

# Experimental Study on Cellular Lightweight Concrete Block (CLC Block)

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**Abstract**—This paper represents the effect on the strength of CLC Block. CLC block manufacturing uses Cement, fly ash, water and foam Agent ash as Raw Material. Gains strength with age like concrete. Pollution free, no primary energy consumption. Any size, shape can be given by mould /cut. CLC is light weight block where water absorption is less than compared to red brick blocks and density is 800 kg/ m<sup>3</sup>. More advantages are involved in CLC block specimen that is thermal conductivity, fire Protection, reduction of dead load, enhances carpet area, surface finish, eco-friendly, speedier constructions, ease of work ability, universal acceptability, low water absorption, ideal material for applications in cold storage rooms, longer service life ,design flexibility, easy handling, compressive strength is more than other bricks, life span is more than other bricks, accurate size and shapes help in reducing plastering costs.

**Keywords**—Fly ash, Cement, Sand, Foaming Agent, Concrete Block

## I. INTRODUCTION

This world is changing day by day. Technologies are also changed with time. Technological advancement leads business process in all new different dimensions. Country like India is growing rapidly. Infrastructure Development is in big bane. Development forms and methods are also changed due to change in technology. In case of a conventional construction of a building or any structure, the main source of raw material is Sand bricks or Stones or wooden sheets as a wall. The new concept for making wall has been developed that is

Cellular Light weight Concrete (CLC) Bricks. It is a light weight, water resistant, fire- proof, sound proof and environment friendly. The main feature of this bricks is light in weight. Cellular Lightweight Concrete bricks are made of fly ash, cement, and foaming agent. These can be extensively used in all building constructional activities similar to that of common burnt clay bricks. The CLC bricks are comparatively lighter in weight and stronger than common clay bricks. Since fly ash is being accumulated as waste material in large quantity near thermal power plants and creating serious environmental pollution problems, its utilization as main raw material in the manufacture of bricks will not only create ample opportunities for its proper and useful disposal but also help in environmental pollution control to a greater extent in the

surrounding areas of power plants. In view of superior quality and eco-friendly nature, and government support the demand for CLC Bricks has picked up.

A majority of the CLC products are compact in size thereby it takes very fewer space. This also contains lesser production capacity. Nevertheless, the completed products need a good number of spaces for curing. These types of bricks may hardly be built up along with each other. For that reason it requires a lot more space for accommodation.

## II. MATERIALS USED

### A. Cement

53 grade ordinary Portland cement (OPC) is used for manufacturing CLC bricks. It will give faster strength to the bricks, besides giving improved consistent quality. It also ensures a better cost effectiveness for the same. Using OPC will be a standardized practice. The other prime advantage of using OPC (compared to other binders) is its easy availability locally through nationwide Retail Network of Cement Companies.

### B. Water

Water is the most important constituent of a concrete mass which enables bonding between cementitious materials and the aggregates. A part of mixing water is utilized in the hydration of cement to form binding matrix in which the inert aggregates are held in suspension until the matrix has hardened. The remaining water serves as a lubricant between the fine and coarse aggregate and makes concrete workable. Water Hardness maximum 100 PPM Need Industrial softer for hard water

### C. Fly Ash

We should use fine fly ash (may be use pond ash), which is available in thermal power plants. (It is also available in certain industries free of cost. There are no taxes on this item whatsoever. Transportation charges are only to be attended by the entrepreneur. This raw material is one hundred percent (100%) suitable for CLC bricks production.

#### 1) Physical Properties

Specific Gravity 2.54 to 2.65 gm/cc

Bulk Density 1.12 gm/cc

2) *Chemical Properties*

Silica	35-59 %
Alumina	23-33%
Calcium Oxide	10-16%
Loss on ignition	1-2%
Sulphur	0.5- 1.5%
Iron	0.5- 2.0 %

D. *Foaming Agent (Chemical)*

Foaming agent is fully biodegradable protein-based foam concentrate that forms stable bubbles and provides necessary porosity to the foam concrete. The bubbles formed are strong enough to last until the concrete is set at required density. 40-80 gms per Liter – Foam Density. Foaming agent is easily available in the market. Protein foaming agent (veg) can be used for roof insulations.

A. *Specification:*

- Physical appearance: Light Yellow Translucent liquid
- Specific Gravity: 1.0-1.05
- pH: >7.5
- Chloride Content: <0.10%

E. *Fine Aggregate*

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970. Sieve analysis was done using standard sieve analysis procedure and the sand conforms to Zone II.

