CELLULAR LIGHT-WEIGHT CONCRETE BLOCKS AS A REPLACEMENT OF BURNT CLAY BRICKS

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ABSTRACT

Burnt Clay Brick is the predominant construction material in the country. The CO2 emissions in the brick manufacture process have been acknowledged as a significant factor to global warming. The focus is now more on seeking environmental solutions for greener environment. The usage of Cellular Light-weight Concrete (CLC) blocks gives a prospective solution to building construction industry along with environmental preservation. In this paper, an attempt is made to compare CLC Blocks and Clay Bricks, and recommend a replacement material to red brick in construction industry.

Keywords: Blocks, High Thermal Insulation,cellular light weight, SoundInsulationEco Friendly Environment.

INTRODUCTION

Bricks remain one of the most important building materials in the country. Brick making is a traditional industry in India, generally confined to rural areas. In recent years, with expanding urbanization and increasing demand for construction materials, brick kilns have to grow to meet the demand. It has directly or indirectly caused a series of environmental and health problems. At a local level (in the vicinity of a brick kiln), environmental pollution from brick-making operations is injurious to human health, animals and plant life. At a global level, environmental pollution from brick-making operations contributes to the phenomena of global warming and climate change. Also, extreme weather may cause degradation of the brick surface due to frost damage.

Global warming and Environmental pollution is now a global concern. Cellular Light Weight Technology blocks can be used as an alternative to the red bricks, to reduce Environmental pollution and Global warming. CLC blocks are environment friendly. The energy consumed in the production of CLC blocks is only a fraction compared to the production of red bricks and emits no pollutants and creates no toxic products or by products.

CELLULAR LIGHTWEIGHT CONCRETE BRICKS

GENERAL

Foam concrete is cellular material made with a mixture of cement, Fly ash, and sand (optional), stable Foam and special additives (if required) which will help to form unique cellular structure material. The hardened material consists of small enclosed air bubbles thereby resulting in a lightweight stable cellular material with densities ranging from 400kg/m3 to 1800kg/m3 according to various compositions. Foam concrete manufacturing consumes higher amounts of fly ash (which is waste material from thermal power stations) hence it is considered as green building material.

The Basic foam concrete is made from mixing aquas which is produced from foam generator into slurry of cement, fly ash, water and other additives in a precisely specially designed mixer for accurately mixing without disturbing its original chemical and physical properties. The final mixture results in many small cells uniformly distributed throughout the concrete which will create cellular structural material from densities ranging from 400kg/m3 to 1800kg/m3. The precise control of volume of air cell in foam will result controlled densities and strengths of foam concrete.

DEMAND AND SOURCES

Construction industry boom can be seen in almost all the developing countries. The demand for supplies is high; supply of raw material like bricks, cement, sand, iron and steel, builder hardware, paints, manpower and everything else regarding construction. The construction industry is also very vital because anybody who is concerned with economic development these days highlights the need for infrastructure development.

Brick making is a traditional industry in India, generally confined to rural areas. Notably, the Indian brick industry, with more than 1 Lakh production units producing about 100 billion tons a brick annually, is the second largest brick producer in the world after that of China. The industry has an annual turnover of more than Rs. 10,000 Crores and, very importantly, it is one of the largest employment generating industries, employing millions of workers.

However, brick making is an energy intensive process as fuel costs account for almost 30% of the production cost. The country consumes about 180 billion tons bricks, exhausting approximately 340 billion tons of clay every year and about 5000 acres of top soil land is made unfertile for a long period.

The demand supply gap for bricks is estimated to be 80 billion tons for the year 2006 thus leaving a scope for establishment of more brick units across India. Despite all initiatives to introduce alternative walling materials like cellular light weight concrete, sand lime bricks, compressed earth blocks, concrete / stonecrete blocks, and fly ash bricks, it is envisaged that sand lime bricks and cellular light weight concrete bricks would still occupy the dominant position in the foreseeable decade.

