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Experimental Investigation On Autoclaved Aerated Concrete Block

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Abstract: AAC stands for Autoclaved Aerated Concrete. It is an ultra-light concrete masonry product having good number of advantages in practicality. It is now gaining its importance in construction industry replacing all the conventional methods. This cellular structure gives AAC a number of exceptional physical characteristics. It weighs as little as 1/5 as much as ordinary concrete because of its distinct cellular structure which posses millions of tiny pockets of entrapped air. AAC consists of basic materials that are widely available. These include sand, cement, lime, gypsum, aluminium paste, water and an expansion.

Keywords: Autoclaved Aerated Concrete, Gypsum, Mineral admixture, Lightweight Concrete.

I. INTRODUCTION

Autoclaved aerated concrete (AAC), is one of the many building products being touted as “green” or “environmentally friendly”. Developed in Sweden in the 1920s in response to increasing demands on timber supplies AAC is a light weight manufactured building stone. Comprised of all natural raw materials AAC is used in a wide range of commercial, industrial, and residential application. The finished product is up to five times the volume of the raw materials used, with an air content of 70% to 80% (depending on the required strength and density.). 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. This study deals with the introduction to the process of the autoclaved aerated concrete and its advantages compared to the normal concrete.At a local level, in the vicinity of a brick kiln, environmental pollution from brick-making operations is injurious to human health, animals and plant life. At a global level, environmental pollution from brick-making operations contributes to the phenomena of global warming and climate change. Extreme weather may cause degradation of the brick surface due to frost damage. Global warming and environmental pollution is now a global concern. Various types of blocks can be used as an alternative to the red bricks, to reduce environmental pollution and global warming. AAC blocks may be one of the solutions for brick replacement.

II. LITERATURE REVIEW

Shweta O. Rathi, P.V. Khandve. Brick is the most commonly used building material for construction. The CO2 emissions in the brick manufacturing process affect the green environment. Therefore, focus should be now more on seeking eco – friendly solutions for greener environment. Analysis of conventional and non – conventional material on cost, energy consumption and carbon emission parameters helps in highlighting suitable options for sustainable construction. AAC block, an eco – friendly material, gives a prospective solution to building construction. In this paper, attempt has been made to replace the red bricks with eco – friendly AAC blocks. The usage of AAC block reduces the cost of construction upto 20% as reduction of dead load of wall on beam makes it comparatively lighter members. The use of AAC block also reduces the requirement of materials such as cement and sand upto 50%.

ParthDesani, MansiSoni. This type of lightweight concrete has no coarse aggregates in its mixture, and it can be mentioned that aerated lightweight concrete is the concrete mortar which is aerated with gas injection and also can be aerated by using air entraining agent. Aerating concrete by using air entraining agents is more practical in production of LWC. Fine aggregates that can be used to produce aerated concrete are known to be silica sand, quartzite sand, lime and fly ash. Considering methods of curing, aerated concrete can be categorized into two main groups which are autoclaved aerated concrete and non-autoclaved aerated concrete. Curing is an important factor affecting mechanical and physical properties of concretes in different categories. According to different reports, AAC can reach higher strength values with less drying shrinkage when it is compared to non-autoclaved aerated concrete (NAAC). Therefore, it can be concluded that autoclaving process has beneficial effects on strength development and also on shrinkage of aerated concrete. Autoclaved Aerated concrete (AAC) has many benefits for structures such as heat insulation, sound insulation, fire and mould resistance, reduced dead weight and many more. AAC products include blocks, wall panels, floor and roof panels, and lintels. Besides insulating capability, one of AAC's advantages in construction is its quick and easy installation since the material can be routed, sanded and cut to size on site using standard carbon steel band saws, hand saws and drills.

