International Journal of Structural Design and Engineering

E-ISSN: 2707-8299
P-ISSN: 2707-8280
www.civilengineeringjournals.com/ijsde
IJSDE 2024; 5(1): 10-14
Received: 09-11-2023
Accepted: 17-12-2023

Praveen
B.Tech. Civil Engineering Student, Department of Civil Engineering, Dayalbagh Educational Institute, Agra, Uttar Pradesh, India

Devesh Jaysawal
Assistant Professor, Department of Civil Engineering, Dayalbagh Educational Institute, Agra, Uttar Pradesh, India

Corresponding Author:
Praveen
B.Tech. Civil Engineering Student, Department of Civil Engineering, Dayalbagh Educational Institute, Agra, Uttar Pradesh, India

Comparative study of clay bricks and AAC blocks

Praveen and Devesh Jaysawal

Abstract
In India, traditional clay brick is the most common filler material used in building. The materials used in construction have a significant influence on both the constructed environment and the project's ultimate cost. AAC has recently emerged as a viable alternative to clay and fly ash bricks. In this work, a comparison of clay bricks and AAC blocks is explored. AAC blocks are more economical for multi-stored building because they required less quantity of steel due to less weight. Due to AAC blocks the cost construction reduces by 20% as reduction of dead load of wall. The need of materials like sand and cement is also reduces by 50% by using AAC block. AAC blocks are 3 times lighter than conventional brick. AAC block cover more area in less weight of conventional bricks.

Keywords: Clay bricks, autoclaved aerated concrete (AAC) blocks, cost analysis, strength parameters, environmental impact

Introduction
Bricks are the world's oldest building material and are frequently utilized in construction. Traditional clay bricks are made from clay and fired at high temperatures, consuming a lot of energy and leaving a huge carbon footprint. These are made from the top fertile layer of the soil, resulting in soil sterility and erosion. Nearly 15% of overall air pollution is caused by brick kilns, which has become a serious environmental problem. There is an immediate need to replace this material, and AAC has emerged as the best clay brick substitute. Because of these characteristics, AAC has gained a lot of attention as a construction material for load-bearing masonry structures in seismic zones. AAC blocks are made in an environmentally benign manner, and their use is growing globally as more sustainable construction techniques are adopted. Figure 1 shows a picture of an AAC block. AAC blocks are low in weight, which makes them a better material for usage in strong seismic areas because it decreases the mass of structure. Autoclave aerated cement block, also known as AAC block, is a type of building material that offers numerous advantages over traditional concrete blocks. These blocks are made from a mixture of cement, lime, sand, water, and aluminium powder. The mixture is poured into molds and allowed to aerate, which forms millions of tiny air bubbles throughout the block. These air bubbles significantly reduce the weight of the blocks, making them much lighter and easier to handle compared to traditional concrete blocks.

One of the key benefits of autoclave aerated cement blocks is their excellent insulation properties. The air bubbles trapped within the blocks create a natural barrier against heat transfer, helping to keep buildings cool in the summer and warm in the winter. This can lead to significant energy savings and reduce reliance on heating and cooling systems. Additionally, AAC blocks have excellent sound insulation properties, helping to reduce noise transmission between rooms or from outside sources.

Another advantage of autoclave aerated cement block is their superior fire resistance. Thanks to their high content of inorganic material and the presence of air bubbles, AAC blocks are able to withstand high temperatures without catching fire. This can be crucial in preventing the spread of fires in buildings and ensuring the safety of occupants. Furthermore, AAC blocks are durable and have a long lifespan, making them a cost-effective and sustainable option for construction projects. In conclusion, autoclave aerated cement blocks offer a range of benefits that make them a popular choice for builders looking for lightweight, energy-efficient, and fire-resistant building materials.

Problem Statement: Comparison between conventional brick and AAC Block with respect to cost, time, weight, compressive strength and water absorption etc.