PREPARATION PROCESS

For smooth surfaces clean moulds completely of remaining concrete, the steel/or wood surface must be oiled, mostly vegetable oil is preferred. Trials with different materials will have to show best results.Oil will not destroy the mix, once the foam has been mixed in the mortar. Steel reinforcement will be placed in the moulds as usual. No coating of the steel is necessary. In panels of more than 12-15 cm thickness, the use of double mesh is recommended.

The steel connected to the lifting anchors should reach more than half of the width of the panel and should possibly not be connected to the mesh. Ordinary steel is used as in CC when casting densities of 1200 or higher. The high ratio of cement to material in CLC ensures proper protection of the steel against corrosion

Charging, Mixing and Pouring:

Before charging the mixer with material, it must be rinsed, in particular if the concrete produced before, used any additive, which might have adverse reaction on the foam. Where possible, start the mixer before charging it with material. If the sand contains excessive amount of water, the weight has to be adjusted, adding that much more sand as it contains water by weight, reducing at the same time amount of water to be added to the mix. To obtain optimum performance, sand is first fed into the mixer, first absorbing water left after rinsing of form the previous CLC mix. Once set correctly,the foam generator will keep the consistency stable, as long as airand water supply remains constant as well.

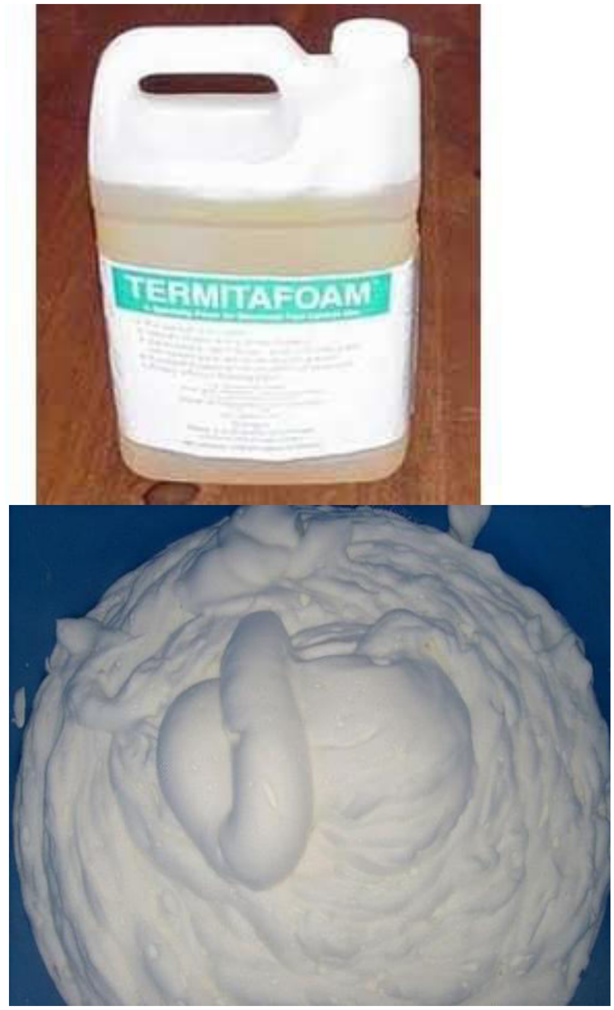
We still recommend to check the weight of the foam once in a week or if the density/consistency of the mix varies. Gravity mixers (e.g. Ready Mix) take the foam under almost instantly and distribute it homogenously in the mix. It takes more time to achieve a proper distribution when using pan-mixers or similar. In between pours, the mixer should be kept in motion until it is completely discharged.

CLC always should be poured in the shortest possible time. If buckets are used to fill moulds, they should hold as much CLC as possible, possibly even pouring one complete panel in one step. Extended time between pours of one building member might result in the creation of dry-joints as happening in the case with regular concrete as well. Although CLC does not require vibration - at least not to density the mix – which is liquid anyhow, vibration of horizontally produced panels will show an even better surface, drawing cement slurry to the mould side. Preference is given to High-Frequency vibrators. Length of vibration 15-20 sec. or until bubbles on the surface appears in large numbers.

