Strength Behavior of various types of Bricks Masonry

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Abstract- Bricks are widely used in construction as a material, 25% of material is bricks in construction. Clay bricks are used for construction purpose but pure clay is not available in suitable amount so fly ash brick is used which is the best replacement of clay brick. But now a days at some places the amount of fly ash is reduced or desire quantity of fly ash is not available which fulfill our requirement so new brick is introduced having a balancing amount of fly ash and stone dust which gives tenacious strength and enduring for life. The disposal of the increasing amounts of solid waste from coal-fired thermal power plants is becoming a serious concern to the environmentalists. Coal ash, 80% of which is very fine in nature and is thus known as fly ash is collected by electrostatic precipitators in stacks. In India, nearly 90 mt of fly ash is generated per annum at present and is largely responsible for environmental pollution. The test results show the comparison of compressive strength of bricks. Bricks manufactured with waste material such as fly ash which are available in ample quantity which results economical in manufacturing.

Keywords – Solid Waste, bricks -Red mud, fly ash & CLC, compressive strength

I. INTRODUCTION

A Brick is building material used to make walls, pavements and other elements in masonry construction. Traditionally, the term brick referred to a unit composed of clay, but it is now used to denote any rectangular units laid in mortar. A brick can be composed of clay-bearing soil, sand and lime, or concrete materials. Bricks are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. General Types of Building Bricks made by the materials compared here are- Red mud, Fly ash, CLC.

1) *Red Mud or Clay* - The red mud is one of the major solid wastes coming from Bayer process of alumina production. The conventional method of disposal of red mud in ponds has often adverse environmental impacts as during monsoons, the waste may be carried by run-off to the surface water courses and as a result of leaching may cause contamination of ground water: Further disposal of large quantities of Red mud dumped, poses increasing problems of storage occupying a lot of space.

2) *Fly Ash* - COAL-based thermal power plants have been a major source of power generation in India which causes generation of a large amount of fly ash. Fly ash is fine glass powder, the particles of which are generally spherical in shape and range in size from 0.5 to 100 μm. Disposal and management of fly ash is a major problem in coal-fired thermal power plants.. The country can gain a lot by gainful utilization of fly ash bricks resulting in conservation of natural resources as well as protection of environment.

3) *CLC* - The usage of Cellular Light-weight Concrete (CLC) blocks in Rat-Trap bond would gives a prospective solution to building construction industry along with environmental preservation. It is a version of lightweight concrete that is produced like normal concrete under ambient conditions. Cellular Light Weight Concrete (CLC) is a version of light weight concrete that is produced like normal concrete under ambient conditions. CLC Blocks are a cement-bonded material made by blending slurry of cement. It is three times less weight then clay or fly ash brocks. It solves the problem of disposal of flyash and at the same time it reduces the cost of the construction. Therefore, fly ash based CLC is considered as environment friendly sustainable material produced with least energy demand. The foam concrete is thus a green building material.

4) *Test on bricks*-A brick is generally subjected to the tests to find out its suitability of the construction work are Absorption, Crushing strength or compression strength, Hardness, Presence soluble salts, Shape and size, Soundness, Structure

II. BRICKWORK AND THE INDIVIDUAL BRICKS AND OF THE MORTAR

Strength of brickwork is only about 1/3rd to 1/5th of individual bricks. Studies maid at the building research station, Watford (England) has revealed a very important feature of the mortar and brickwork strength relationship. There is optimum brickwork strength with certain strength of the mortar used and there is no advantage using a stronger mortar with more of cement. With a greater or lesser amount of cementitious material the brickwork is weaker. Used of rich cement mortars or jointing makes the structure unnecessarily rigid and tend to developed cracks stronger mortar with stronger brickwork and weaker mortars with weaker bricks developed the maximum strength; for any particular strength of brick, a corresponding mortars strength gives the maximum strength of brickwork.

