Experimental Investigation on Autoclave Aerated Concrete

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Abstract— AAC blocks are light weight Aerated Autoclave Concrete Block. It is manufactured through a reaction of Aluminium Powder and a Proportionate blend of Lime, Cement, and Fly Ash or Sand. The Product thus formed is not only Light Weight Concrete but also has Higher Compressive Strength AAC is one of the materials which can cope up with the Shortage of Building Raw Materials and can produce a Light Weight, Energy Efficient and Environmentally Friendly Concrete.

Keywords: AAC, Aluminium, Fly Ash, Cellular Concrete, Lightweight Concrete

I. INTRODUCTION

Within wall sections, the use of breathing, porous and lightweight materials improves thermal performance and thereby contributes to energy efficient building design. These lightweight materials also provide sound and fire insulation apart from being environmentally friendly and need less embodied energy in their production. Autoclaved Aerated Concrete (AAC) is one of the mostcommonlyused light-weight construction materials for contemporary buildings, especially due to its low density, unique thermal and breathing properties and high fire resistance (Tasdemir & Ertokat, 2002; Andolsun, Tavukçuoglu and Caner- Saltık,2005;Narayanan & Ramamurthy, 2000a). Moreover, such advantageous properties make it preferable for earthquake-resistant housing (Tasdemir & Ertokat, 2002). It is also used as an infill material in restorations of timber framed historical buildings. This material has, however, some disadvantages; for instance, its very high water absorption capacity makes it susceptible to deteriorations due to water. It is, therefore, essential to better understand and develop the material properties of AAC for use in both contemporary and historical buildings.

II. MATERIALS USED

A. Cement

Ordinary Portland Cement (OPC) is the most common cement used general concrete construction when there is no exposure to sulphates in the soil or groundwater. Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. The OPC was classified into three grades namely, 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested.

Fig. 1: Cement

B. Water

Water is an important constituent of concrete. It chemically reacts with cement to produce the desired properties of concrete. Mixing water is the quantity of water that comes in contact with cement, impacts slump of concrete and is used to determine the water to cementitious ratio of the concrete mixture. Strength and durability of concrete is controlled to a larger extent by its w/c .The quality of mixing water used in concrete has important effects on fresh concrete properties.

Fig. 2: Water

C. FlyAsh

Fly ash is one of the naturally-occurring products from the coal combustion process and is a material that is nearly the same as volcanic ash. When coal is burned in today's modern electric generating plants, combustion temperatures reach approximately 2800°F. The noncombustible minerals that naturally occur from burning coal form bottom ash and fly ash. Fly ash is the material that is carried off with the flue gases, where it is collected and can be stored in silos for testing and beneficial use. Fly ash can be classified into classes. Class F fly ash normally produced by burning anthracite or bituminous coal.

Fig. 3: Fly Ash

D. Lime

Lime is a calcium-containing inorganic material in which carbonates, oxides, and hydroxides predominate. It is also the name of the natural mineral (native lime) CaO which occurs as a product of coal seam fires and in altered limestone xenoliths in volcanic ejecta. The word "lime" originates with its earliest use as building mortar and has the sense of sticking or adhering. These materials are still used in large quantities as building and engineering materials the rock and minerals from which these materials are derived, typically limestone or chalk, are composed primarily of calcium carbonate. "Burning" converts them into the highly caustic material"quicklime".

Fig. 4: Lime

E. Aluminium Powder

Aluminium powder is usually used to obtain autoclaved aerated concrete by a chemical reaction generating a gas in fresh mortar, it contains a large number of gas bubbles. When aluminium is added to the mixing

Ingredients by 0.2%-0.5% to the dry density of cement. The Aluminium powder can be classified into three types: atomized, flake and granules. In case of an atomized particle, its length, width and thickness are all of approximately the same order where the length or width of a flake particle maybe several hundred times it thickness.

Fig. 5: Aluminium Powder

F. Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica, usually in the form of quartz.

Fig. 6: Sand

G. Plaster of Paris

Plaster is a building material used for the protective and decorative coating of walls and ceilings and for moulding and casting decorative elements. In English plaster usually means a material used for the interiors of buildings. The most common types of plaster mainly contain either gypsum, lime, or cement but all work in a similar way. The plaster is manufactured as a dry powder and is mixed with water to form a stiff but workable paste immediately before it is applied to the surface.