Literature Review

AAC is an ultra-light concrete masonry product made up of readily accessible basic ingredients such as sand, cement, lime, fly ash, gypsum, aluminum powder paste, water, and an expansion agent. Because of the huge increase in volume, AAC is highly resource efficient. With an air concentration of 70% to 80%, the final product is five times the volume of the raw ingredients utilized (depending on required strength and density). As a result, AAC is one of the materials that can help with such issues. Bricks are one of the most frequently used and maybe the oldest construction and building materials on the planet. Bricks have been a wonderful, easily used, and practical product since 3000 BC, when humanity first began to settle. Traditional (clay) bricks are made from clay and fired at a high temperature, consuming a lot of energy and leaving a huge carbon footprint. For masonry wall construction (load-bearing and non-load-bearing), floors, roof insulation, trench fills, and other insulating applications, autoclaved aerated concrete (AAC) is utilized in the form of block and panel [3]. AAC can be used in the construction of residential, commercial, and industrial structures. Because AAC blocks are lightweight, they are ideal for the construction of masonry bearing walls in low to medium storey buildings in seismic zones [4]. AAC panels are directly utilized in the inside walls of concrete and steel constructions, such as schools, hotels, offices, homes, and markets. AAC panels are also used on internal walls such as separation walls, domestic walls, and partition walls in bathrooms and kitchens. AAC panels are also approved for use as a basement wall in a number of nations. Both exterior and internal walls can benefit from AAC blocks. In the last decade, this material has become more popular for non-structural applications such as infill panels and cladding. The greatest replacement to clay brick is the autoclaved aerated concrete (AAC) block or unit. In the AAC manufacturing sectors, kilns used for heat treatment of clay bricks pollute the air and are being replaced by steam-based heat treatment known as Autoclave. As a result, AAC is also recognized as a long-lasting construction material. Because of its low weight, it has the potential to increase a building's seismic performance. Costa *et al*. used experimental testing of the in-plane capacity of walls to building response modelling to evaluate the seismic performance of AAC Masonry [5]. AAC (Autoclaved Aerated Concrete) is a light-weight cementitious (due to the nature of the cement) product made up of fly ash or sand, water, cement, lime, and aluminum powder that is used for brickwork all over the world. AAC is now generally recognized as a cutting-edge, high-performance construction material. AAC has been increasingly popular for the interiors of industrial, commercial, and residential buildings in recent years. It protects against fire and earthquakes, as well as providing superior thermal and acoustic insulation. AAC is produced in an ecologically sustainable manner. The usage of AAC is likely to increase as demand mounts to embrace sustainable engineering methods. In the next part, we will compare the environmental effect, cost, and characteristics of clay bricks with AAC blocks.

Fig 1: AAC Block

Objectives and scope

Aerated concrete (AAC) is a certified green building material and a plentiful natural resource that may be utilized in commercial, industrial, and residential construction. The goal of this research is to learn more about the advantages of AAC blocks over clay bricks, which are the most widely used construction material. Research has been conducted to achieve following objectives:

- To study the role of AAC blocks in green housing and its impact on the environment.
- To better understand the utility of AAC blocks over clay bricks and cost comparison between two materials.
- To study the physical and mechanical properties of both the materials.

Methodology

Sample collection

- We collected three conventional bricks of size 0.19*0.09*0.09 m.
- Three samples of AAC blocks of sizes 0.6*0.19*0.15m were collected. 2.2 Water absorption test • Put the brick in oven at temperature 105 ºC-115 ºC.
- Cool the brick to normal room temperature and take its weight (w1).
- Sink completely dried brick in water at temperature of 27 ºC for 24 hours
- Remove the brick from water and put it in gunny bag then take weight of brick as (w2).
- A brick with water absorption of < 7% p submergence. Overall, the choice of erosion control method should be driven by a comprehensive assessment of the site's unique characteristics and the desired level of protection. These enhancements provide a more detailed overview of the available erosion control options and the factors to consider.

Water absorption test

- Put the brick in oven at temperature 105 ºC-115 ºC.
- Cool the brick to normal room temperature and take its weight (w1).
- Sink completely dried brick in water at temperature of 27 ºC for 24 hours.
- Remove the brick from water and put it in gunny bag then take weight of brick as (w2).
- A brick with water absorption of < 7% provide better resistance to damage by freezing.

