JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

COMPARATIVE STUDY OF GEOTECHNICAL AND THERMAL RESISTANCE PROPERTIES OF CLAY, FLY ASH, AND LATERITE BRICKS

[1]R. S. Mayekar, [2]S. M. Pore, [3]S. P. Bandekar, [4]A. S. Khandare, [5]A. P. Yadav

[2]Professor, Department of Civil Engineering, Dr. Babasaheb Ambedkar Technological University, Lonere, India

[1345]UG Students, Department of Civil Engineering, Dr. Babasaheb Ambedkar Technological University, Lonere, India

Abstract : Bricks are the most widely used construction material on the planet earth. After China, India is the world's second-largest brick manufacturer. India's brick manufacturing is projected to be 140 billion bricks. Clay brick is one of the earliest construction materials, dating back to the dawn of civilization. It's a type of crystalline ceramic that's one of the most widely used building materials on the planet. The findings of research on different characteristics of laterite, clay brick, and fly ash are discussed in this paper. The goal of this research is to examine several attributes of these bricks, such as thermal resistivity, compressive strength, and water absorption rate, as well as to determine their availability. As a result, clay and fly ash bricks were used.

While studying, tests like thermal resistivity test, compressibility test, and water absorption test were carried out to compare the properties of bricks. Instruments like a compressive testing machine, infrared thermometer, and thermostatic oven were used. Studying these properties and comparing them makes it easier to know which material will be suitable for construction as well as efficient. Laterite from a nearby area was used. From each type of brick, 6 bricks were prepared and tested for compressive strength in the compressive testing machine (CTM). The results were presented for easy comparison. Using laterite stone is one way of cutting down construction costs. For all materials, it is required to know well in advance the approximate cost. Studying water absorption rate helps to know durability properties like degree of burning, quality, and weathering behavior. This helps construct houses in heavy rainfall areas and regions with cold climates.

***IndexTerms* – Compressive Strength, Water Absorption, Thermal Resistivity.**

I. INTRODUCTION

Brick is a versatile construction material with a lengthy history of use spanning thousands of years. It is a long-lasting material with high compressive strength, making it ideal for use as a structural element in construction and civil engineering projects such as buildings, tunnels, bridges, walls, floors, archways, chimneys, fireplaces, patios, and sidewalks. Aesthetic charms to the material, in addition to its mechanical capabilities, promote its employment in architectural applications. A brick is a person-made constructing cloth used to make walls and make locations to walk. It’s far a single unit of a kneaded clay-bearing soil, sand, and lime, or concrete cloth, fireplace-hardened or air-dried, utilized in masonry construction.

Bricks are made mainly of clay. They are put into moulds or cut with wires, after which baked in an oven. The colour of brick depends on the clay from which it becomes made. Masons construct brick partitions. They join bricks collectively the usage of mortar. Bricks can be assembled into many specific styles. The maximum common pattern is referred to as "running bond". A row of bricks is known as a direction. A wall that is just one brick thick has one wythe. Bricks used outside at the ground are known as "pavers". Engineering bricks are used for excessive load-bearing walls and damp-proof publications. They’re greater steeply-priced and are made from higher clays and fired at a better temperature. Unburnt bricks, also known as sun-dried bricks, are among the earliest types of brick. They are dried naturally utilizing light from the sun. Because of their poor strength, they are rarely employed in modern building and civil engineering.

II. OBJECTIVES

- To compare geotechnical properties of clay bricks, laterite, fly ash bricks and sandstone such as compressive strength, water absorption, and thermal resistivity.
- To determine the pros and cons of using natural brick-like laterite and artificial bricks like clay bricks and fly ash bricks.
- To determine and compare of water absorption rate of clay bricks, laterite, fly ash bricks and sandstone.
- To assess the knowledge related to laterite, clay bricks, fly ash bricks and sandstone.

- To check the availability of laterite, clay bricks, fly ash bricks and sandstone in Maharashtra.
- To compare and suggest more environment-friendly bricks among selected natural and artificial bricks.
- To check if epoxy resin reduces water absorption rate of bricks.

III. RESEARCH METHODOLOGY

3.1 Compressive Strength of Bricks

The capacity of a brick to resist or survive compression when tested on a Compressive Testing Machine [CTM] is known as its compressive strength. A material's compressive strength is measured by its capacity to withstand failure in the form of cracks and fissures. The compression force is applied to both sides of the brick in this test, and the greatest compression that the brick can withstand without cracking is seen and recorded.