Cracks develop between the mortar and the bricks and may pass also through the bricks themselves. With a weaker mortar, however the mortar can "give" a little to take up differential movements and so cracking is often avoided, should movement be so great that cracking still of occurs, it will tend to distributed throughout the brickwork in the joints rather than through the joints through the bricks a 1:3 cement mortar is often specified for brickwork which is needlessly strongly, expensive undesirable for most of the works. A mortar richer 1:3 reduce the strength of the brickwork

TABLE.1.Comparison Between Bricks Used

Sr.No.	Parameter	Clay bricks	Fly Ash bricks	CLC bricks
1	Basic Raw Material	Agricultural/Red soil and wood, coal/ Bagasse for firing	Cement, Fly ash, sand, aggregate	Cement, Fly ash, Foaming agent.
2	Production process	Process in brick kiln	Plant /project site	Plant /project site
3	Dry Density	1800 -2000	900 -2100	400—1800
4	Application	Load bearing and non-load bearing	Load bearing and non-load bearing	Thermal insulation, partition wall, non-load bearing external wall
5	Compressive strength	20—80(kg/cm^2)	30—150(kg/cm^2)	25—40(kg/cm^2)
6	Block size Lx B x H mm	190x90x90, 230 x 110 x 76 and 230 x 150 x 76	190x90x90, 230 x 110 x 76 and 230 x 150 x 76	I230x76x95 And 300x150x150 or 600x300x100/150/200
7	Efflorescence	Slight – Moderate	Nil	Nil
8	War page	<2.5 to 3.0 mm	< 1.0 to 2.0 mm	< 1.0 to 2.0 mm
9	Aging	No	Yes	Gains strength with age
10	Thermal Insulation	Better	Normal	Very good
11	Sound insulation	Normal	Better	Very good
12	Ease in working	Normal	Normal	Very good
13	Labour requirement	100%	100%	50% of normal brick work
14	Eco Friendliness	Process creates smoke, - Uses high energy for firing, - Agricultural soil is wasted	no smoke - low energy only for hydraulic press and mixing of ingredients	Pollution free - Least energy requirement - consumes fly ash which is a waste from thermal power plant - Green building product - Uses no Agricultural soil and natural sand

III. METHODOLOGY & METHODS

Manufacturing Process

1) *Fly Ash* Bricks are made bricks manufactured by hydraulic or vibratory press. Raw material required are fly ash shall conform to Grade 1 or Grade 2 of IS 3812 (60-65%), Bottom ash used as replacement of shall not have more than 12 percent loss on ignition when tested according IS 1727, lime shall conform to class C hydrated lime of IS 712(8-12%), gypsum (5%), locally available sand/stone dust (18-27%) and water. Ordinary Portland cement can also be used in place of hydrated lime and gypsum.
2) *CLC Brick* is produced by initially making a slurry of Cement +Sand + Fly Ash (constituting 26% – 34 % content) + water. It consisting of Portland cement, cement-silica, cement-pozzolan, lime-pozzolan, lime-silica pastes or pastes containing blends of these gradients and having homogeneous void or cell structure, attained with gas-forming chemicals of foaming agents. Aqueous foam is produced from the foam generators and injected

into slurry of cement, fly ash and water in foam concrete mixture. The final mixture is then used for different applications without any vibration or compaction.

3) *Brick Masonry Work*-Masonry is defined as the art of construction in which building units, such as clay bricks, fly ash brick, and CLC bricks. combination of some of these building units etc are arranged systematically and bonded together to form a homogeneous mass in such a manner that they can with stand point to other loads and transmit then through the mass without fail or Disintegration. The standard ratio of cement mortar as per IS taken for the brick to fill the frog is 1:3.

4) *Curing For Bricks&Masonry Work*-After constructing the brick masonry & frog filling it has cure for 15 days. We cured it in twice a day.

TABLE.2.Properties of Brick Masonry Used For Testing

Sr. no	Types of Masonry	Length(m)	Breadth (m)	Height (m)
1	Red Mud Brick Masonry	0.477	0.275	0.100
2	Fly Ash Brick Masonry	0.490	0.260	0.100
3	CLC Brick Masonry	0.470	0.245	0.104

TABLE.3.Properties Of Bricks Used For Testing (avg values)

Sr. no	Types of Brick	Length(m)	Breadth (m)	Height (m)
1	Red Mud	0.230	0.105	0.080
4	Fly Ash	0.230	0.100	0.075
7	CLC Brick	0.230	0.103	0.075

Table.3.2 Dimensions of red mud, fly ash & CLC brick

VI.EXPERIMENT AND RESULT

A. *Test Procedures Performed On Bricks are as follow:*

1) *Water Absorption Test*-Immerse completely dried specimen in clean water at a temperature of 27 +2°C for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after the specimen has been removed from water (M2). Water absorption, percent by mass, after 24-hour immersion in cold water is given by the Following formula:

$$\textbf{Water absorption\%} = \frac{\textbf{(M2-M1)}}{\textbf{(M1)}} \times 100$$