III. EQUIPMENTS DETAILS

A. *Foam Generator*

Foam generator comes with fully automated System, Timer with high quality of imported Motor. It produces high quality of Foam With customized and large output Production.

1) *Specification:*

- 3 Digit timer relay
- Two pole MCCB
- LED Automatic ON/OFF Switch
- 1 hp single phase motor
- Comes with emergency switch
- Production Capacity: 600 ltrs foam Out Put / min
- Timer : Automatic timer System
- Weight : 60 kgs

B. *CLC Mixer Machine*

CLC mixer machine is a ribbon type blender capacity range in between 15 cubic meters to 150 cubic meters. In this machine we can produce high quality of CLC blocks at required density. In this we are using high quality of materials like gear box and motor 15 m<sup>3</sup> : 5 hp Gear Box / Motor.

- 30 m<sup>3</sup> : 7.5 hp Gear Box / Motor

- 50 m<sup>3</sup> : 10 hp Gear Box / Motor
- 100 m<sup>3</sup> : 20 hp Gear Box / Motor
- 150 m<sup>3</sup> : 30 hp Gear Box / Motor

C. *CLC Plant*

Two types of CLC Plant are available. Water Curing and Steam Curing. Water Curing is best one. Because the Investment is very less and it is suitable for Builders, Building Material Suppliers, Clay Brick, Fly Ash Brick, Concrete Brick Manufacturers.

D. *CLC Pump*

It is a Slurry Pump Used to Pump the Material from 30 meters to 100 meters as per the requirement 3 hp to 10 hp motor.

E. *CLC Mobile Unit*

CLC Mobile Unit is the Movable Type Machine. We Can Directly Take The Machine To The Construction Site. Production Capacity From 15 m<sup>3</sup> to 100 m<sup>3</sup>

F. *CLC Moulds*

Two types of CLC Moulds are available

A. *Battery Moulds*

Battery Moulds are Adjustable Moulds for various sizes in single mould we can adjust our required sizes of Blocks. In 1 Mould We Get 10/15/20 Blocks as Per our Requirement.

B. *Vertical Moulds*

Vertical Moulds are also Size adjustable Moulds We Can Adjust Required Sizes of the Blocks. The Capacity Of Vertical Mould Is 1m<sup>3</sup>

G. *Steam Curing*

This is suitable for higher production capacities. We get high Production in very quick time. Production capacity from 15 m<sup>3</sup> to 150 m<sup>3</sup>.

H. *Foam Concrete Machine*

Foam Concrete Machine also Known as CLC Machine. In This We Can Make Foam Concrete Blocks Otherwise We Can Pour Foam Concrete Directly For Compound Wall, Floorings etc . Without making block capacity range from 15 m<sup>3</sup> to 150 m<sup>3</sup>.

I. *Foaming Agent*

It Is an anti Foaming agent. In this Two Types are available Synthetic Based and Protein Based

1) *Synthetic Based*

- It Is Purely Natural Based Foaming agent

2) *Protein Based*

- It is an animal Based foaming agent taken from animals.

J. Trolleys

Two Types Of Trolleys are available

- Material Trolley
- Block Trolley

1) Material Trolley

Material Trolley used to Carry the Materials From Mixer Machine to Pour in to the Moulds. Capacity 200 ltrs.

2) Block Trolley

Block Trolley Used To Carry Blocks From Moulds.

available in CLC Blocks & its weight are given below.

TABLE 1 Details of Block size

Size in MM	Size in inches	No of Block in one m3 (kg)	Weight (kg)
600 x 200 x 100mm	24 x 8 x 4"	82	10 – 10.5
600 x 200 x 150mm	24 x 8 x 6"	55	15 – 15.5
600 x 200 x 200mm	24 x 8 x 8"	41	20 – 20.5
600 x 200 x 225mm	24 x 8 x 9"	36	25 – 26

K. CLC Block Size and Details

CLC block size can be cut at any size according to local market needs. The different sizes

GREEN STONE								
RELATIVE COMPARISON OF ALTERNATIVE WALLING MATERIALS								
S.NO.	Parameters	Burnt Clay Bricks	Concrete Hollow Blocks	Lightweight Concrete				
				AAC Aerated Auto Calved		CLC Cellular Lightweight Concrete		
1	Basic raw materials and other inputs.	Top agricultural soil, energy.	Cement, Sand, Aggregate.	Cement, Lime, Sand Gypsum, Aeration Compound		Cement, fly ash, water and foaming compound		
2	Dry Density Kg/M <sup>3</sup>	1900	1700	650	750	400	800-1000	1200-1800
3	Comp. Strength- Kg/cm <sup>2</sup>	35-125	30-50 KG/CM <sup>2</sup>	35	40	20-30	40-60	125-180
4	Usage	Load Bearing and Non-Load bearing	Non - Load bearing walls	Non Load Bearing Blocks	Reinforced Panels	Insulation	Partitions, Low-rise Load Bearing	RCC Elements
5	Water Absorption age weight	15 - 20	-20	-60		15	12.5	7.5-10
6	Pre cast block size	229 x 114 x 70 mm.	400 x 200 x 200/100 mm.	625 x 250 x 100/200 mm.		500 x 250 x 100/200 mm.		