3.1.1 Procedure:

The unevenness on the brick faces is addressed by grinding three bricks from the brick pouch. Submerge the brick samples in water at a temperature of 23 degrees Celsius for 24 hours. Make the mortar by combining the cement and sand in a 1:1 ratio. Fill the frog with mortar paste and leave the bricks to dry in jute bags for 24 hours. Look for voids in the brick surface as well. If any cavities exist, fill them with mortar and flush them down. Remove the bricks from the bags and re-immerse them in water for 7 days to complete the mortar hardening process. Dry the bricks before putting them on the compressive testing equipment. Lay the specimen flat-side down on the CTM's base, with the mortar-filled face up between the two flat plywood sheets. During testing, plywood sheets are utilized to keep the brick in the proper position. Start the CTM and apply a force of 14 N/mm2 (140 kg/cm2) per minute axially on the specimen until the brick begins to shatter. Continue with the remaining bricks in the same manner. Once the brick begins to tear, take a note of the CTM reading for each brick.

3.1.2 Formula to calculate the Compressive strength:

Compressive Strength = Max load at which Specimen starts breaking (N) / Contact area (mm^2)

3.2 Water Absorption Test on Bricks:

Water absorption tests on bricks are used to measure the bricks' durability properties, such as degree of burning, quality, and weathering behavior. A brick with a water absorption rate of less than 7% is more resistant to freezing damage. Water absorption tests may be used to determine the degree of compactness of bricks, as water is absorbed through pores in bricks. Water absorption by bricks increases as the number of pores increases. As a result, vitrified bricks are those with a water absorption rate of less than 3%.

3.2.1 Procedure:

Dry the specimen from 105°C to 115°C in a vented oven until it reaches a constant mass. Bring the specimen to room temperature and weigh it (M1) a specimen that is too hot to handle should not be utilized for this purpose. Immerse the thoroughly dry specimen in clean water for 24 hours at a temperature of 27+2°C. Remove the item from the water and wipe away any signs of moisture with a wet towel before weighing it (M2).

3.2.3 Calculation of Water Absorption of Bricks:

$$W = \frac{M_2 - M_1}{M_2} \times 100$$

3.3 Thermal Resistivity:

Thermal resistance is the material's ability to withstand the flow of heat. Thermal resistance is a component of thermal conductivity and can be expressed as

r = 1/k

where,

r = thermal resistivity

k = thermal conductivity

3.3.1 Procedure:

Roast the samples in an oven at a constant temperature and various voltages (60v, 80v, 100v), with the temperature increase by the sample being recorded every 25 minutes. Heat the samples to two different temperatures and the temperature increase by the sample was observed over 20 minutes. Record the temperature of samples at 10°C, and then they were placed in a thermostatic oven at a constant temperature of 50°C and various voltages, such as 60v, 80v, and 100v. Record the temperature of samples again recorded using an infrared thermometer at a time interval of 25 minutes. Take 3 readings before the final temperature is recorded. Record the temperature of the sample at room temperature. Heat the sample twice and take 20 min gap. After 20 min gap record the rise in temperature. Take 3 readings for each sample and calculate the mean temperature.

