International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Cellular Light Weight Concrete

Shaikh Salim Raees[1], Ghanchi Mohammad Shahid[2], Shaikh Ayyan[3], Shaikh Mohd. Anas[4], Pinjari Abdul Hafiz[5], Ansari AbdulHaq[6]

[1]Asst. Professor Dept. of Civil Engineering, Jamia Institute of Engineering & Management Studies, Akkalkuwa, K.B.C. North Maharashtra University, Maharashtra, India
[2,3,4,5,6]Final Year Civil Engineering, Jamia Institute of Engineering & Management Studies, Akkalkuwa, K.B.C. North Maharashtra University, Maharashtra, India

---***---

Abstract – *one to a second support and piled in reversed order thereon, at least one of the two broadsides of each body slice being subjected to a treatment before being covered by the next transferred Cellular lightweight concrete slabs are manufactured by cutting a still plastic block of cellular concrete mass resting on a first support horizontally into slices which are then moved over one by slice. The treatment prevents the body slices from cementing together during the subsequent steam-hardening process and may also improve the quality of the slabs when hardened. An apparatus for such manufacture features a movable suction head for transferring the body slices as well as associated means for cutting and treating said slices. Within the cellular lightweight concrete industry it has for a long time been used a method of manufacturing cellular lightweight concrete products that comprises the steps of first molding a large, cellular and at least approximately parallel-epipedic body from a concrete mass, which in a given stage after molding is plastic but nevertheless self-supporting so that it does not need the support of the mold walls any more, subsequently dividing said body, when it is resting on a first support and while the concrete mass thereof is still plastic, by horizontal cuts into a plurality of slab-like slices, each of which has a thickness that is substantially less than the original height of the body, and finally steam-hardening a plurality of the slab-like slices thus obtained as a group in an autoclave, while they arrested one on top of the other to form a pile. This manufacturing method has many advantages butis not entirely free of problems, and the most dominant one of them is that the slab-like slices frequently show a great tendency of binding or cementing together during the steam-hardening process, so that they afterwards must be separated from each other by force, in which case the products can easily be damaged. This cementing results from the fact that the concrete material on the facing broadsides of the piled body slices, i.e. the recently cut, horizontal surfaces thereof, because of the plastic character of the concrete mass and other circumstances will show a tendency to again coalesce with one another at least in spots here and there after the passage of the cutting members, by means of which the cuts have been produced, and during the steam-hardening process this junction between the piled slices will then be considerably strengthened and form an unacceptly firm bond. It is known that such cementing can be counteracted at least to some extent by changing the composition of the concrete mass, but frequently a change of the concrete mix formula cannot be resorted to for various reasons.*

***Key Words*: Rat-Tarp Bond, Cellular lightweight concrete, alternative building material, Cost Effective.**

1. INTRODUCTION

Foam Concrete is also Known as " Cellular light weight concrete", "CLC", "Foamed cement", "Light Weight Concrete" across the world with its greater advantages from 5 years. The basic foam concrete is made from mixing aqueous foam which is produced from generators (IFG) into Slurry of Cement, fly ash OR sand, water and other additives in a precise mixing in foam concrete mixer (IFM) for accurate mixing without disturbing its original chemical and physical properties.

Lightweight concrete (brick) as known as AAC (Autoclaved Aerated Concrete) is a well-known constructing material all over the world; it was first invented by a Swedish Architect named Johan Axel Eriksson in 1923.Lightweight concrete contains no aggregate larger than sand, lime, thermal ash, synthetic fiber, cement, aluminum powder and water as binding agent. When AAC is mixed and cast in forms, several chemical reactions take place that give AAC its light weight (20% of the weight of concrete) and thermal properties. Therefore, lightweight concrete is quite light and may suffer extreme pressure as well as insulate the high and low temperatures.

In Rat-Trap bond the bricks were laid in alternate Shiner and rowlock pattern but the dimensions of the brick are so kept that even though the bricks are laid in header and stretcher pattern the cavity in the Rat-trap bond is kept intact. In brick the brick is narrowed on the stretcher side i.e. horizontally and its height is increases on shiner side i.e. vertically.

