respectively for the age of concrete 3 days.
6. The compressive strength was found 9.23%, 12.08% higher than that of conventional concrete when the coarse aggregate is replaced by 20% and 40% by Jhama class brick aggregate respectively for the age of concrete 7 days.
7. The compressive strength was found 5.69%, 9.25% lower than that of conventional concrete when the coarse aggregate is replaced by 60% and 80% by Jhama class brick aggregate respectively for the age of concrete 7 days.
8. Compressive strength of Jhama class brick based concrete was higher by 10.02% and 11.95% than that of conventional concrete for the replacement of 20% and 40% at the age of concrete 28 days. For further increased in the percentage of replacement up to 60% and 80%, the compressive strength was decreased by2.72% and 6.87% respectively.
9. Split Tensile strength of Jhama class brick based concrete was higher by 5.26% and 8.68% than that of conventional concrete for the replacement of 20% and 40% at the age of concrete 28 days. For further increased in the percentage of replacement up to 60% and 80%, the Split Tensile strength was decreased by3.94% and 12.1% respectively.
10. Flexural strength of Jhama class brick based concrete was higher by 2.74% and 4.76% than that of conventional concrete for the replacement of 20% and 40% at the age of concrete 28 days. For further increased in the percentage of replacement up to 60% and 80%, the Flexural strength was decreased by 3.16% and 7.5% respectively.

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