3.4 Instruments:
1. Compressive Testing Machine
2. Infrared Thermometer
3. Thermostatic Oven

IV. RESULTS AND DISCUSSION

4.1 Results of calculated values of properties of bricks:

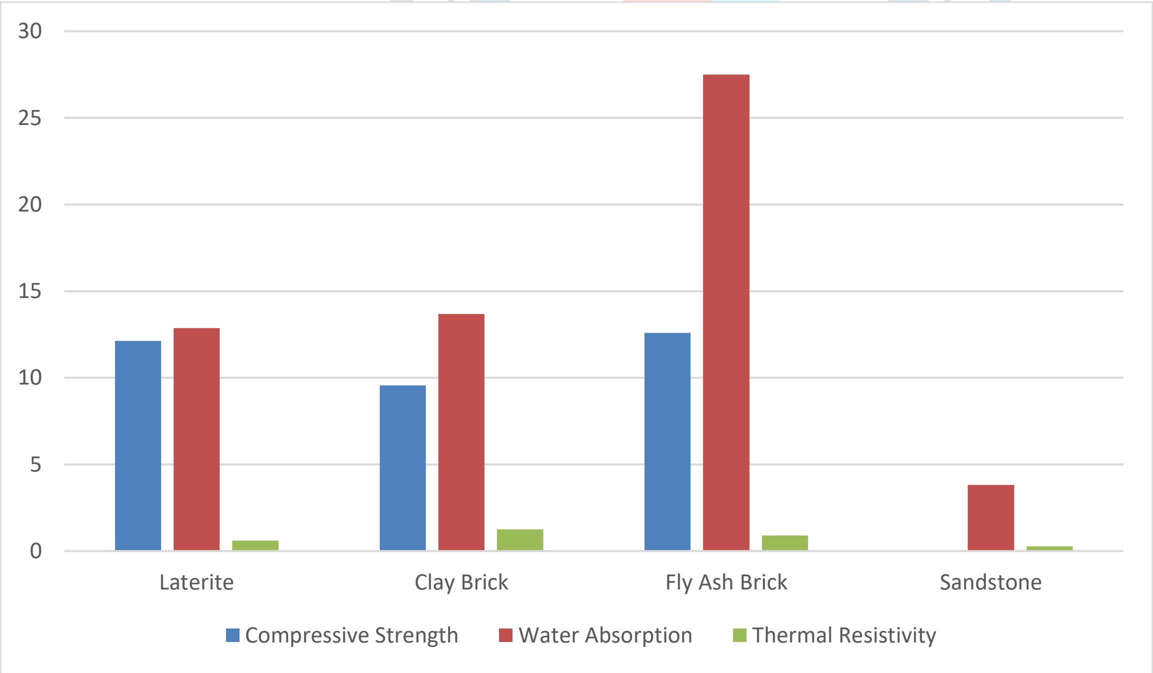
Table 4.1 Properties of Bricks

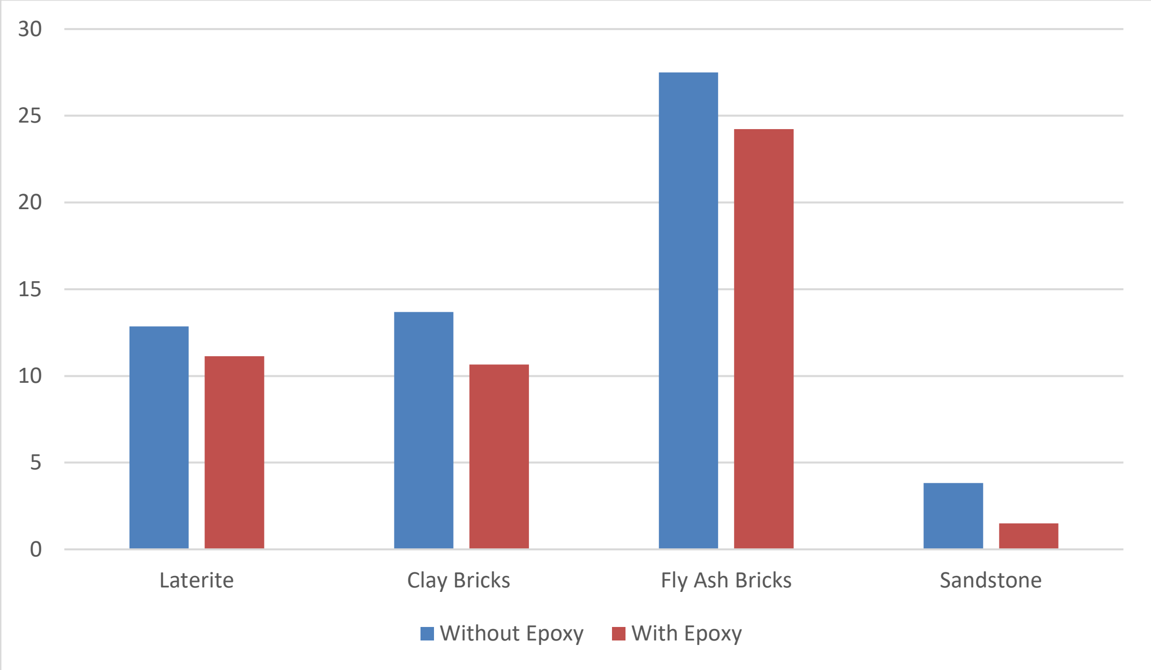
Sr. no.	Brick Sample	Compressive Strength (N/mm^2)	Water Absorption	Thermal Resistivity (mK/W)
1	Laterite	12.13	12.86	0.60
2	Clay Brick	9.56	13.68	1.26
3	Fly Ash Brick	12.6	27.5	0.9
4	Sandstone	-	3.82	0.28