Ashish Kurweti, Ruchi Chandrakar, The main objective of this paper is to comparing the different types of light weight concrete according to their physical properties. Light weight concrete are widely used in all over the world, these types of concrete having densities ranges 450-1800 kg/m3 and are more sustainable than burnt brick clay or ordinary types of concrete. In this paper a deep discussion are carried out between the properties of AAC, CLC and fly ash. AAC(Autoclaved aerated concrete) is a light weight concrete material that was developed in many years ago, the main constituents used in making of this type of concrete is cement grade53 , gypsum, class C lime (hydrated lime), aluminium powder(.05-.25% by wt of cement) , fine aggregate or fly ash (class F) combining with definite proportions. CLC (Cellular light weight concrete) is another light weight concrete material which are widely used in making infrastructure and high rise building, the main ingredients of making CLC is cement(OPC grade 53), Fly ash (class F),sand (passing 2mm sieve) , foaming agent(either protein based or synthetic based). Fly ash is also taken in this paper as a light weight concrete because it replaces partially fine aggregate and fully coarse aggregate the raw materials of this type of concrete is cement (grade53/grade43), Fly ash (class F),sand (passing 2mm sieve). On keeping density as a constant parameter their load carrying capacity in compression, thermal insulation and water absorption are to be tabulated and then conclusions are made by their best performance.

Nidhi Gandhi, Vivek Mishra. The main objective of this paper is the presentation of the potentiality and ormation techniques of aerated concrete in the context of Bangladesh. In this experiment, generation method of hydrogen gas was used for the aeration process. In this gasification method, a finely powdered aluminium powder was added to the slurry of Ordinary Portland cement with different percentages such as 0.05%, 0.1%, 15%,0.2%, and 0.25%.

To determine the effect of aluminium powder on the final product properties, some test has been conducted such as density, water absorption and compressive strength test. However, it was observed that the concrete having 0.15% aluminium powder contributes in the strength gaining process of aerated concrete.

III. MANUFACTURING PROCESS

Manufacturing process of AAC contains five main steps which are as following –

- Mixing of raw materials.
- Addition of expansion agent.
- Pre curing, cutting.
- Curing process with autoclave.

1. Mixing Of Raw Materials

In this part of manufacturing aggregates like silica sand or quartz sand and process, fine lime are mixed with cement. Then water will be added to this mix and hydration starts with cement forming bond between fine aggregates and cement paste.

2. Addition Of Expansion Agent

After mixing process, expansion agent is added to the mixture for increasing its volume and this increase can be from 2 to 5 times more than original volume of the paste. Expansion agent which is used for this process is aluminium powder; this material reacts with calcium hydroxide which is the product of reaction between cement and water.

This reaction between aluminium powder and calcium hydroxide causes forming of microscopic air bubbles which results in increasing of pastes volume.

2Al + 3Ca(OH)2 + 6H2O 3 CaO . Al2O3 + 3H2

Aliminium powder + Hydrated lime Tricalcium hydrate + Hydrogen

3. Moulding And Pre-Curing

Pre curing process starts after concrete mix is poured into metal moulds with dimensions of 600 mm × 200 mm × 200 mm. In these moulds, concrete will be pre cured after it is poured into mould to reach its shape and after this pre curing process. Aerated concrete blocks are available in different dimensions and various thicknesses.

Dimensions for these blocks which are commonly used are: 600×250×100 mm, 600×250×150mm, and 600×250×200.

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4. Curing Process By Autoclave

Autoclave is defined as a strong, pressurized and steam-heated vessel. Concrete mix that is categorized as autoclaved has its ultimate mechanical properties conditions. In order to reach the ultimate mechanical characteristics for AAC, Domingo states, Curing with autoclaving method requires three main factors which are moisture, temperature and pressure. These three factors should be applied on material all at the same time. Temperature inside autoclave should be 1900C and essential pressure should be about 10 to 12 atmospheres. Moisture will be controlled by autoclave and this process should be continued up to 12 hours to provide proper condition for hydration

IV. MATERIALS USED

The following raw materials are used in the manufacturing process of AAC blocks

1. Cement

Cement is a binding material used in construction projects that sets and hardened to other materials when reacts with water. If cement is used with only fine aggregate then it known as mortar and if cement, fine aggregate and coarse aggregate used together then it is known as concrete. Ordinary Portland cement type grade53 is commonly used.