2) *Compressive Strength*-Place the perforated faces of the brick between two 3-ply plywood sheets each of 3 mm thickness and carefully centered between the plates of the testing machine. Apply the load axially at uniform rate of 14 N/mm2 (140 kg/cm2) per minute till the failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

NOTE:- In place of plywood sheets plaster of Paris may be used to ensure a uniform surface application of load. By using following formula:

$$\textbf{Compressive strength } (\textbf{N/mm}^2, \textbf{(kg/cm}^2\textbf{)}) = \frac{\textbf{Maximum load at failure in N (kg)}}{\textbf{Average net area of the two faces under compression in mm}^2\textbf{ (cm2)}}$$

3) *Density Test:*-Used the balance to determine the weight of each bricks. Measure the length width and height of each. Calculate the volume of the each bricks. Determined the density of each brick By using following formula:-

$$\textbf{Density (kg/m}^3\textbf{)} = \frac{\textbf{Mass of Brick}}{\textbf{Volume of Bricks}}$$

TABLE.4.Test results of single Bricks

Sr. no	Age (Hr.)	Bricks	Load (KN/m^2)	Area (m^2)	Total load(KN/m^2)
1	24	Red Mud	107	0.0232	4612.06
2	24	Fly Ash	61	0.0232	2629.31
3	24	CLC	87	0.0241	3605.76

TABLE.5.Test results of Brick Masonry

Sr. no	Age (days)	Bricks masonry	Load (KN/m^2)	Area (m^2)	Total load(KN/m^2)
1	15	Red Mud	228.06	0.0477	4781.13
2	15	Fly Ash	44.010	0.0490	898.16
3	15	CLC	74.70	0.0488	1530.73