Use aluminum or other straight and sharp-edged screed slats immediately after pouring the concrete. Delayed screeding might "smear" the surface. If moulds have to be moved after screeding, this might have to be repeated. Any disturbance of the freshly poured CLC during the setting process, might be harmful and cause part of it to collapse, in particular when the concrete is not hard enough yet to carry the weight and the foam has been weakened by loss of water, drawn by the cement already for setting. Using most standard types of cement, panels may be lifted the day after casting. Due to the reduced strength in CLC, moulds should be tilted before lifting the panels. For the same reason panels of CLC should be handled with utmost care to avoid damage.

PROPERTIES OF LIGHT WEIGHT CONCRETE

PROPERTIES	VALUE
Color	White
Density	1750kg/m^3
Water absorption	17%
Compressive strength	17.5N/mm^2
Acoustic impedance	3.14*10^6 Kg/m^2/s
Bulk density	840kg/m^3



Photographic view of foam

OBJECTIVES
To determine the strength and weight of normal burnt fire clay bricks with respect to lightweight concrete blocks by replacing with fly ash and foam(as cement) in different proportions.

SCOPE
To reduce the weight of concrete blocks by partial replacement of clay with foam based materials.

RESULTS AND DISCUSSIONS

GENERAL

The purpose of this test is to identify the performance of aerated lightweight concrete in term of density and compressive strength. The result are presented in Table Based on Figure, it can be seen that compressive strength for aerated lightweight concrete are low for lower density mixture. The increment of voids throughout the sample caused by the foam in the mixture will lower the density. As a result, compressive strength will also decrease with the increment of those voids.

The required compressive strength of lightweight concrete is 3.45 MPa at 14 days as a non load bearing wall. The compressive strengths obtained from these mixtures carried out are higher than 4.5 MPa and therefore it is acceptable to be produced as non-load bearing structure.

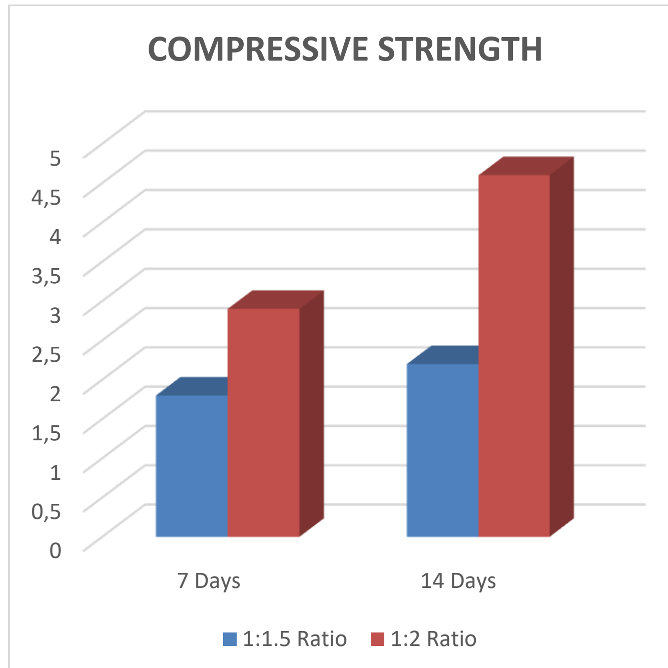
S.NO	RATIO (cement: flyash)	CURING PERIOD (DAYS)	COMPRESSION STRENGTH (N/mm^2)	DENSITY (kg/m^3)
1	1:2	7	2.9	1600
2	1:2	14	4.6	1600
3	1:1.5	7	1.8	900
4	1:1.5	14	2.2	900

Table-1

Compression Testing Machine

Overall Comparison of Compressive Strength

Compressive strength of aerated lightweight concrete is determined on the 7 and 14 days for each sample. There were two samples for each test and the results would be taken as the average of these two. Fewer variables had been set for different mixture, this variable would be changed accordingly while the others were fixed to forecast their effect on the mixture.Percentage of foam, foam agent and water, cement and sand ratio were the variables made during the mixing process. For example, three mixtures were prepared to determine the effect of different foam agent and water, cement and sand ratio.