Fig 1 Comparison Details

IV. INSPECTION AND QUALITY CONTROL

The Bureau of Indian Standards has formulated and published the specifications for maintaining quality of product and testing purpose. IS: 12894: 2002. Compressive strength achievable: 60-250 Kg/Cm. Sq. Water absorption: 5 – 12 %; Density: 1.5 gm/cc Co-efficient of softening (depending upon water consistency factor) Unlike conventional clay bricks fly ash bricks have high affinity to cement mortar though it has smooth surface, due to the crystal growth between brick and the cement mortar the joint will become stronger and in due course of time it will become monolithic and the strength will be consistent.

A. Pollution Control

The technology adopted for making fly ash bricks is eco-friendly. It does not require steaming or auto-calving as the bricks are cured by water only. Since firing process is avoided. There are no emissions and no effluent is discharged. Facial masks and dust control equipment may be provided to the employees to avoid dust pollution more over all the

raw materials are kept under covered by polythene sheet to avoid air pollution.

V. RESULTS AND DISCUSSION

A. Power Consumption

TABLE 2 Power Consumption Required For Running CLC Plant

SI No	Name of the Machine	No. of machines	H.P Connected
1	1.5 cubic meter mixer	1	7.5
2	Foam generator	1	2.0
3	Compressor	1	2.0
4	Water motor	1	2.0
5	Belt Conveyor	1	2.0
6	Screw Conveyor	1	2.0
7	Cutting Machine	1	5.0
8	Other electrical fittings/ lighting etc	-	2.5
Total			25.0

B. Financial Aspects

TABLE 3 Land & Building

Sl.no	Description	Amount in Rupees
1	Land 1 Acre	3,00,000
2	Building (60 x 40 = 2400 Sq. feet.) x Rs.500	12,00,000
3	Overhead water tank	50,000
4	Office and Security room 300 Sq. Ft	3,00,000
	TOTAL	18,50,000

C. Recurring Expenditure (per month)

TABLE 4 Raw Materials Per Month

Estimates of Raw Material Consumption per m3			
Raw Material	Qty	Rate / per kg	Amount in Rupees
Fly Ash	500 kg	0.80	400.00
Cement	250 kg	8.00	2000.00
Chemical	1.5 kg	150.00	225.00
Water	200 lit	0.05	10.00
Power (KWH)& Fuel	-	-	20.00
Labour .	-	-	200.00
Total	-	-	2855.00
Damages & Miscellaneous @ 2%	-	-	57.00
Local Transport	-	-	200.00
Others (Marketing the Product)	-	-	200.00
<b>Total</b>			<b>3312.00</b>

D. Selling Price (Approx)

- 3800 m3 - 3312 = 488 / m3 profit
- 488 X 15m3 =7320 day profit
- 7,320 X 26 = 1,90,320 profit per month for 26 day working
- Per year profit is 1,90,320 X 12 = 22,83,840
- Working Capital Calculation- per day/per Shift 15 m<sup>3</sup>  
15 m<sup>3</sup> x 2855 x 90 days = 38, 54,250/-

E. Production Capacity Per Year:

Project having production capacity of 15 cubic mtr per day. So it is assume that plant will run 300 days in year.

- Total capacity range is 15 cubic mtr x 300 days = 4500 cubic mtr

VI. CONCLUSION

Cement industry globally account for nearly 6.5% of CO<sup>2</sup> emissions. Use of fly-ash would reduce clinker consumption and bring down emission of green house gases in the atmosphere. The increasing awareness and legislation on environmental issues would enable cement industry to use fly ash not only in production of cement but as a constituent in raw-meal in production of clinker wherever possible. The durability of construction especially in aggressive and

marine environment will also help in utilization of more fly ash as cementitious material.

- Strength values are increased compared conventional brick
- Reduction in cost of production
- Increase in throughput of cement plant

CLC is light weight block where water absorption is less than compared to red brick blocks and density is 800 kg/ m3

VII. REFERENCES

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