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Case Study on Comparison between Laterite Stone and Concrete Block

Mohamed Nasheed N[1], Muhammad Junaid MK[2], Dr. V. Sreevidya[3], R. Preethi[4],
[1]*(ME Structural Engineering, Sree Krishna College of Technology, Coimbatore, Tamil Nadu, India)*
[2]*(ME Structural Engineering, Sree Krishna College of Technology, Coimbatore, Tamil Nadu, India)*
[3] *(Associate Professor, Sree Krishna College of Technology, Coimbatore, Tamil Nadu, India)*
[4]*(Assistant Professor, Sree Krishna College of Technology, Coimbatore, Tamil Nadu, India)*

Abstract: The use of local materials is an important step reduce transportation cost, saves energy, and protect the environment. This paper deals the occurrence and characteristics of laterite and concrete block and then showing strength properties of both laterite and concrete block. Study was conducted to compare the engineering property such as compressive strength and total cost of the common residence construction by laterite stone andconcrete block casted by 10% cement,30% metal with 6mm size and remaining dust(crushed rock or manufactured sand).The concrete brick varies in size and thus the compressive strength. The load bearing capacity of the brick varies from 16T(Tones) to 33T depending upon sizes. By knowing the properties of using this laterite stone and concrete block will benefit for the development of suitable techniques for sustainable construction. Overall, this study identifies by comparing strength parameters of both laterite stone and concrete blockvarious factors that should be considered for efficient usuage to meet the growing demand of new housing .

Keywords: Concrete block, Compressive Strength, Laterite Stone, Strength

1. Introduction

In the region of Maharashtra and Kerala laterite stones are used for various construction ,especially for small residential purposes.It is estimated that 2.83cum(100 cu-ft) is excavated in each load.It creates problem in quarries and needs other materials for construction to replace the demand of such laterite stones.

To meet the requirements of the lack in laterite stones we must introduce new sophisticated item which does not compromise the load bearing capacity,compressive strength and moreover it should be economical to common people when comparing laterite stone. In 1950, when concrete block became common for homes, there were number of disadvantages. The walls were not fully finished on both interior or exterior, making the homes unattractive, were not insulated for northern climates. All of those problems are rectified now. The homes made of concrete blocks withstand earthquake when steel reinforcements and poured concrete are added in the central area of the block walls.For such needs we introduce this concrete bricks which meets all the conditions above mentioned and proved successfullypractically. The concrete block is resistant to wind, concrete block is not easily attacked to fire. The less risk to the homeowner. Savings will vary across the country and other individual factors of the home. Tested and proved successful and economical in African countries fire time in the world it was welcomed in india too especially through outkerala.

2. Laterite Stone

2.1 Quarrying of Laterite Masonry Blocks

Quarrying methods are different from the other masonry materials,becauselaterite stone are soft in nature in the quarry and hard when exposure to the atmosphere. The ease of cutting and shaping of laterite and hardening with age due atmospheric exposure makes its use different and versatile in building applications. Machine quarrying of laterite was invented and used for the first time in Kerala, India using mobile rotary saw machine that was introduced for the first time since 1993. It consists of following steps: (i) Removal of top soil and levelling the surface, (ii) Marking lines on levelled horizontal bed of laterite, (iii) Moving cutters through these lines up to desired depth of stone

Fig. 1 Machine quarrying of laterite masonry blocks (a) Quarrying of laterite using mobile rotary saw machine; (b) Laterite blocks detached from the bed

