
Use of Autoclaved Aerated Concrete Blocks as Energy Efficient Building Construction Materials

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Abstract.

In the history of building construction, brick is one of the oldest of all materials used. Bricks are very widely used building material due to very low manufacturing cost and simple manufacturing procedure. Generally, bricks are used in partition wall and main wall of building. Brick masonry takes time in construction of wall and other components of building. So, a new masonry technique for building construction is required [1,5]. Autoclaved Aerated Concrete (ACC) block is a light weight concrete block and its weight is 1/5 of than that of concrete block to reduce dead load of wall and other components. AAC block have more air bags due to which weight of AAC block is very less as compared to ordinary concrete block [12]. The manufacturing of ACC blocks requires cement, sand, fly ash, gypsum, lime, aluminium powder and expansion agent. AAC blocks are very excellent material for construction site due to its energy efficient and it is ecologically friendly concrete. This paper presents the properties of ACC blocks and its advantages compared to other construction materials.

Keywords. Autoclaved Aerated Concrete, Energy Efficient, Aluminium, Fly ash, Cellular concrete, Lightweight concrete.

1. INTRODUCTION

Autoclaved aerated concrete (AAC) is a technology in masonry construction where special type of concrete is used for manufacturing of blocks. These blocks have special characteristics, so these blocks have good demand in construction industry. These blocks are porous and light in weight to decrease dead load of structure. AAC blocks have thermal resistance and sound resistance. Due to its low density, unique thermal and breathing properties, and high fire resistance, AAC is one of the most commonly used light-weight construction materials for contemporary buildings [2]. ACC structures also have earthquake resistant in nature. If AAC blocks are used in building construction then cost is comparatively less as compared to other traditional buildings and also time of construction of building is less compared to traditional building. ACC completely replaces the other construction materials like brick, stone, wood because of good fire resistance, sound resistance, less in cost, less time consumption in construction of structures as compared to other building material. In addition, AAC blocks are very excellent material for construction site due to its energy efficient and environmentally friendly concrete [5,6].



Figure 1.1 Autoclaved aerated concrete block [14]

2. RAW MATERIALS OF ACC BLOCKS

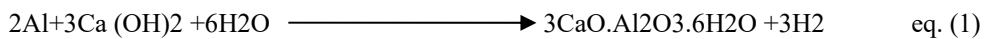
Cement: Cement is a binding material which is used in construction of buildings and other structures. In Autoclaved Aerated Concrete we use OPC 53 grade of cement and the density of cement is 1440 kg/m^3 .

Fly Ash: Fly ash is a by-product of the construction industry that is used to save money. Fly ash density varies between 400 and 1800 kg/m^3 [6,7]. It provides sound absorption, heat insulation, and fire resistance. Class C fly ash was employed, which includes 20% lime (CaO) and has a loss of ignition of less than 6%.

Sand: Sand is a crushed material of rock which is used in concrete as fine aggregate. We use fine sand as per codal provision IS383:1970.

Lime Stone: Limestone is made up of calcite or aragonite. Limestone is obtained by crushing it to a fine powder at an AAC factory or by acquiring it in powder form straight from a merchant.

Aluminium Powder: Aluminium powder is mixed in concrete and this powder works as an expansion agent. When the raw material reacts with aluminium powder, air bubbles are formed as a result of the reaction of calcium hydroxide, aluminium, and water, and hydrogen gas is generated. [9].



Gypsum: Gypsum is a common building material that comes in powder form.

3. PHYSICAL PROPERTIES OF AUTOCLAVED AERATED CONCRETE

The density of autoclaved aerated concrete affects several of its physical qualities. The density of autoclaved aerated concrete classified in European Norms are shown in the table below:

Table 1. Density Classes of Autoclaved Aerated Concrete

Sl. No.	Density class	Dry density (kg/m ³)
1	300	250 - 350
2	400	350 - 400
3	500	450 - 500
4	600	550 - 600
5	700	650 - 700
6	800	750 - 800
7	900	850 - 900
8	1000	950 - 1000

AAC have wide range of density and no other industrial product that covers such a range in apparent density. In AAC we use 350 kg/m³ or more Density use for load bearing purpose and less than 350 kg/m³ density use for thermal insulation purposes [12]. Density is related to water/cement material ratio of the mixture since it is related to the amount of aeration obtained. For a given density, water/cement ratio increases with proportion of sand.