Fig.1 Typical picture of Rat-Trap bond

2. LITERATURE REVIEW

Lightweight concrete (brick) as known as AAC (Autoclaved Aerated Concrete) is a well-known constructing material all over the world; it was first invented by a Swedish Architect named Johan Axel Eriksson in 1923.Lightweight concrete contains no aggregate larger than sand, lime, thermal ash, synthetic fiber, cement, aluminum powder and water as binding agent. When AAC is mixed and cast in forms, several chemical reactions take place that give AAC its light weight (20% of the weight of concrete) and thermal properties. Therefore, lightweight concrete is quite light and may suffer extreme pressure as well as insulate the high and low temperatures.

Density 300-600 kg/m^3: This density is primarily applied for thermal insulation or fire protection. It uses only cement (or little flashy), water and foam and can easily be pumped. Foam generators allow the production of stiff foam for slopes to be applied on roof-tops.

Density 700-800 kg/m^3: Is also used for void-filling, such as an landscaping (above underground construction), to fill voids behind archways and refurbishing of damaged sewerage systems. It is also been used to produce building blocks.

Density 900-1100 kg/m^3: Serves to foremostly produce blocks and other non-load bearing building elements such as balcony railings, partitions, parapets and fence walls etc.

Density 1200-1400 kg/m^3: Are the most commonly densities for prefab and cast in situ walls, load-bearing and non-load-bearing. It is also successfully used for floors creeds (sound and insulation plus weight reduction).

Density 1600-1800 kg/m^3: would be recommended for slabs and other load-bearing building elements where higher strength is obligatory.

2.1 Site Study: -

We construct the all structure and blocks of CLC in our Concrete technology lab under the guidance of prof. Sheikh Salim Raees. This is the sufficient and best places for complete our project work.

2.2 Collection of Sample and Their Analysis

Foaming Agent :- We collect the foaming agent from India mart Surat by courier.

Cement :- This is purchases by us from akkalkuwa of construction materials shop.

Fly Ash:- It is collected from kukarmunda from brick construction company.

Fig-2 Collection of Fly Ash

Fig-3. Collection of cement

Fig-4. Materials

3. METHODOLOGY

3.1 Production Procedure of CLC brick:

The production of CLC brick requires much precision than the burnt clay brick. The casting brick in clay soil was not easy. Also making brick in cement concrete was not feasible as the brick would be heavy in weight and cost more. The best option for producing brick was to use the material which is easy to cast, with precision and should be cost effective. The material which fulfills these requirements is Cellular light weight concrete brick. CLC brick is easy to produce, precise in dimensions due to use of moulds and light in weight. Following are the steps of casting brick in Cellular light weight concrete:

3.1.1 Preparation of moulds:

For smooth surfaces clean the moulds completely of remaining concrete, the steel/ wood surface must be oiled. Mostly vegetable oil is preferred. Trials with different materials will have to show best results. The oil is applied thoroughly to the corners of the mould so that the brick can be easily dismantled from mould without breaking its edges. Oil will not destroy the mix, once the foam has been mixed in the mortar.

3.1.2 Preparation and mixing of foam:

The foam is a vital part of cellular lightweight concrete so it is also called as foam concrete. The foam is produced by using a protein based liquid compound. This compound is diluted in water at 30 ml/liters. This foam is put into specially designed machine for producing foam. The machine comprises of two units viz. pump for suction of diluted compound and air compressor for mixing air and producing foam. There is a unit which mixes the compressed air with diluted compound at given pressure resulting in foam. The foam is dense and containing small uniform shape bubbles. The bubbles in the foam do not disperse like soap bubbles but when mixed with the cement fly ash mixture it forms a homogenous mixture. The bubble in the foam gets trapped in the cement fly ash mixture making the brick light weight.

3.1.3 Charging and Mixing:

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. The material viz. cement and fly is placed in the mixing drum in 1:5 proportion and mixed by adding water, if the mixture is dry mixed the fly ash will disperse away as it is very fine. The mixture is of different type than normal concrete mixture. It has stationary outer drum unlike the moving drum of concrete mixture, and inner helix which is revolving at 250-300 RPM. The helical operation is used instead of revolving entire drum so that the bubbles in the foam do not get dispersed. If the drum is used for mixing instead of helix the bubbles would get dispersed due to descending of material on each other.

