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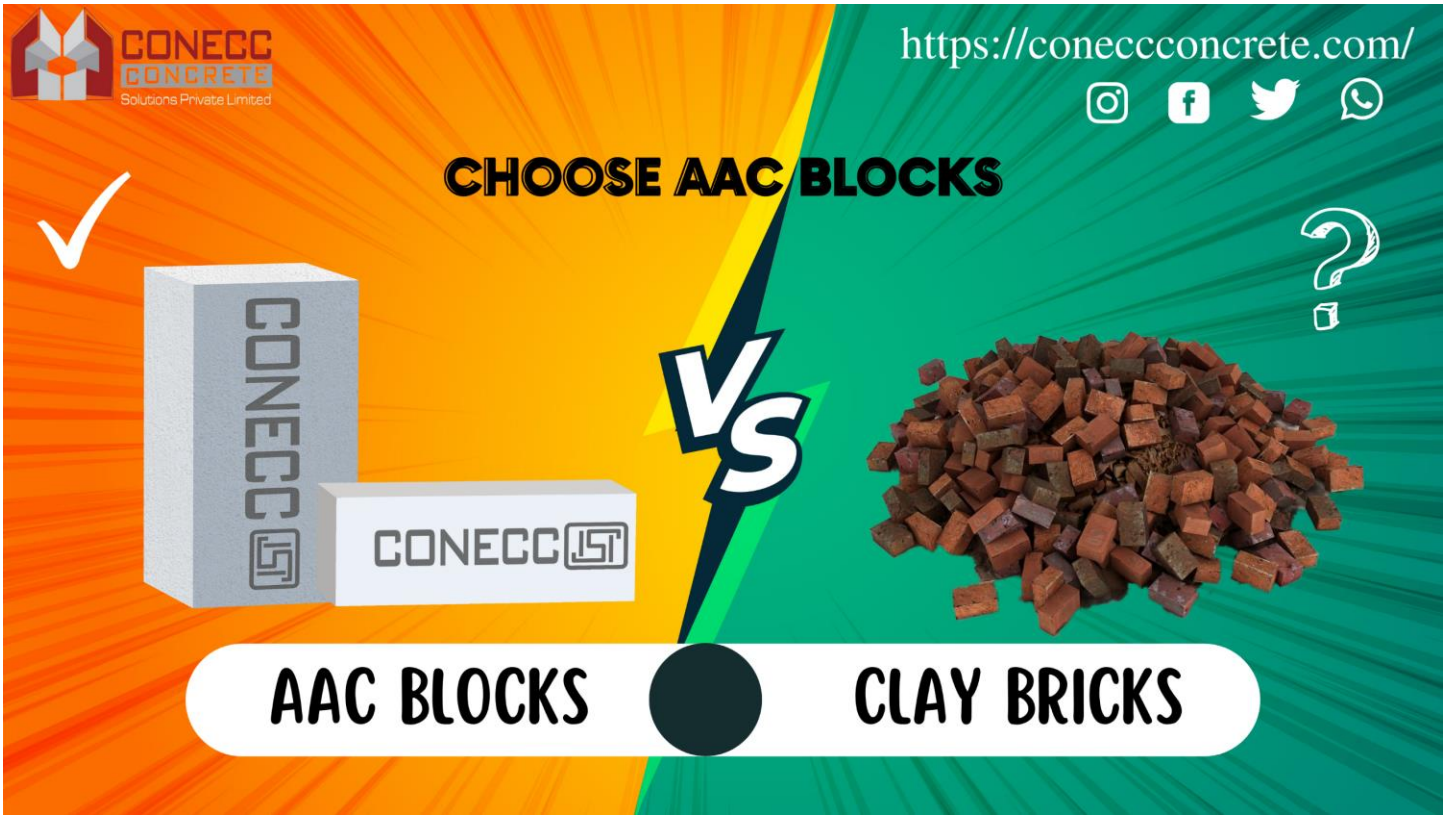

A Comparison of Autoclaved Aerated Concrete (AAC) Blocks with Conventional Cay Bricks

Traditional clay bricks are the most prevalent filler material used in construction in India. The materials used in building have a considerable impact on the built environment as well as the final cost of the project. The use of autoclaved aerated concrete (AAC) as a feasible alternative to clay and fly ash bricks has lately gained popularity. A comparison of clay bricks and AAC blocks is investigated in this paper. Even though AAC blocks have been used in construction since 1924, they today account for just 16-18% of total construction in India. Because of its low bulk density, superior thermal and acoustic characteristics, lightweight, and simplicity of installation, AAC blocks are an apparent replacement for traditional clay bricks. The goal of this research is to show that AAC blocks have the potential to replace clay bricks as an infill material and to encourage their use in construction to generate more energy-efficient and sustainable constructions. The potential of AAC blocks as an infill material in hilly terrain is examined.

