From Bricks To Blocks: A Masonary Unit From Western Gujarat Region Of India

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ABSTRACT: The conventional masonry unit used is clay bricks for construction of masonry works but with advancement of time these clay bricks were replaced by fly ash bricks of same size and shape. But the masonry unit used for the construction of masonry works in the western Gujarat region of India, Kutch is a lean concrete blocks of size varying as per the purpose of masonry work i.e. for load bearing or partition work. This research paper presents the introduction to such masonry units through its manufacturing process and experimental work by performing compression test, water absorption test, cost feasibility and comparing it with the conventional clay bricks (bricks readily available from market).

Key words: Western Gujarat, Kutch, Lean concrete blocks, clay bricks, fly ash bricks, compressive strength, water absorption, cost feasibility.

INTRODUCTION

The western Gujarat region of India is known as Kutch, which is a largest district of Gujarat state of India with an area of 45,652 km² and according to the 2011 census Kutch District has a population of 2,090,313, roughly equal to the nation of Macedonia or the US state of New Mexico. The masonry unit used for the construction of masonry works in the western Gujarat region of India (Kutch) is a lean concrete blocks of size varying as per the purpose of masonry work i.e. for load bearing or partition work. As the raw material required for the manufacturing of clay bricks is not available within the Kutch region, therefore the production of such bricks is not done in this region and hence the clay bricks are imported from the vicinity of Kutch regions for construction of masonry works which incurs the cost of bricks in addition of transportation and handling charges and as result of which such a masonry units proves to be the costlier and uneconomical for the lower and middle class locality. And hence the local engineers and contractors have developed an alternative masonry unit called lean concrete blocks which are commonly known as 'blocks' in that locality.

Figure 1: Western Gujarat region of India (Kutch)

Source:
http://en.wikipedia.org/wiki/Little_Rann_of_Kutch

EXPERIMENTAL MATERIALS

A. Cement

In the most general sense of the word, cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The cement used in this research is TATA OPC 53 grade cement. The Ordinary Portland Cement of 53 grades conforming to IS: 8112-1989 is being used. Tests were conducted on the cement like Specific gravity, consistency tests, setting tests, soundness, Compressive strength N/mm^2 at 28 days.

Figure 2: TATA cement (OPC)

TABLE – 1
PROPERTIES OF CEMENT

Sr.No	Physical properties Of TATA OPC 53cement	Result	Requirements as per IS:8112-1989
1	Specific gravity	3.14	3.10-3.15
2	Standard Consistency (%)	31.7 %	30-35
3	Initial setting time (hours, min)	81 min	30 minimum
4	Final setting time (hours, min)	231 min	600 maximum
5	Compressive strength N/mm^2 at 28 days	58 N/mm^2	53 N/mm^2 minimum

B. Coarse Aggregate

The fractions from 10 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below 15%.

Figure 3: 10mm Coarse aggregate

C. Fine aggregate

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screened, to eliminate deleterious materials and oversize particles.

Figure 3: Fine aggregate (River sand)

TABLE- 2
PROPERTIES OF FINE AGGREGATE

Property	Fine Aggregate (River sand)
Fineness modulus	3.10
Specific Gravity	2.76
Water absorption (%)	1.20
Bulk Density (gm/cc)	1.78

D. Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water are required to be looked into very carefully.

PROCEDURE

The size of block which are used widely for load bearing masonry construction are of dimension: (150mm×200mm×400mm) and hence the same dimension will be used for experimentation and study work. The mix proportion for manufacturing of such blocks is as shown in table-3. The blocks casted are sun dried and they are cured by spraying method of curing.

TABLE-3
MIX PROPORTION

	W	C	F.A.	C.A.
By volume	0.5	1	6	4

W= Water, C= cement, F.A. = Fine Aggregate, C.A. = Coarse Aggregate

The procedure for casting of block is as follows:

1. The materials (i.e. cement, sand, coarse aggregate and water) are batched by volume and mixed in a tilted concrete mixture.

Figure 4: Volume batching of materials and tilted concrete mixture

2. A lean concrete is produced and used for casting in a casting machine (mould-vibrator assembly) as shown in figure 5

Figure 5: Lean concrete produced and casting machine (mould-vibrator assembly)

3. Concrete pressed in the machinery gets shape of the mould that is block and they are stacked for sun-drying for one day.

Figure 6: Concrete pressed in the machinery and are stacked for sun-drying

4. After 24 hours the blocks are stacked on plant as shown in figure 7below and cured by spraying method of curing.

Figure 7: Blocks stacked at plant

5. Blocks are stacked and cured as shown above for 7 days and then send to sites for use.

TESTING

A. Compression Test

The compression test will be carried out on the specimens at the end of 7 days, 14 days and 28 days of curing. The procedure to be followed is as given below:

1. After cleaning the bearing surface of the compression testing machine, the concrete block will be placed on its face side having dimension 200 mm × 400 mm. The axis of the specimen is to be carefully aligned with the center of the lower pressure plate of compression testing machine. Then an upper pressure plate is to be lowered till the distance between pressure plate and the top surface of the specimen achieved. No packing used between face of the pressure plates and block.

2. The load will be applied without shock and increased gradually until the specimen gets crushed.
3. The compressive strength calculated in N/mm^2 from the maximum load sustained by the block before failure.

   Compressive strength= P/A

   Where, P = failure load (N)

   A=cross sectional area (mm^2)
4. Average of three values was taken for determining compressive strength of lean concrete block.