Fig.5 Mixing of CLC with foam

3.1.4 Placing/Pouring of CLC in the mould:

The oiled mould is placed on clean surface preferably in shade avoiding direct sunlight. The prepared foam is then poured slowly in the mould and at the same time the mould is shaken so that the material reaches in every corner of the mould. The mould is filled completely and the extra material top surface is striped out and made plain. The mould is then kept for 24 hours for setting of material. 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. Use aluminum or other straight and sharp-edged screed slats immediately after pouring the CLC.

3.1.5 Curing &Transport:

The brick should be positioned upwards on the curing yard, resting on a soft underground - best on a rake or wooden beams. All possible efforts should be taken, in particular in dry and hot climate or more even when windy, to keep the brick damp for at least three, better for more days. It should be preferably kept in shade and in damp condition as the dry condition would absorb the moisture from the brick reducing its strength. A sprinkler will be helpful or gunny bag that is kept wet. Curing compound would be the costly alternative. Standards call for a 24 day curing period for cement-based bricks. Due to reduced weight, more volume of CLC more bricks can be transported at the same (increased pay-load) then of CC. Brick should be kept upright during transport and also on a soft/wooden underground. Unload properly.

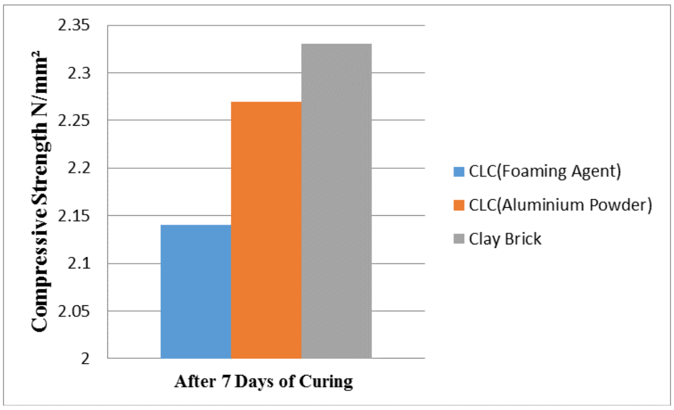
3.1.6 Assembly:

Assembly of brick in CLC happens usually the same way as with normal bricks. Special care has to be taken not to apply any mechanical force to avoid damage. If necessary, CLC bricks may be sawn (no gravel), definitely nailed (without the use of dowels as in AAC), drilled or profiled. In densities of 1200 kg/m^3 and higher, where reinforcement is used, CLC requires no special coating/plaster on the outside. Water-repellent paint (dispersion paint) will be suitable.

4. Result: -

Table 1: Average Strength of CLC Blocks & Conventional Clay Bricks after 7 Days

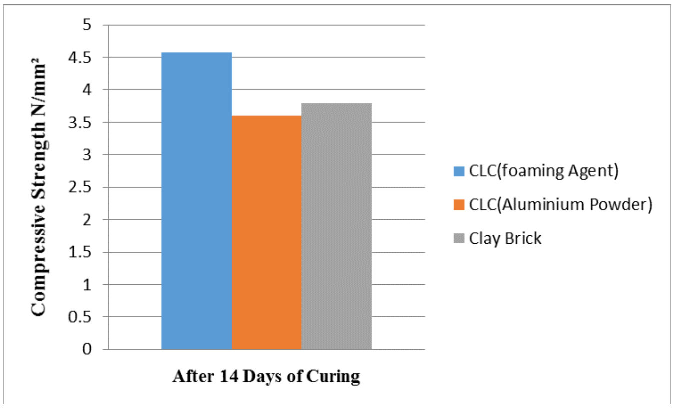
Sr. No	Description	Load (kN)	Area (mm^2)	Average Strength N/mm^2
1	CLC Blocks (Protein based)	36.59	3375000	2.14
2	CLC Blocks (Aluminum as Foaming Agent)	38.81	3375000	2.27
3	Conventiona l Clay Bricks	39.84	3375000	2.33