01. Introduction

Bricks are the world's oldest building material and are used in many construction projects. Clay bricks are traditionally manufactured from clay and burnt at high temperatures, costing a great deal of energy and leaving a large carbon footprint. These are created from the soil's top fertile layer, which causes sterility and erosion. Brick kilns are responsible for over 15% of all air pollution, making them a severe environmental issue. This material must be replaced immediately, and AAC has shown to be the finest clay brick alternative. AAC has received a lot of interest as a building material for load-bearing masonry structures in seismic zones because of these qualities. AAC blocks are created in an ecologically friendly way, and their use is increasing throughout the world as more environmentally friendly construction approaches are used. An AAC block is depicted in Figure 1. Because AAC blocks are light, they are superior materials for use in high-seismic locations because they reduce the structure's bulk.

02. Review of past literature

Sand, cement, lime, fly ash, gypsum, aluminium powder paste, water, and an expansion agent make up AAC, an ultra-light concrete masonry product. AAC is particularly resourced and efficient due to the massive increase in volume. The finished product is five times the amount of the basic components used, with an air concentration of 70% to 80%. (Depending on required strength and density). As a result, AAC is one of the materials that can aid in the resolution of such problems. Bricks are one of the most widely used and possibly the world's oldest construction and building materials. Since 3000 BC, when humans first began to settle, bricks have been a lovely, easy-to-use, and utilitarian product. Traditional (clay) bricks are composed of clay and burnt at a high temperature, requiring a significant amount of energy and leaving a significant carbon footprint. Autoclaved aerated concrete (AAC) is used in the form of blocks and panels for masonry wall construction (load-bearing and non-load-bearing), floors, roof insulation, trench fills, and other insulating applications.

Residential, commercial, and industrial constructions may all be built with AAC. AAC blocks are appropriate for masonry-bearing walls in low to medium-story buildings in seismic zones since they are lightweight. Inside concrete and steel structures, such as schools, hotels, offices, houses, and marketplaces, AAC panels are used directly on the inside walls. Internal walls, such as separation walls, domestic walls, and partition walls in bathrooms and kitchens, are also made of AAC panels. In a few countries, AAC panels are also permitted for use as a basement wall. AAC blocks can be used on both the outside and inside of a building. This material has grown in popularity in recent years for non-structural applications such as infill panels and cladding.

The autoclaved aerated concrete (AAC) block or unit is the best alternative for clay brick. Kilns used for heat treatment of clay bricks pollute the air and are being replaced with steam-based heat treatment called Autoclave in the AAC manufacturing industries. As a result, AAC has earned a reputation as a long-lasting building material. It can improve a building's seismic performance due to its lightweight. Costa et al. evaluated the seismic performance of AAC Masonry by combining experimental testing of in-plane wall capacity with building response modelling.

AAC (Autoclaved Aerated Concrete) is a cementitious (due to the nature of the cement) product consisting of fly ash or sand, water, cement, lime, and aluminium powder that is used for brickwork all over the world. AAC is now widely acknowledged as a leading-edge, high-performance building material. In recent years, AAC has

become increasingly popular for the interiors of industrial, commercial, and residential structures. It provides great thermal and acoustic insulation while also protecting against fire and earthquakes. AAC is made in an environmentally friendly manner. As the demand for sustainable engineering solutions grows, the use of AAC is projected to grow. We'll evaluate the environmental impact, cost, and qualities of clay bricks with AAC blocks in the next section

03. Research significance and objectives

Aerated concrete (AAC) is a natural resource that may be used in commercial, industrial, and residential construction. It is a recognized green building material. The purpose of this study is to learn more about the benefits of AAC blocks over clay bricks, which are the most often used building material. The following aims were pursued through research:

- To investigate the function of AAC blocks in green housing and their environmental effect.
- To have a better understanding of the advantages of AAC blocks over clay bricks and to compare the costs of the two materials.
- Investigate the materials' physical and mechanical qualities.

3.1 Environmental impact

Bricks are one of the most often utilized building materials in India. As urbanization and demand for construction materials have expanded in recent years, brick has evolved to meet demand. Ordinary brick kilning contributes to global warming and climate change, as well as a plethora of environmental and health hazards on a global scale. It has directly or indirectly caused a host of global environmental and health crises. Various greenhouse gases such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), carbon monoxide (CO), total nonmethane hydrocarbons, nitrogen oxides (NOx), and total suspended particulates (TSP) are emitted during kilning, as well as charcoal production efficiency and carbon and energy content of charcoal and fuelwood.