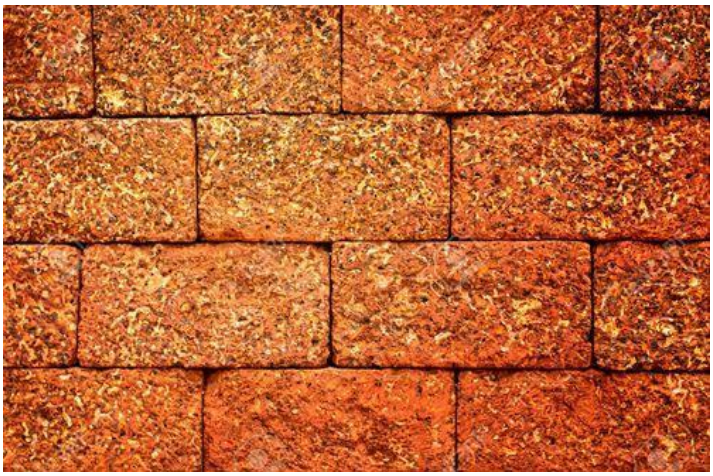


Fig 2 Machine cutting laterite stone

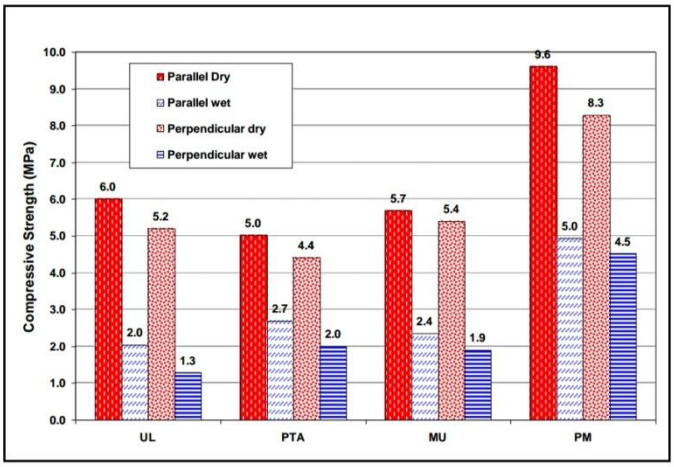
2.2 Engineering Poperties of Laterite Stones

Experimental investigation of laterite from four active quarries of Malabar region of Kerala, SW India were undertaken at IITMs to determine compressive strength, water absorption, and specific gravity. Standard size laterite of 300 x 200 x150 mm were obtained from the quarry. Table 2 shows the typical physical properties of laterite, while Fig.8 shows the variations in compressive strength of laterite under different conditions tested. The results of research studies on Malabar laterite reported from other locations of Malabar region are summarized

Density	Dry	1.80- 2.78
	Saturated	2.36-3.04
Specific gravity		2.84-3.58
Porosity	%	20-40
Water absorption	%	10- 18
Compressive strength (MPa)	Perpendicular to bedding plane	Wet 1.29-4.54
		Dry 4.41-8.29
	Parallel to bedding plane	Wet 2.03-4.92
		Dry 5.02-9.60
Flexural Strength (MPa)	Wet	1.29- 2.96
	Dry	2.85- -3.21
Modulus of Elasticity (Flexure) (MPa)	Wet	2.09-4.66
	Dry	4.41-5.96

Fig 3 Typical Physical properties of Kerala from Malabar region, Kerala

2.3 Variation in Compressive Strength of Laterite Tested Under Different Conditions



3. Concrete Block

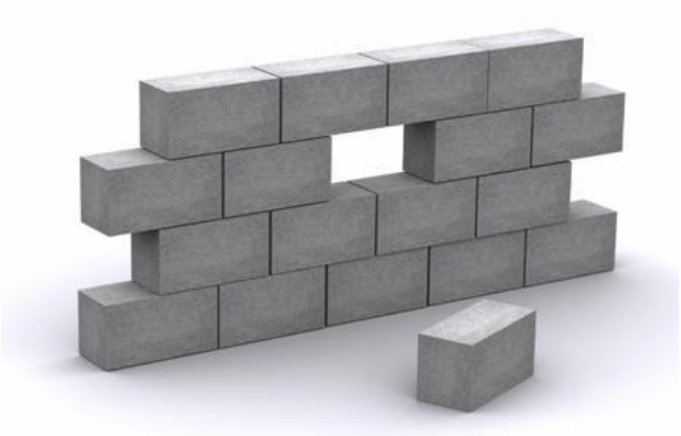


Fig 4.Concrete Interlocking mechanism

A concrete block is primarily used as a building material in the construction of walls. A concrete block is one of several precast concrete products used in construction. The term precast refers to the fact that the blocks are formed and hardened before they are brought to the job site. The concrete blocks have one or more hollow cavities, and the sides of concrete block may be cast smooth. In use, concrete blocks are stacked one at a time and held together with fresh concrete mortar to form the desired length and height of the wall. Concrete masonry units may be formulated with special aggregates to produce specific colors or textures for finish use. Blocks may be scored by grooves the width of a mortar joint to simulate different block modules. Take an example 8-by-16-inch (200 mm × 410 mm) block may be scored in the middle to simulate 8-by-8-inch (200 mm × 200 mm) masonry, with the grooves filled with mortar and struck to match the true joints.Concrete blocks are made from cast concrete (e.g. Portland cement and aggregate, usually sand and fine gravel, for high-density blocks