Figure 8: Compression Testing Machine with arrangement of laying block

B. Water Absorption Test

The 150mm×200mm×400mm block after casting will be cured for 28 days curing. These specimens will then oven dried for 24 hours at the temperature 110°C until the mass became constant and again weighed. This weight was noted as the dry weight (W1) of the block. After that the specimen will be water at normal temperature for 24 hours. Then this weight will noted as the wet weight (W2) of the block.

% water absorption = [(W2 – W1) / W1] x 100

Where, W1 = Oven dry weight of block in grams

W2 = After 24 hours wet weight of block in grams.

RESULTS

TABLE-4
COMPRESSION TEST RESULTS FOR BLOCK AT 7, 14 & 28 DAYS

Types of Sample	Average Compressive Strength of Lean Concrete Block (N/mm^2)		
	7 days	14 days	28 days
Block	5.84	7.56	10.17

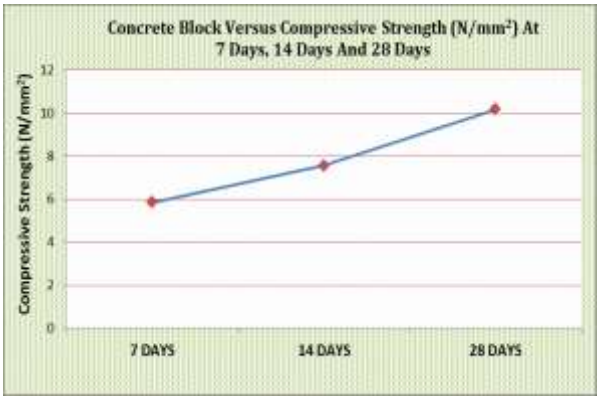

Figure 9: Compression Test Results for Block at 7, 14 & 28 Days

TABLE-5
COMPRESSION TEST RESULTS FOR CLAY BRICK AT 7, 14 & 28 DAYS

Types of Sample	Average Compressive Strength of Clay Brick (N/mm^2)		
	7 days	14 days	28 days
Clay Brick	5.08	5.34	5.96

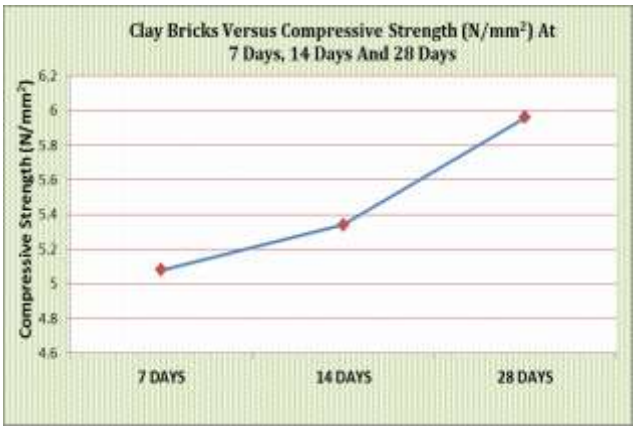

Figure 10: Compression Test Results for Clay brick at 7, 14 & 28 Days

TABLE-6
WATER ABSORPTION TEST RESULTS FOR BLOCK AND CLAY BRICKS AT 28 DAYS

Sr. No.	Sample	Wet Weight of sample in grams	Dry Weight of sample in grams	% Water Absorption
1	Block	27,180	26, 250	3.57
2	Clay Brick	3567	3126	14.23

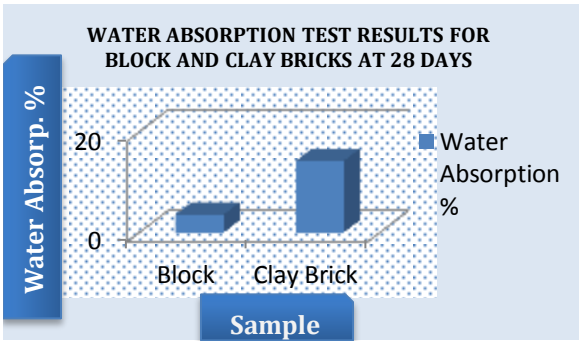

Figure 11: Water Absorption Test Results for Block and Clay Bricks at 28 Days

TABLE-7
RATE ANALYSIS FOR BLOCK

Materials	Qty.(m3)	Rate (Rs)	Cost (Rs)
Cement	0.15	7142.85	1071.43
FA	0.8	450	360.00
CA	0.55	600	330.00
	Total Cost of Materials		1761.43
	Total Cost of Materials per Block		20.97
	Add Labour Charges per Block		5.00
	Add Miscellaneous Charges per Block		0.50
	Total Cost of One Block		26.47

Whereas the clay bricks are available at the cost of about 5 Rs. per brick in that locality on which the above tests were performed (for clay bricks).

CONCLUSION

From this study the following conclusion can be drawn:

- In the terms of compressive strength the blocks have 1.7 times higher strength than that of clay bricks.
- Whereas 3.98 times lesser water absorption is being observed in case of blocks compared with clay bricks.
- From the view point of cost feasibility it can be observed that the cost of one block is 26.47 Rs. whereas the cost of equivalent volume of bricks is 30 Rs. (As volume of one block is almost six times the volume of one brick).
- Hence the savings in mortar along with masonry units can be achieved as well as the construction speed increases.
- As the locally available materials are used for production of blocks, the saving in transportation and handling cost can be achieved along with reducing environmental pollution from transportation and burning of fuel for burning the bricks.

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