Table.4.2 Compression testing On different Brick masonry

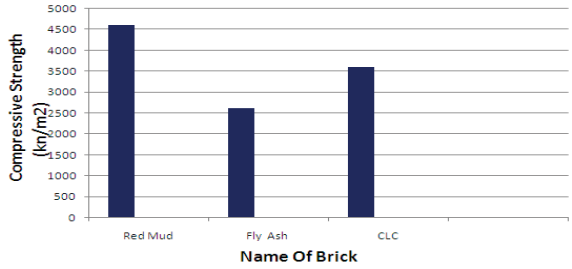


Fig.4.1.Compressive Strength on single bricks at 24 hr

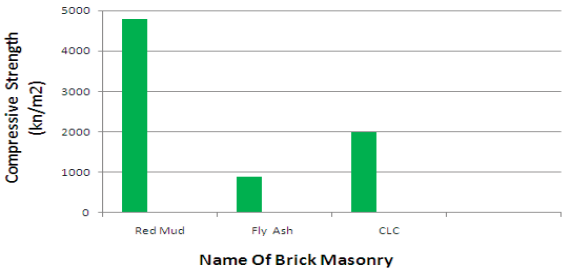


Fig.4.2.Compressive Strength on different bricks masonry at 15 days

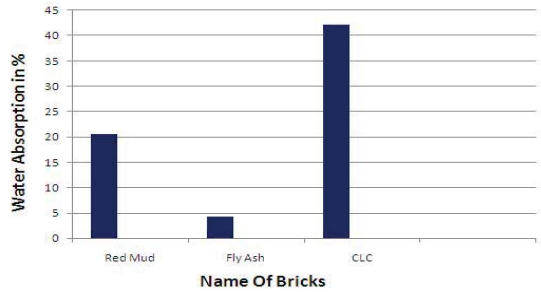


Fig.4.3. Water Absorption on different bricks at 24 hr

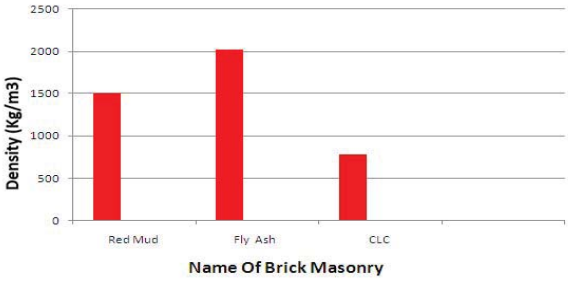
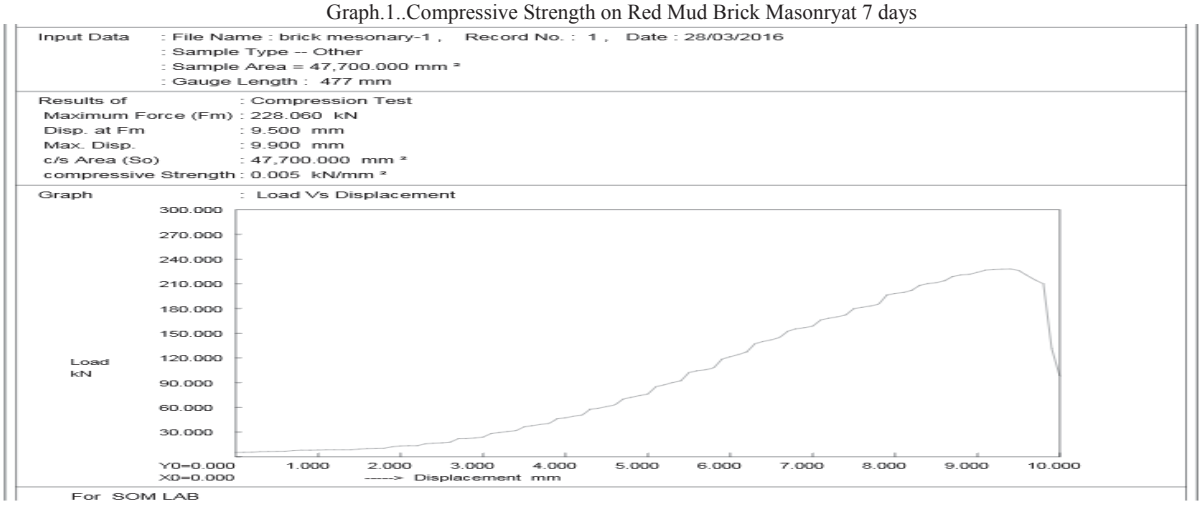


Fig.4.4. Avg Density on different bricks

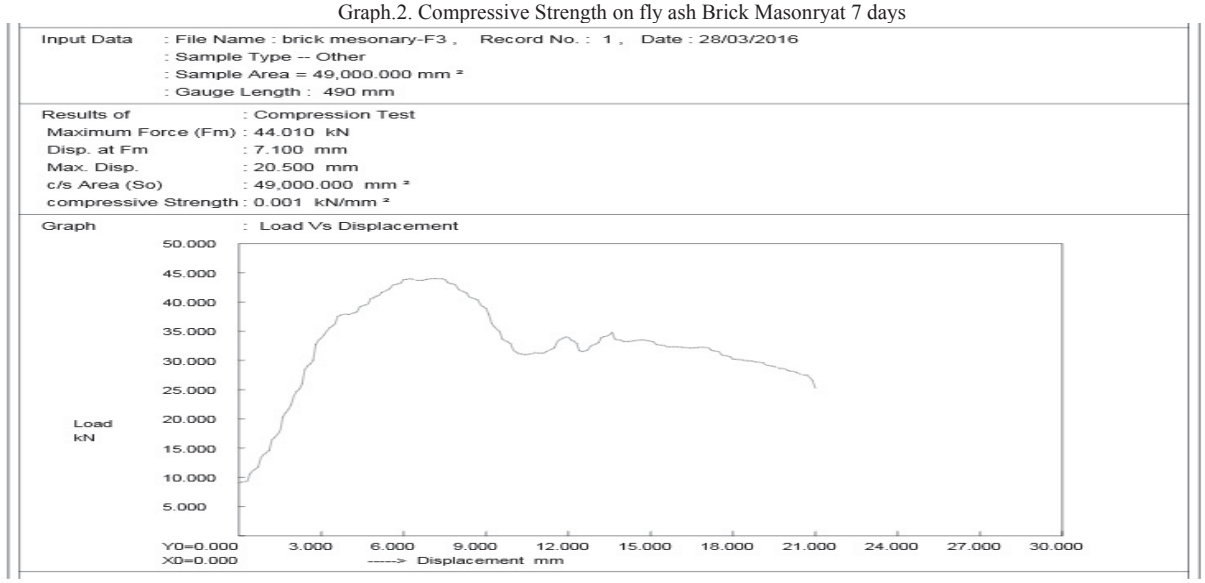
fig.4.5 compressive strength on brick & brick masonry