AAC will have a lesser environmental impact than ordinary bricks and will assist to minimise global warming. AAC is a green building material with a composition similar to that of a foam block. AAC blocks are created from fly ash, a waste product from power plants, and are an ecologically friendly, green, and long-lasting construction material. AAC bricks create waste that may be recycled. The usage of raw materials like clay and sand in the production of red bricks depletes resources and harms the environment. The topsoil is removed during the production of red bricks, wasting the virgin clay raw material. In AAC blocks, no topsoil is used.

Fly ash, on the other hand, is a waste product from power plants that are used to make AAC bricks. Because of the autoclaving recycling process, AAC blocks consume less energy and emit less CO2. Using AAC blocks reduces the cost of transportation significantly. It is substantially lighter than normal bricks, making transportation easier and less expensive. The usage of AAC blocks reduces the overall dead weight of a structure, allowing for the construction of taller buildings. It helps to reduce the bulk of a structure because it is so light.

The structure of AAC blocks provides excellent thermal insulation for walls and building interiors, decreasing heat loss. The material contains microscopic air pockets, and hydrogen is used to foam the concrete, giving it outstanding heat insulation capabilities that allow for moderate winter and cool summer temperatures. As a consequence, you may be able to save up to 25% on your air conditioning costs. Because they need less energy to manufacture, AAC blocks are energy efficient throughout their lifespan. Buildings are frequently designed to withstand vertical forces such as gravity and self-weight. Horizontal forces are also present, such as those caused by earthquakes. The AAC blocks generate a high level of strength during the manufacturing process, assuring the

lifespan of the finished construction. As a consequence, structures made of AAC blocks can endure higher seismic loads than structures made of ordinary bricks, offering superior property protection and lowering property damage to a scale that has a substantial impact on sustainability.

3.2 Cost Comparison

A space of 3m x 3m x 3m has been considered for the cost analysis. IS codes were used to determine the size of both the clay bricks and the AAC blocks. Reduced apertures were not included in the calculations to keep things simple.

3.3 Physical and mechanical properties

Various investigations on the physical and mechanical qualities of AAC blocks and clay bricks have been undertaken in the past. A graphical comparison of the distinct characteristics of both materials is shown.

- **Water absorption**

  A traditional soaking-in-water test may be performed to determine the porosity of bricks and blocks, which can then be utilized as a predictor of concerns such as salt attack efflorescence caused by salt and other materials penetrating the units.

  (Wet weight-oven dried weight/Oven dry weight) x 100 = percentage water absorption

  - Water Absorption Test of Bricks following IS 3495 - 1992
  - AAC water absorption according to IS 2185 - 1979.

- **Compressive strength**

  Autoclaved aerated concrete (AAC) blocks have outstanding compressive strength. The compressive strength varies between 35 and 50 kg per square meter (according to IS: 2185). According to previous research, AAC blockwork may be utilized to securely raise loadbearing buildings to three stories high.

  Compressive Strength= Ultimate Compressive load/Contact area

- **Dry density**

  As illustrated in Figure 8, the density of a porous material is estimated by dividing its mass by its apparent volume, which includes pores, fractures, and any internal empty spaces. With a lower bulk density, there are more empty spaces or pores, which results in better thermal insulation. In addition, the lower the apparent density, the lower the loads on the structural system, resulting in smaller structural parts that require less reinforcing steel.

- Burnt clay bricks have a density of 1800-1950 kg/m3.
- The density of AAC blocks ranges from 450 to 950 kg/m3.

- **Weight**

  The average weight of an AAC block is 13 kg, while burned clay bricks weigh 2.8 kg. Ten standard bricks are needed to build a similar-sized structure to the example. The total weight of traditional bricks built to the same size as an AAC block is 35.260 kg. It indicates that a traditional brick building, which is identical to the AAC block, is 2.712 times heavier. As a result, in terms of size, AAC Block is lighter than traditional brick.

4. Summary and Conclusions

This study presents a comparison of clay bricks with AAC blocks. Building operations are swift and efficient due to the inherent properties of AAC blocks. AAC has grown into a flexible construction material used in a wide range of residential, commercial, and industrial constructions. Clay bricks and AAC blocks material features and pricing comparative findings

Properties	Traditional Brick	AAC Block
Water Absorption	15.07%	17.43%
Compressive Strength	3.5N/mm2	3-5 N/mm2
Dry Density	1893.36 kg/m3	510.40 kg/m3
Weight Comparison	35 kg	13 kg
Cost for 7.2 cumec masonry	48571.20 Rs.	44186.40 Rs