3.1 Interlocking Concrete Blocks

Interlocking blocks were made in special moulds, in which compaction is done mechanically, depending on the type of concrete block, material used, required quality. The blocks can be made directly at the building site, or on a larger scale in a production yard. Concrete blocks are the common manufactured interlocking load bearing blocks that require high compression strength.

3.2 Interlocking Masonry Features

• High finish blocks are made; result in exposed finish aesthetic walls, saving on plaster/rendering & finishes.
• Blocks can be made with lower water absorption properties making them useful for even relatively wet applications.
• Dry-stacked masonry results in speedier construction.
• Blocks can be made with reinforcement / conduit features facilitating earthquake resistant construction.
• Blocks made are eco friendly as no burning is involved.

3.3 Standard Dimensions of Concrete Block

LENGTH	BREADTH	HEIGHT	BRICKS NEEDED FOR 1000 SQ HOUSE
30CM (12'')	20CM (8'')	13CM (5'')	3750
30CM (12'')	15CM (6'')	15CM (5'')	3200
30CM (12'')	13CM (5'')	18CM (7'')	FOR COMPOUND WALLS

3.4 Ancient Interlocking Structures

Interlocking technology is one of the most ancient tested best technology in the world,when two stone or bricks are locked each other the load bearing strength increases rapidly and even it is more resistent against the siesmic forces.

Ancient interlocking structures are given below,

Fig 5 Ancient Inetrlocking in Bhutan

Fig.6Ancient Inetrlocking in Ghana

Fig 7 Ancient Inetrlocking in South Africa

3.4 The Concept Of Interlocking Blocks Is Based On The Following Principles:

- The concrete blocks were shaped with parts, which fit exactly into recess parts in the blocks placed above, such that they are aligned automatically in horizontally as well as vertically – so bricklaying is possible without much skills.
- The blocks can be laid dry, no mortar is required and a considerable amount of cement can be saved.
- Each block has vertical holes, which serve four purposes:
- To reduce the weight of the block.
- To insert steel rods for reinforcement.

- To pour liquid mortar (grout) into the holes, which run through the full height of the wall, so it increasing block stability and providing barrier to seepages.
- The length of each block is exactly double its width, it is for to achieve accurate placing of blocks placed at right angles, otherwise a junction block is required.

3.5 Dual Compressing Interlocking Concrete Machine.

Fig 7 Dual Compression Machine

Total power	23 hp
Cycle time	25 sec
Production per shift (8hrs	2500-2300 blocks
Labour required	6- 7 n
Brick sizes in inches	L x B x H
	12x 8x 5
	12x6x5
Bricks required for 1000 sq.ft building	3750 bricks
Water curing period	7 days

3.6 Mixing of Concrete

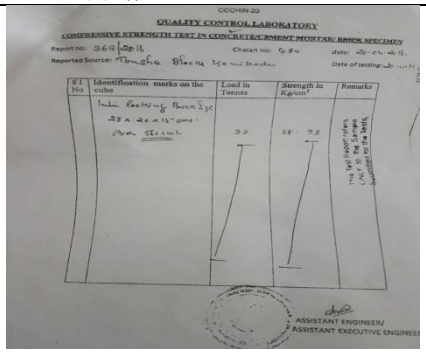
- 10% cement
- 30% coarse aggregate
- Remaining dust(manufactured sand or crushed rock),
- Maintaining 0.3 water cement ratio
- 6mm gravel (chips) mixed with crusher dust and cement and then passed in hydraulic press (15T). the block is ready for use after water curing for 7 days . the block will have compressive strength of (33T).
- The ingredients are poured into the conveyor belt and concrete is prepared by the machine itself in an automated way with programmed propotion.Then the concrete prepared is casted in a mould by machine and its compressed.
- Apart from other concrete blocks this brick is made by dual compression technology,where compression is done from below and above.This dual compression helps the concrete block for avoiding void space and increase the bearing capacity of the concrete.Curing is done for 7 days.