SUMMARY AND CONCLUSION

SUMMARY

SUPPLEMENTARY TEST

Moisture test and comparison between hardened and wet concrete is another supplementary test in this research. Figure 8 show that different percentage of foam will give different percentage of moisture content as well.

It can be seen that moisture content is increased when percentage of foam is increased too. 35% of foam gives the highest moisture content followed by 35%, and 20% of foam.

SPECIMEN	RATIO (CEMENT:FLYASH)	DRY WEIGHT (GRAMS)	WET WEIGHT (GRAMS)	WATER ABSORPTION (%)
CLC BRICK	1:2	2450	2890	17.9
CLC BRICK	1:1.5	1485	1780	19.8
CLAY BURNT BRICKS	-	2845	3556	24

Table 2: 'Moisture content'

COMPARISON BETWEEN BURNT CLAY BRICK AND CLC BRICK

S. No	Parameters	Burnt Clay Bricks	CLC Bricks
1	Basic Raw Material	Agricultural/Red soil and wood, coal or Bagasse for firing	Cement, Fly ash, Foaming agent.
2	Production process	Process in brick kiln	Plant/project site
3	Dry Density	1800-2000	400-1800
4	Application	Load bearing and non load bearing	Thermal insulation, partition wall, non load bearing external wall
5	Compressive strength kg/cm^2	20-80	25-40
6	Block size LxBxH mm	190x90x90, 230 x 110 x 76 and 230 x 150 x 76	Int brick 230x76x95 And 300x150x150
7	Thermal Insulation	Better	Very good
8	Sound insulation	Normal	Very good
9	Ease in working	Normal	Very easy
10	Labour requirement	100%	50% of normal brick work
11	Eco Friendliness	Process creates smoke, - Uses high energy for firing, - Agricultural soil is wasted	Pollution free - Least energy requirement - consumes fly ash which is a waste from thermal power plant - Green building product - Uses no Agricultural soil and

Table-3

COST ANALYSIS OF CLC BRICK

To produce 1 m^3 CLC the brick of dry density 1400 kg/m^3 raw material is used in following quantity:

Cement - 250 kg & Fly ash – 500 kg

Making proportion of 1:2

Item	**Qty.**	**Rate**	**Amount (Rs.)**
Cement	250 kg	6 /kg	1500
Fly ash	500 kg	1.5/kg	750
Foaming agent	1.2 liter	30 /liter	36
Labour (semi-skill)	2	200 /day	400
Operating cost & over head charges	-	-	100
Total	Rs.	2786	
Profit (Add 5% in total)	Rs.	**2925.3**	

Table 4: 'Cost analysis of CLC brick'

Therefore cost for producing 1m^3 CLC material is = Rs. 2925/-

Cost of CLC brick of size 9" x 4" x 3"

Brick size – 9" x 4" x 3" - 0.23 x 0.10 x 0.075 m = 0.001725 m3

Bricks casted in 1 m3 CLC material = 1/0.001725 = 579.71 ≈ 575 Nos.

Therefore cost of brick = 2925/575 = 5.08 ≈ Rs. 5.00 /-

CONCLUSION

The clay brick production industry is a major source of air pollution in developing countries. The major issues in environmental improvement involve improving the combustion efficiency of existing kilns, and upgrading kilns to newer and more efficient process designs. The process of manufacturing clay bricks also requires high energy to burn due to the emission of CO2 gas in the process. This study has shown that the use of fly ash in foamed concrete, either 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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