Table 4.2 Water absorption properties with and without epoxy

Sr. No.	Brick Sample	Water Absorption without Epoxy	Water Absorption with Epoxy
1	Laterite	12.86	11.14
2	Clay Brick	13.68	10.65
3	Fly Ash Brick	27.5	24.24
4	Sandstone	3.82	1.49

From observations, the values of compressive strengths, water absorption, and thermal resistivity of the bricks were calculated and graphs were plotted. From the samples of the bricks, fly ash bricks and laterite had more compressive strength. Also, the water absorption of fly ash bricks was most. Epoxy resin applied to the bricks reduced the water absorption of bricks up to some extent. Calculations were made of the heat content of each sample based on the observations made above. Thermal resistance was evaluated by taking dimension, temperature differential, and heat amount into consideration. The earlier estimated values from the study article and IS code were used to alter all the variables. And the values of the outcomes that we calculated were satisfactory.





V. CONCLUSION

This chapter presents the conclusion made based on the experiment and data analysis done. Based on the experimental results and analysis did the objectives of the research stated at the early phase have been achieved. In order to determine if bricks are appropriate for use in construction, it is crucial to understand their compressive strength. Laterite and fly ash bricks had the highest compressive strength so they can be used in the construction of high-rise buildings and structures with heavy loads.
A water absorption test on bricks is conducted to determine the durability property of bricks such as degree of burning, quality and behavior of bricks in weathering. The water absorption rate of fly ash bricks was the most whereas sandstone had the least water absorption. Clay bricks and laterite had nearly the same water absorption. Sandstone is thus found to be resistive to weathering action and can be used for outdoor flooring. Due to the low water absorption rate, fly ash bricks are not suitable for areas with heavy rainfall or for marine construction.
Thermal resistivity of walls play an important role in maintaining the ambient temperature of house. The thermal resistivity of clay bricks were observed to be the most among the four brick samples taken followed by laterite and fly ash bricks. Sandstone had the least thermal resistivity so it can get heated quickly during summer and are not suitable for areas with high temperatures. Hence clay bricks and laterite show more resistance to heat due to presence of cavities and air bubbles and can be used in the construction of walls of houses to keep the interior of rooms cool to control room temperature.
Also tests to calculate water absorption of the bricks when epoxy resin is applied were conducted to check if epoxy resin can be used to reduce water absorption of bricks so they can be used for construction in humid areas. The results and graphs showed that application of epoxy resin reduces the water absorption of bricks. Thus, epoxy resin being cheap it can be applied on bricks for construction in humid region to prevent leakage and moisture problems. It can also be used to prevent algae growth on outdoor flooring during monsoon which makes it slippery. The bricks can be made resistant to weathering with the help of epoxy resin.

REFERENCES

[1] A. J. Vanreyk. "A Comparative Study of Clay Bricks and Laterite Soil", International Journal for Research in Engineering Application and Management. May 2018.
[2] A. H. Abdullah, S. K. A. Bakar and I. A. Rahman. Indoor. "Thermal Performance of an Office Building using Conventional Brick Versus Interlocking Compressed Earth BrickWall", International Journal of Construction Technology and Management. 2013, pp. 22-27.
[3] G. Keshav and K. B. Jamdade. "Study on Fly Ash Mixed Laterite-Cement Bricks", International Journal of Engineering Research and Technology. July-2015.
[4] N. N. Mohamed, M. K. Muhammad, Dr. V. Sreevidya and R. Preethi. "Case Study on Comparison between Laterite Stone and Concrete Block". International Journal of Latest Engineering and Management Research. Volume 03, pp. 81-88.
[5] N. Ali, N.A. Zainal, M. K. Burhanudin, A. A. A. Samad, N. Mohamad, S. Shahidan and S. R. Abdullah. "Physical and Mechanical properties of Compressed Earth Brick (CEB) containing Sugarcane Bagasse Ash". 2016, pp.1-7.
[6] F. A. Olutoge and O. M. Oladunmoye. "An Investigative Study on the Water Absorption Rate of Laterite Bricks Stabilised with Cement and Wood Ash". International Journal of Civil Engineering and Technology. 2017, pp. 13-22.
[7] P. P. Gadling and Dr. M. B. Verma. "Comparative Study on Fly Ash Bricks and Normal Clay Bricks". International Journal for Scientific Research and Development. Vol. 04, 2016, pp. 673-676.
[8] S. K. Jain, P. G. Patil and N. J. Thakur. Engineering Properties of Laterite Stone Scrap Blocks. Agricultural Engineering International: CIGR Journal. Vol. 13, No. 3, September 2011.