Fig 8 Preparation of cement sand mixture

Production of concrete blocks using Dual compression machine

3.7 Test Results

Compressive Stength Test results for the 28x20x15 cm are given below


COCHIN-20
QUALITY CONTROL LABORATORY
COMPRESSIVE STRENGTH TEST IN CONCRETE/CEMENT MORTAR/ BRICK SPECIMEN
Report no: 368/2016 Chalan no: 0.84 date: 28-04-2016
Reported Source: Tonghie Blocks Kanjikkode Date of testing: 28-04-16

Sl No	Identification marks on the cube	Load in Tonnes	Strength in Kg/cm²	Remarks
	Indi Rastaing Bricks Size 25 x 20 x 13 cms. Area 500 cm²	3.2	64.00	This Test Report refers Only to the Sample Submitted for the Tests

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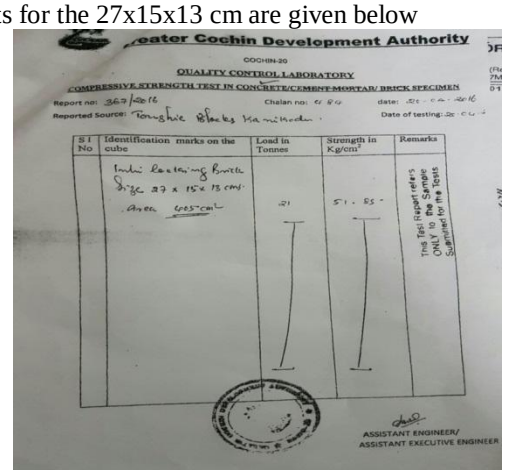
Compressive strength-5.78mpa.

Compressive Stength Test results for the 27x15x13 cm are given below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Sl No	Identification marks on the cube	Load in Tonnes	Strength in Kg/cm²	Remarks
	Indi Rastaing Bricks Size 27 x 15 x 13 cms. Area 405 cm²	2.1	51.85	This Test Report refers Only to the Sample Submitted for the Tests

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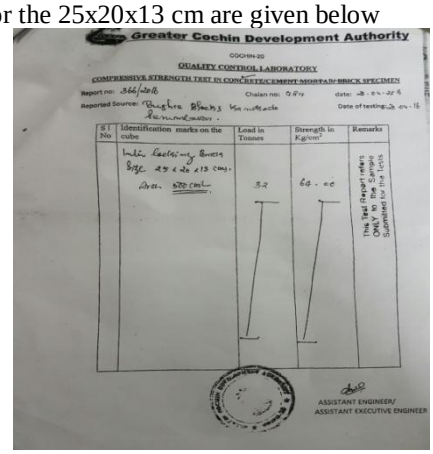
Compressive Stength Test results for the 25x20x13 cm are given below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Sl No	Identification marks on the cube	Load in Tonnes	Strength in Kg/cm²	Remarks
	Indi Rastaing Bricks Size 25 x 20 x 13 cms. Area 500 cm²	3.2	64.00	This Test Report refers Only to the Sample Submitted for the Tests

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3.8advantages of Interlocking Bricks

1. No Mortar Necessary
2. No skilled labours, heat proof, water proof
3. Cold proof, damp proof
4. 40% (averge) cost effective, stylish and strong
5. Cost – savings as cement and sand are not used for constructing the wall.
6. Less labour- intensive and more time- savings as the Interlocking blocks need only be fitted to each other.
7. The interlocking bricks can be salvaged without damage when the house being dismantled in the future

4. Conclusion

Laterite is a weak stone, but can be used for masonry constructions. The property of laterite can be enhanced by suitable water proofing treatments. This block masonry is quite generic and does not require sophisticated machine or equipment, can be done with local materials with optimum moisture & stabilizers on the site itself Long term study is required to find an optimum size for its varied masonry applications. To arrive at more conclusive suggestions for laterite standards, further studies on structural evaluation and statistical analysis are required. Before making any concrete blocks of desired size, testing is required as the mix proportion ingredients, compression by machine, platen affect will produce different types of blocks with different structural properties.Various factors highlighted in this paper can form a basis for a better understanding to and improvements of cncrete blockagainst laterite stone for sustainable construction world-wide.

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