Compressive Strength after 7 Days of Curing

Table 2. Average Strength of CLC Blocks & Conventional Clay Bricks after 14 Days

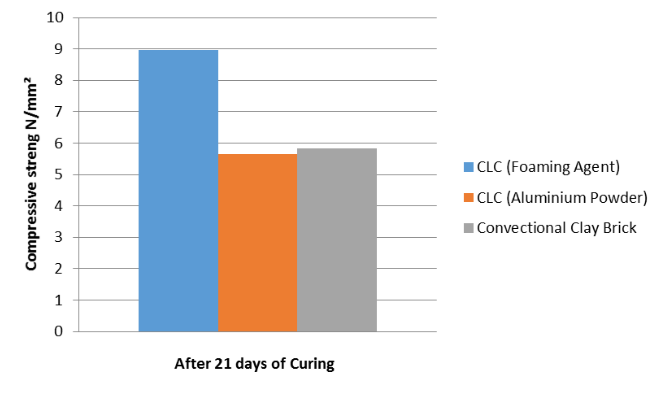
Sr N0	Description	Load (kN)	Area (mm^2)	Avg. Strent. N/mm^2
1	CLC Blocks(Protei n based)	78.14	3375000	4.57
2	CLC Blocks (Aluminum as Foaming Agent)	61.56	3375000	3.6
3	Conventional Clay Bricks	64.98	3375000	3.8



Compressive Strength after 14 Days of Curing

Table 3: Average Strength of CLC Blocks & Conventional Clay Bricks after 21 Days

Sr no	Description	Load (KN)	Area Mm^2	Avg strnth N/mm^2
1	CLC Blocks(Protein based)	153.33	375000	8.96
2	CLC Blocks (Aluminum as Foaming Agent)	96.67	375000	5.65
3	Conventional Clay Bricks	100	375000	5.84



Compressive Strength after 21 Days of Curing

5. Conclusions: -

After the experimental work done the following conclusion are made: 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. This study shows that the reduction in self-weight of CLC blocks is 32% compare to conventional clay bricks and increase in compressive strength after 21 days of curing is 36% compare to conventional clay bricks.

CLC brick in Rat-Trap bond is an innovative technique for efficient brick work system with many advantages over the conventional brick work system. It reduces the use of material (natural river sand and red soil) and uses the waste material (fly-ash), hence it is green construction material. CLC brick is designed specially to build wall in Rat-Trap bond as efforts have not yet been made to design CLC brick in Rat-Trap bond. The test results on CLC brick are quite satisfactory and it can be used for non load bearing exterior and interior wall. Also the light weight of CLC brick in Rat-trap reduces the dead load on the structure and provides good thermal insulation. Thus this CLC brick in Rat-trap bond has a very good future scope for its development as a commercial product.

REFERENCES

[1] Agus Setyo Muntohar, (2011), Engineering characteristics of the compressed-stabilized earth brick, Construction and Building Materials, Elsevier, vol – 25, pp – 4215-4220.

[2] Alex Liew, Mazhar ul Haq, Light Weight/Low Cost Construction Methods For Developing Countries, CBM-CI International Workshop, Karachi, Pakistan, pp – 491-504.

[3] B. V. Venkatarama Reddy, (Feb 2007), Richardson Lal, and K. S. Nanjunda Rao, Enhancing Bond Strength and Characteristics of Soil-Cement Block Masonry, Journal Of Materials In Civil Engineering, ASCE, Vol. – 19, pp – 164- 172.

[4] K. B. Anand and K. Ramamurthy, (May-June 2003), Laboratory-Based Productivity Study on Alternative Masonry Systems, Journal Of Construction Engineering And Management ASCE, volume/issue-129, pp – 237-242.

[5] Krishna Bhavani Siram, (Dec 2012), Cellular Light-Weight Concrete Blocks as a Replacement of Burnt Clay Bricks, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-2, pp – 149- 151.

[6] Mucahit Sutcu, Juan José del Coz Díaz, Felipe Pedro Álvarez Rabanal, Osman Gencel, Sedat Akkurt, (Feb 2014) Thermal performance optimization of hollow clay bricks made up of paper waste, Energy and Building ELSEVIER, Vol. – 75, pp – 96-108.

[7] S. Krishnaiah, P. Suryanarayana Reddy. 1-6 October (2008), Effect of Clay on Soil Cement Blocks. 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG), pp – 4362-4363.

[8] S. Saileysh Sivaraja, S. Vijayakumar, T. S. Thandavamoorthy, S.Moses Aranganathan And K. Chinnaraju, (Feb 2012), Base Shock Excitation of Rat-Trap Bond Masonry with and Without Roof Slab, International Journal of Earth Science And Engineering, Cafet-Innova Technical Society, Vol. – 4 No. 01, pp – 146-153.