STRENGTH, WATER ABSORPTION AND DENSITY OF CELLULAR LIGHT WEIGHT CONCRETE (FOAM BRICK)

Parashuram Lokre[1], Abhishek Kulkarni[2]
[1]Assistant Professor, [2]Student

Abstract
The paper summarizes the development brick knowledge and techniques. Emphasizing which benefit from building and design feedback. Recent projects and achievements allow emphasizing the specific points of the designed environmental effects which justified the use of foam brick. The paper finally list scientific and technological breaks engendered by foam brick which impose the engineers and the designers to think out of the reflexes attached to the burnt red brick or laterite stones.
Index Terms: Brick, Coast-effective, Foam-brick, Coast Analysis.

I. INTRODUCTION

1.1 FLY ASH: AN OVERVIEW

Fly ash is the by-product of coal combustion collected by the mechanical or electrostatic precipitator (ESP) before the flue gases reach the chimneys of thermal power stations in very large volumes. All fly ash contain significant amounts of silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), iron oxide (Fe_2O_3), calcium oxide (CaO), and magnesium oxide (MgO) however, the actual composition varies from plant to plant depending on the coal burned and the type of burner employed. Fly ash also contains trace elements such as mercury, arsenic, antimony, chromium, selenium, lead, cadmium, nickel, and zinc.

1.2 AMOUNT OF FLY ASH GENERATED IN INDIA

The principle source of energy in India is the coal and it will remain the major source of thermal power for the next few decades. Nearly 65% power in India is generated through thermal power plants (TPP). The high ash content of Indian coals (30% to 40%) is contributing high volumes of fly ash. It is estimated at present nearly 160 million ton fly ash is produced every year.

The fly ash generation is increasing in such a proportion that it will not be possible for the cement industry alone to utilize the same. New avenues of gainful utilization of fly ash have to be found and promoted. The generation of fly ash in different five year plans is given in Table.

Table1: Generation Of Fly Ash During Different Five Year Plans

Plan Period	Terminal Year	Power Generation (MW)	Coal (million tons)	Fly ash (million tons)
8th Plan	1996 – 97	50,000	210	80
9th Plan	2001 – 02	87, 000	285	110
10th Plan	2006 – 07	1, 16, 400	400	140
11th Plan	2011-12	1, 38, 3000	500	175

II. FLY ASH BRICK

Production of burnt clay bricks requires consumption of coal leading to green house gas emissions. The primary raw material used for bricks is the soil, which is often taken from prime agricultural land, causing land degradation as well as economic loss due to diversion of agricultural land. Use of traditional technologies in firing the bricks results in significant local air pollution. The burnt clay brick industry in India produces over 180 billion clay bricks annually with a strong impact on soil erosion and unprocessed emissions. At the same time, the thermal power plants in India continue to produce a huge amount of fly ash, disposal of which poses significant challenges for the power plants.

Production of building materials, particularly bricks using fly ash is considered to be one of the solutions to the ever-increasing fly ash disposal problem in the country. Although there exist several technologies for producing fly ash bricks, the one that is gaining popularity is the cellular light weight brick which is also known as foam brick.

Fig. 1 – CLC bricks V/S clay bricks (ordinary bricks)

III. CELLULAR LIGHT WEIGHT CONCRETE BRICK

Global warming and Environmental pollution is now a global concern. Cellular Light Weight Technology bricks can be used as an alternative to the red bricks, to reduce Environmental pollution and Global warming.

It is produced by initially making slurry of Cement + Fly Ash + Water, which is further mixed with the addition of pre-formed stable foam in an ordinary concrete mixer under ambient conditions. The addition of foam to the concrete mixture creates millions of tiny voids or cells in the material, hence the name Cellular Concrete.

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.

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. It is produced by initially making a slurry of Cement + Fly Ash + Water, which is further mixed with the addition of pre-formed stable foam in an ordinary concrete mixer under ambient conditions. Based on the trial mixes, it is found that compressive strength of CLC blocks is more than the compressive strength of conventional clay bricks. The addition of foam to the concrete mixture creates millions of tiny voids or cells in the material, hence the name Cellular Concrete.

IV. FLOW CHART DIAGRAM OF MANUFACTURING OF CLC BRICKS

FLY ASH+ CEMENT
↓
Weighing
↓
Pan Mixer
↓
Making of foam (using foaming agent and water) With help of foam generator or (drilling machine)
↓
Transported To Pan Mixer & mix it
↓
Transport to steel molds
↓
Allow for 24 hours for setting
↓
Water Curing
(7 to 28 days)
↓
Sorting and Testing
↓
Dispatch

V. TESTS CONDUCTED:

1. Compressive strength test.
2. Water absorption test.
3. Density test.

VI. SPECIMENS

The fly ash, cement, and CLC bricks of mould23cm x 11cm x 8cm size with varying mix proportions of Fly ash, cement and clc foaming agent ratio and constant water to cement ratio of 0.45 were casted in the lab. A total of 40 bricks specimens were casted & tested in the laboratory.