D. Test Results on CTM

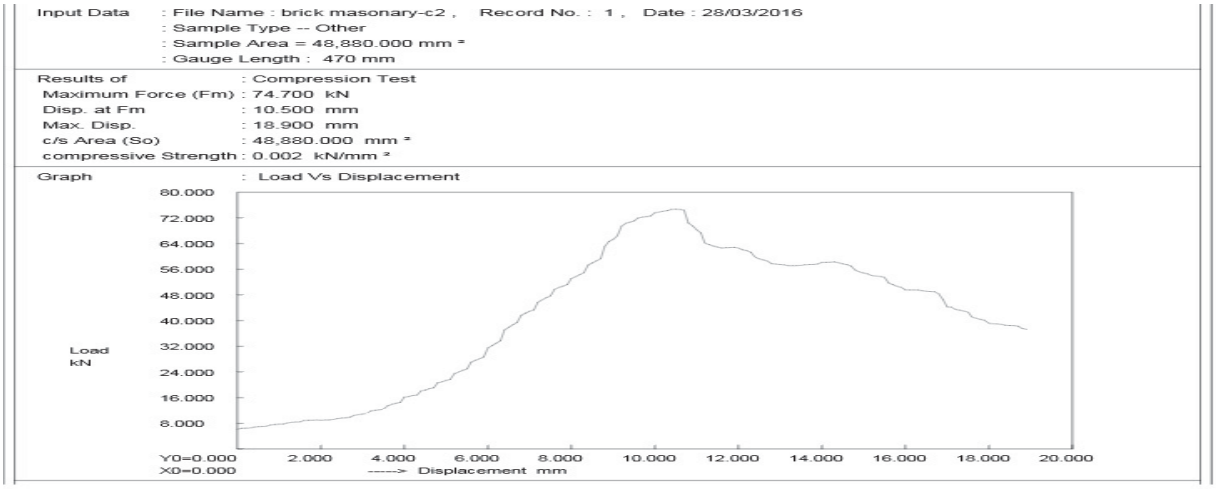
Graph.1..Compressive Strength on Red Mud Brick Masonryat 7 days



Graph.2. Compressive Strength on fly ash Brick Masonryat 7 days



Graph.3.Compressive Strength on CLC Brick Masonryat 7 days



V.CONCLUSION

- The result shows average absorb moisture contain of clay bricks is found to be 20.53% and for fly ash bricks are found to be 4.17% .Thus there is net 16.36% decrease in moisture observed for fly ash bricks as a part to clay brick.
- The crushing strength of clay brick is found to be 4612.06 KN/m², for fly ash bricks are found to be 2629.32 KN/m² and for CLC brick is found to 3609.95 KN/m². And the crushing strength of clay brick masonry work is found to be 4781.13 KN/m², for fly ash brick masonry is found to be 498.16 KN/m²and for CLC brick masonry is found to 1530.73 KN/m².
- As compare to fly ash and CLC bricks, Red mud bricks give 75.41% and 27.71% more compressive strength and give no change in the compressive strength. But we can improve the properties of fly ash and CLC bricks by using geopolymer materials or other waste material such as rice husk, banana fibers, saw dust, lime sludge or partially clay.
- Fly Ash has become an important material for various industrial and construction applications. It is widely used in manufacturing of bricks, cement, asbestos-cement products and road/embankments Fly ash bricks were found to be sufficiently hard as scratching by the figure nail on the surface left no compression on it as compare to normal bricks. Structure of the bricks was found to be compact, homogeneous and free from any defects like holes, lumps, etc., as compare to normal bricks.
- CLC brick reduces the use of material (Natural river sand and red soil) and uses the waste material (fly ash), hence it is green construction material. The test result on CLC brick is quite satisfactory and it can be used for non-load bearing exterior and interior as the light weight reducing dead weight by more than 50% of the normal concrete.
- The clay brick production industry is a major source of air pollution in developing countries. The major issues in environmental improvement involve improving. The process of manufacturing clay bricks also requires high energy to burn due to the emission of CO_2 gas in the process. This study has shown that the use of fly ash with some admixtures can greatly improve its properties. Most of the cleaner production effort is required in India and hence CLC blocks may be used as a replacement of burnt clay bricks, for construction purpose, which is advantageous in terms of general construction properties as well as Eco-friendliness.

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