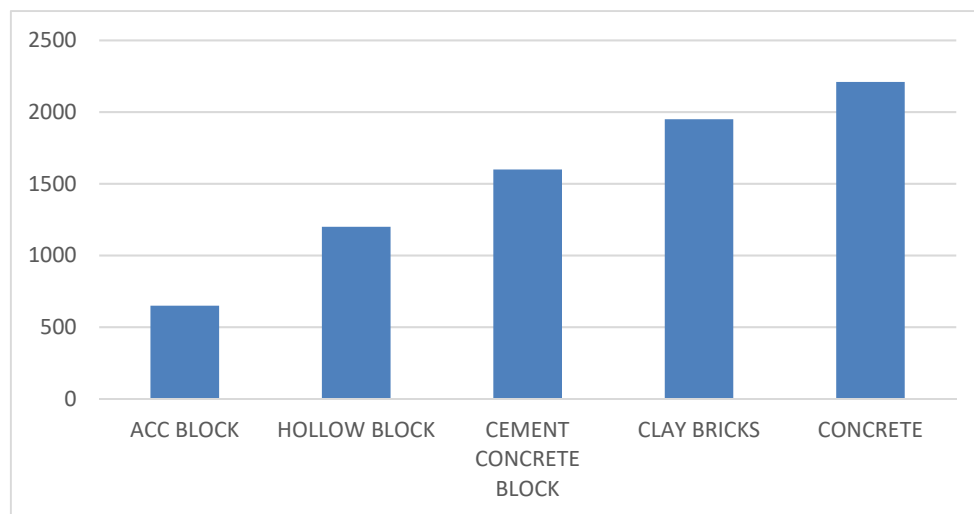


Figure 3.1. Density comparison Autoclaved aerated concrete block

3.1. Size of Autoclaved Aerated Concrete

Generally used autoclaved aerated concrete size is 600mm X 200mm X (75mm to 300mm). Autoclaved aerated concrete block height is varying according to requirement of construction. Size of autoclaved aerated concrete is more than clay brick (230mm X 115mm X 75mm) so they are placed easily at location and cover more area as compared to clay

brick. when we construct two walls of same size by autoclaved aerated concrete blocks and clay brick than we find that time consumption in both walls is different and difference is surprisingly affecting our work tradition because autoclaved aerated concrete blocks wall takes just half time of clay brick wall [10]. Working with autoclaved aerated concrete blocks is very simple and easy to understand.

3.2. *Compressive Strength of Autoclaved Aerated Concrete*

Compressive strength of autoclaved aerated concrete is more than general clay brick. Generally, we use clay bricks in building construction and these bricks compressive strength (2.3 N/m² to 3.5 N/m²) is less than AAC blocks compressive strength (3 N/m² to 4.5 N/m²).

3.3. *Normal Dry Density of Autoclaved Aerated Concrete*

Normal dry density of autoclaved aerated concrete is much less than general clay brick. Dry density of any material is directly affecting the water absorption capacity of material [10]. Autoclaved aerated concrete blocks required less curing as compare to clay brick.

Table 2. Dry Density of Autoclaved Aerated Concrete

Property	Autoclaved Aerated Concrete	Clay Brick
Dry density(kg/m ³)	550-650	1800

3.4. *Other physical properties of Autoclaved Aerated Concrete*

Many physical properties of Autoclaved Aerated Concrete are use in engineering works. Different engineering properties are use in different works. Some Physical properties of Autoclaved Aerated Concrete are given bellow:

Table 3. Physical Properties Autoclaved Aerated Concrete

Sl. No.	Property	Autoclaved Aerated Concrete	Clay Bricks
1	Sound Reduction Index (Db)	45 for 200 mm thick wall	50 for 230 mm thick wall
2	Fire Resistance (hr)	2-6 (depending on thickness)	2

3	Thermal Conductivity,K (W/m-K)	0.16-0.18	0.81
4	Drying Shrinkage (%)	0.04	-

4. ECONOMIC CONSIDERATION

When we make a simple building than first factor which affect directly to owner is economic condition. Now days a building construction is a very difficult for medium economic condition family because cost of a simple building is very high and medium economic family cannot bear cost of a building. If we use AAC block than cost of building decrease and strength also increase [11,13]. Some Parameter is given below which show that how cost of building affected by AAC block.

Structural Cost: Every concrete structure requires steel for bearing tensile load of structure. If we use Autoclaved Aerated Concrete in structure than we save up to 15% of steel.

Cement Mortar for plaster & masonry: Quantity of cement mortar is less required in Autoclaved Aerated Concrete Blocks because they have regular shape and less no. of joints as compare to clay brick.

Breakage: AAC blocks have good strength and light in weight so they do not break easily. AAC Blocks generally break less than 5% and clay brick break average 10 to 12%.

Construction Speed: Speed in construction of Autoclaved Aerated Concrete block is very fast as compare to clay brick [3,7]. Autoclaved Aerated Concrete block have large size so speed of construction is obviously increase.

Quality: Autoclaved Aerated Concrete quality is very good because they are manufacture in industries and clay brick have average quality.

Carpet Area: Carpet area of Autoclaved Aerated Concrete is more because less thickness of walling material as compared to clay brick.

Availability: Autoclaved Aerated Concrete blocks available every time and clay bricks generally not available in monsoon.

Energy Saving: Autoclaved Aerated Concrete reduce air-conditioned load approx. 30%.

Chemical composition: Sand, fly ash used around 60-70% which reacts with lime & cement to form Autoclaved Aerated Concrete and in clay brick soil is used which contains many inorganic impurities like sulphates etc. resulting in efflorescence.

5. CONCLUSIONS

- AAC blocks have a higher compressive strength than ordinary clay bricks.
- AAC blocks have a density that is 1/3 that of ordinary clay bricks, and there is no change in wet conditions.
- Structures with autoclaved aerated concrete have less dead weight.
- Cost of construction reduces up to 30%.
- The energy used throughout the manufacturing process produces no pollutants, by-products, or harmful waste products.
- The workability of AAC helps to eliminate waste on the job site.

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Biographies



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