Mix proportion of foam brick

Taking a mix proportion of 1:4

Size of the brick = 23cmx11cmx8cm

Size of the brick = 0.23mx0.11mx0.08m

= 0.002024 m^3

For four brick = 4x0.002024

= 0.008096 m^3

$= \frac{0.008096}{(1+4)}$

= 0.0016192 m^3

1:4

Cement = 0.0016192 x 1

=0.0016192 m^3

= 0.0016192 x 1000

=1.6192 ≈ 2kg

Fly ash = 2x4= 8kg

Taking water cement ratio of 0.4

$\frac{w}{c} = 0.4$

w = c x 0.4

w = 2 x 0.4

w = 800ml of water

Fly ash ratio, $\frac{w}{f} = 0.4$

= 8 x 0.4

= 3.2 liters of water

For more workability

Taking a ratio of = 0.45

$\frac{w}{c}$ = 0.45, w = c x 0.45= 2 x0.45 = 900ml

$\frac{w}{f}$ = 0.45= 8 x 0.45= 3.6 liters of water

Table2:Showing Brick Specimens With Various Proportions And With Variable W/C Ratio (F Type Fly Ash)

Mix proportion	1:2	1:3	1:1.5
Vol of 1 brick (in m^3)	0.002024	0.002024	0.002024
Vol of 4 brick (in m^3)	0.008096	0.008096	0.008096
Ratio	0.0027	0.002024	0.00302
Cement (in kg)	3	2.1	3.3
Fly ash (in kg)	6	6.1	4.6
w/c ratio	0.55	0.55	0.5
Quantity of water in cement	1700ml	1200ml	1700ml
f/a ratio	0.55	0.55	0.5
Quantity of water in fly ash	3.5	3.5	2.4

COMPRESSIVE STRENGTH OF CLC BRICKS:

FORMULA:

$$\text{Compressive Strength (N/mm}^2\text{)} = \frac{\text{Max.Load at Failure in N}}{\text{Avg. Area of bed face in mm}^2}$$

Table3: 14 DAYS STRENGTH 0f (F TYPE FLY ASH)

Sl No.	Ratio	Avg. area of bed surface (mm²)	Load at failure (ton)	Compressive Strength (N/mm²)
1	1:2	25300	27	1.08
2	1:3	25300	37	1.48
3	1:1.5	25300	52	2.1

Table4:28 DAYSF TYPE FLY ASH

Serial No.	Ratio	Avg. area of bed surface (mm²)	Load at failure (KN)	Compressive Strength (N/mm²)
1	1:2	25300	56	2.21
2	1:3	25300	70	2.76
3	1:1.5	25300	90	3.56

Fig. 2 – Testing of Foam Brick in CTM

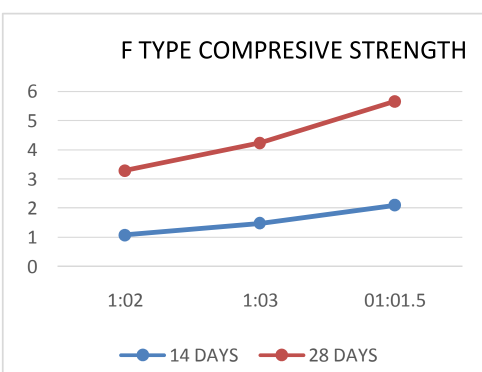

Fig.3–Graph Shows The Variation Of Compresive Strength With Respect To Ratio

VII. WATER ABSORPTION

Percentage of water absorption= $\frac{M2 - M1}{M1} \times 100$

Table5: F Type Fly Ash

SL.NO	Ratio	Weight (dry)	Weight (wet)after 24hr in gm	% of Water absorption
1	1:2	1350	1700	25.90
2	1:3	900	1300	44
3	1:1.5	1400	1700	21.24
4	Clay brick	2222	2852	28

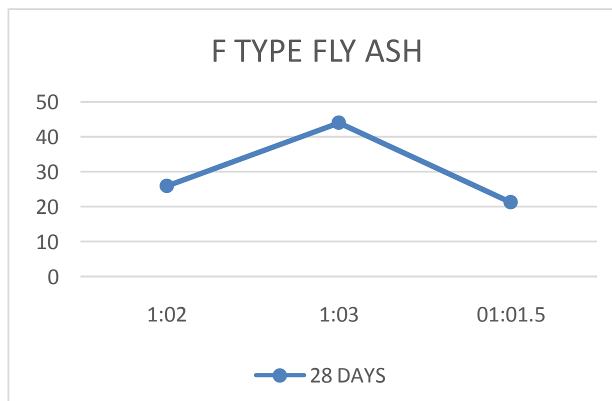

Fig.4–GRAPH SHOWS THE VARIATION OF WATER ABSORPTION WITH RESPECT TO RATIO

VIII. DENSITY

Density in kg\m^3 =$\frac{\text{Mass of block}}{\text{Volume}}$

Table6: F Type Fly Ash

SL.NO	Ratio	Weight of brick kg	Volume m3	Density Kg\m3
1	1:1.5	1.4	2.024x10^{-3}	691.69
2	1:2	1.35	2.024x10^{-3}	666.99
3	1:3	0.9	2.024x10^{-3}	444.66

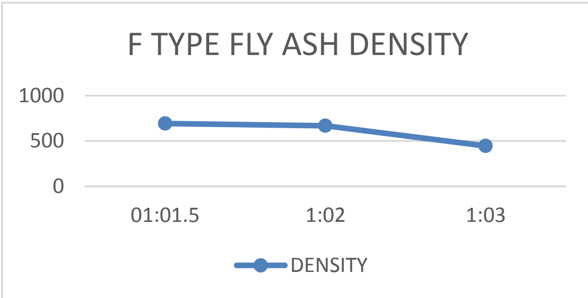

Fig.4–GRAPH SHOWS THE VARIATION OF DENSITY WITH RESPECT TO RATIO

IX. CONCLUSION

Based on the experimental investigations the following conclusions were made.

1. Due to high strength, practically no breakage of foam brick during Transport & use.
2. Due to uniform size of bricks mortar required for joints & plaster reduces almost by 50%.
3. The results shows the CLC bricks are more safe, economical and having higher strength compare to conventional bricks.
4. It can be understood that CLC bricks are better alternative to conventional burnt clay bricks in structural, functional and economic aspects. By use of this aspect we can convert waste into wealth.

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