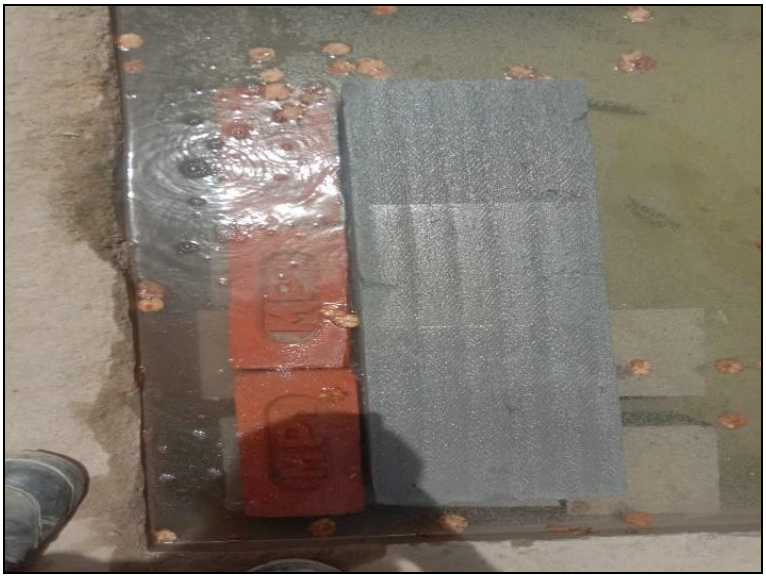

Fig 2: Water Absorption test

Compressive strength test

- Place the brick in compression testing machine (CTM) in such way that the load shall be applied to the opposite side of the brick.
- Align the brick centrally on the base plate of the machine.
- Rotate the movable portion gently by hand so that it touches top surface of the brick.
- Apply the load gradually which should be without shock and continuously at the rate of 140kg/cm2.
- Record the maximum load and note any unusual features in the type of the failure.

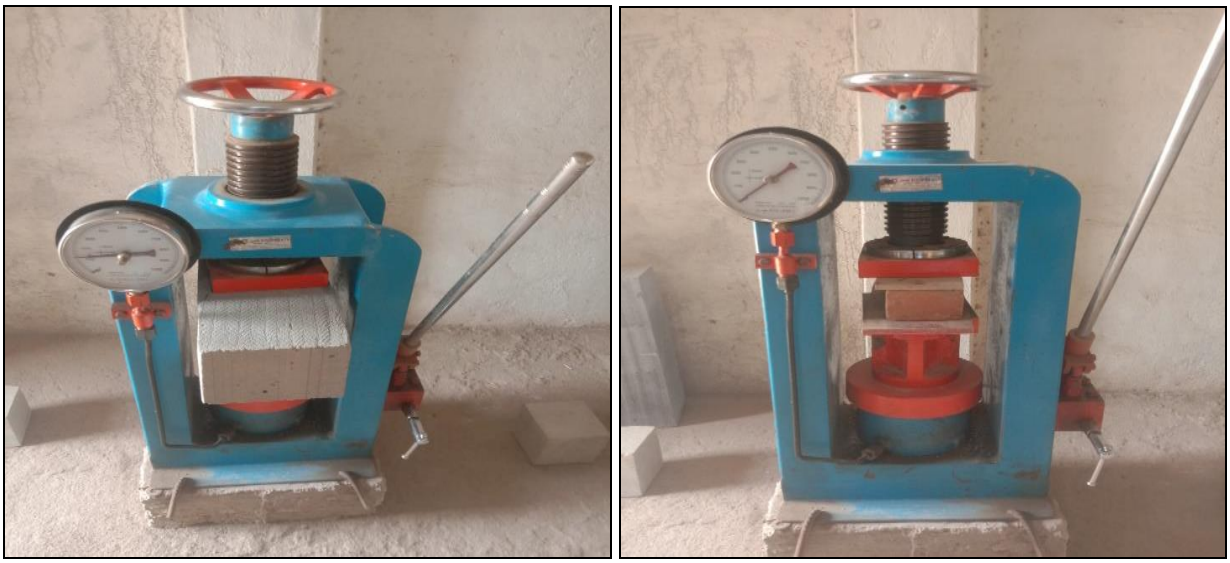

Fig 3: Compressive test on Red Brick and AAC Block

Weight comparison

- The dimensions of AAC block is 0.6m*0.19m*0.15m.
- The average weight of AAC block is 13 kg.
- To construct similar sized constructon, 10 conventional bricks were required.
- We used mortar of grade 1:6
- The total weight of conventional brick construction similar to size of AAC block is 35.260 kg.
- It means the conventional brick construction similar to AAC block size is 2.712 times heavier than AAC block.