Fig. 7: Plaster of Paris

H. Quarry Dust

Quarry dust, a waste product from the crushing process during quarrying activities. Quarry dust have been used for different activities in the construction industry such as for road construction and manufacture of building materials such as lightweight aggregates, bricks, tiles and autoclave blocks. Researches have also been conducted to study the effects of partial replacement of sand with quarry dust in the properties of freshly mixed and hardened concrete applications.

Fig. 8: Quarry Dust

I. Saw Dust

Sawdust or wood dust is a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood or any other material with a saw or other tool, it is composed of fine particles of wood. It can present a hazard in manufacturing industries, especially in terms of its flammability.

Fig. 9: Saw Dust

III. PROPERTIES OF MATERIALS

A. Properties of Cement

Properties	Details
Grade	43 OPC
Consistency	34%
Specific gravity	3.15
Fineness	2%

Table 1: Properties of Cement

IV. LITERATURE REVIEW

Mallampalli.Ch, et al, have discussed about the reactions undergone while casting the block. They used gypsum for filler.

Ali J. Hamad,etal, have discussed about the Ac block production in industry.The ratios are explained about in this literature on what stage aluminium powder should bemixed.

Miloš Jerman, et al, it explain about the hygric, thermal and durability properties of Autoclaved aerated concrete. They have compared 3AAC block with different densities and tested results of thermal property and durability.

V. MIX PROPORTION

Materials	Percentage by Volume of Block	Quantity of Materials KG/L
Cement	15	4.38
Water	0.65	4.22 L
Fly Ash	65	9.152
Lime	10	2.112
Aluminum Powder	0.2	0.221
Sand	10	3.168
Plaster of Paris	10	3.168
Quarry Dust	8	0.258
Saw Dust	7	0.258

Table 2: Mix Proportions

VI. RESULT AND DISCUSSIONS

A. Compression Strength of Blocks

The compressive strength of a glass powder is that price of uniaxial compressive stress reached once the fabric fails utterly. The compressive strength is typically obtained through an experiment by means that of a compressive check. The equipment used for this experiment is that the same as that employed in a tensile check. However, instead of applying a uniaxial tensile load, a uniaxial compressive load is applied. As is unreal, the specimen (cube and cylindrical) is shortened still as unfold laterally. A Stress–strain curve is a forethought by the instrument and would look the same as the following.

Compressive strength of concrete is typically found bytesting Cubes and cylinders. Cube of size a 150mm X150mm X 150mm concrete specimens w were casting mistreatment M30 grade concrete.150mm specimen and 180kg/min for 100mm specimen, stress increase rate 0.06+/-0.04N/mm2.s according to British standard). For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm depending upon the size of aggregate are used. For most of the works cubical molds of size 15cm x 15cm x 15cm are commonly used.

S No	Type of Blocks	Strength of Blocks (N/mm^2)
1.	Hollow Block	1.37
2.	Propertion1	1.89
3.	Propertion 2	2.13
4.	Propertion 3	2.51

Table 3: Comparison of Hollow Block Strength

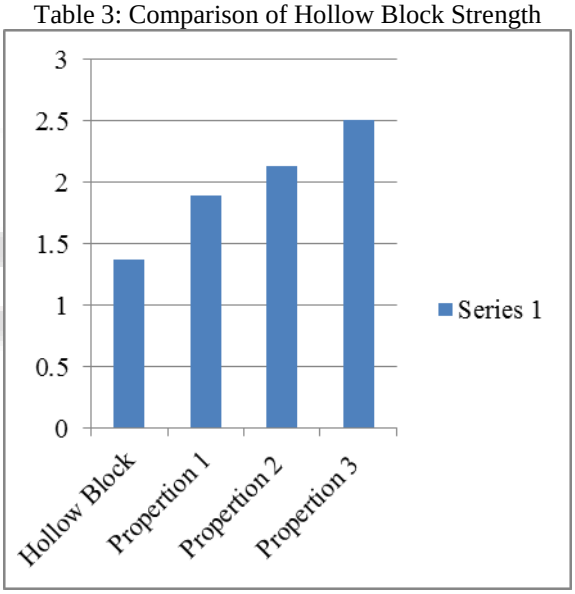

Chart 1: Compression Strength of Blocks

VII. CONCLUSION

The compressive strength obtained from test show that AC is greater than hollow block in strength and it is light weight compared to hollow block. Therefore the AC block can be effectively used instead of hollow blocks and conventional bricks blocks. AC block can be used for better insulation process and these block are used for making prefabricated structures has it is light weight can be cut with saw, blade, drilled easily. This paper concludes that AC blocks can be produced more cost effectively and light weight in small scale compared to large scale industries.

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