Fig 4: Weight Comparison

Dry density

- Dry the brick in an oven at temperature of 105-115 degree Celsius till it attain substantially constant mass.
- Then cool the brick in room temperature and record the weight as W.
- After measure the dimension of brick and calculate the volume.
- Now calculate the dry density by the formula weight/volume.

Conclusion

A comparison of clay bricks and AAC blocks is presented in this study. Because to the inherent characteristics of AAC blocks, building procedures are quick and efficient. AAC has evolved into a versatile building material that may be found in a variety of residential, commercial, and industrial structures.

Following points can be concluded based on this study: The use of AAC block reduces the overall cost of project.

- Speed up the construction process as installation of AAC blocks is easier vis-a-vis clay bricks.
- It helps in reducing dead load of structure and hence can be used as replacement of conventional.
- Clay bricks as an infill material in high seismic zones. AAC is efficient and eco-friendly. Since AAC blocks use readily available raw materials in the manufacturing process, have excellent durability, are energy efficient, and cost-effective, therefore AAC can be referred as a sustainable building material.

References

1. Saha U, Hossain MA, Gulshan F. Making non-fired brick using locally produced induction furnace steel slag. In: Proceedings of the 5th International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2 2019). Institute of Electrical and Electronics Engineers Inc.; c2019.
2. Churilov S, Dumova-Jovanoska E. In-plane shear behaviour of unreinforced and jacketed brick masonry walls. Soil Dynamics and Earthquake Engineering. 2013;50:85-105.
3. Munir MJ, Kazmi SMS, Gencel O, Ahmad MR, Chen B. Synergistic effect of rice husk, glass and marble sludges on the engineering characteristics of eco-friendly bricks. Journal of Building Engineering, 2021, 42.
4. Sola OC, Sayin B, Ozyazgan C, Bostanci L. Effect of silica fume and solid borax waste on compressive strength of fired briquettes. Revista la Construcción. 2017;16:355-360.
5. Türkmen ÖS, De Vries BT, Wijte SNM, Vermeltfoort AT. Quasi-static cyclic in-plane testing of masonry walls strengthened with a single-sided fabric-reinforced cementitious matrix overlay and flexible anchorage. Journal of Building Pathology and Rehabilitation; c2019.
6. Rasheed LS, Mahmmod LMR, Alameer SAA, Abdulrasool AT. Behavior of concrete beams internally cured with clay brick waste. Pollack Periodica. 2021;16:32-37.
7. Lozano-Miralles JA, Hermoso-Orzáez MJ, Martínez-García C, Rojas-Sola JI. Comparative study on the environmental impact of traditional clay bricks mixed with organic waste using life cycle analysis. Sustainability; c2018.
8. Özkaynak H, Sürmeli M, Yüksel E. A capacity curve model for confined clay brick infills. Bulletin of Earthquake Engineering. 2016;14:889-918.
9. Alavez-Ramirez R, Chiñas-Castillo F, Morales-Dominguez VJ, Ortiz-Guzman M. Thermal conductivity of coconut fibre filled ferrocement sandwich panels. Construction and Building Materials. 2012;37:425-431.
10. Berggren B, Wall M. Review of constructions and materials used in Swedish residential buildings during the post-war peak of production. Buildings. 2019;9:21-23.
11. Simón D, Quaranta N, Medici S, Costas A, Cristóbal A. Immobilization of Zn(II) ions from contaminated biomass using ceramic matrices. Journal of Hazardous Materials. 2019;373:687-697.
12. Aeslina AK, Mohajerani A. Leachability of heavy metals from fired clay bricks incorporated with cigarette butts. Proceedings of the IEEE Symposium on Business, Engineering and Industrial Applications (ISBEIA 2012). IEEE; c2012.
13. Marotta A, Sorrentino L, Liberatore D, Ingham JM. Statistical seismic vulnerability of New Zealand unreinforced masonry churches. In: Structural Analysis of Historical Constructions: Anamnesis, diagnosis, therapy, controls - Proceedings of the 10th International Conference on Structural Analysis of Historical Constructions, SAHC 2016. CRC Press / Balkema; c2016. p. 1536-1543.