Physical properties of the cement is

- Colour-white
- Specific gravity-3.15
- Specific surface area-2250cm2/kg
- Compressive strength-53MPa
- Codal provision- IS.269.1989 and IS.383.1970
- Chemical composition of cement

2. Fly ash

Fly ash is poorly graded particles, generally spherical in shape and range in size from 0.5µm to 300µm. It contains nearly about 15-25% cementitious material. It provides great workability and consistency to the concrete and lowers the heat Of hydration. Fly ash increases setting of concrete.

It also provides higher strength at later stages in concrete.
Physical Properties of concrete used are

- Type- Class C Fly ash
- Specific gravity-2.5
- Color- white
- Specific surface area-4000cm2/g
- Codal provision- IS.3812.1.2003
- Chemical composition of fly ash

3. Sand

Sand is generally obtained from marine environment. Sand is a naturally occurring granular material which composed of finely divided rock and mineral particles. It is defined by size being finer than gravel and coarser than the silt.Amount of sand is used to ensure less quantity of cement and less water, which are further increased strength, durability but lowers the shrinkage of concrete. Sand is also used as fine aggregate because of its size ranges between 0.0625mm to 2mm. the specific gravity of sand used in this experiments is 2.6 and having fineness modulus 2.63. Coda provision used IS.383.1970.

4. Gypsum

Gypsum is a type of mineral and a hydrated calcium sulfate in chemical form. It plays a vital role in compensating the rate of hardening of the cement.

It is used to control the setting time of cement but if it is in excess it may unsound the cement concrete because of sulfate.
Physical properties of gypsum are

- Color- white grey
- Specific gravity-2.3
- Specific surface area-3800cm2/g
- Size- less than 1mm
- Chemical formula-Ca(OH)2.2H2O

5. Lime

Lime is used in making AAC and reduces the amount of water into the concrete block. It prevents the AAC from drying out too quickly and also from dry shrinkage. Hydrated lime, fat lime and quick lime are the main types of lime in which hydrated lime are widely used in making construction.

Physical properties of hydrated lime are as follows

- Color-white
- Type- Hydrated lime
- Specific gravity-2.81
- Specific surface area-4300cm2/g
- Codal provision- IS.3115.1992
- Chemical formula- CaO

6. Aluminum powder

Al powder is a finely grinded powder, such that it reacts with calcium hydroxide a byproduct of cement-water reaction and then after reaction between Al powder and calcium hydroxide generates uniform micro air bubbles which results in increasing concrete volume making it very light weight concrete.

Cement + water → C-S-H gel +3Ca(OH)2

$2Al + 3Ca(OH)_2 + 6H_2O \rightarrow 3\ CaO.Al_2\ O_3 + 3H_2$

Aluminum powder + Calcium hydroxide → Tricalcium hydrated + Hydrogen

Physical properties of Al powder

- Color-Grey
- Melting moint-660ºC
- Specific surface area-7000cm2/g
- Specific gravity-0.22
- Particle size- 45µm

V. COMPRESSION TESTING

0.5 % REPLACEMENT

Compression test is carried out on specimen cubical in shape. The cube specimen is of the size of 200*200mm.

S.No	Size Of Cubes	Compressive Strength @ 14days In N/Mm^2	Compressive Strength @ 28days In N/Mm^2
1	200*200	1.96	3.9
2	200*200	1.99	4.1
3	200*200	1.98	4.3
		1.97	4.2

RESULT:

The compressive strength of specimen after 14 days curing is 1.97N/ m m^2

The compressive strength of specimen after 28 days curing is 4.2N/mm^2

0.10 % REPLACEMENT:

Compression test is carried out on specimen cubical in shape. The cube specimen is of the size of 200*200mm

S.No	Size Of Cubes	Compressive Strength @ 14days In N/Mm^2	Compressive Strength @ 28days In N/Mm^2
1	200*200	2.81	6.31
2	200*200	1.98	6.32
3	200*200	1.99	6.34
		2.80	6.33

VI. RESULT

The compressive strength of specimen after 14 days curing is 2.80N/ m m^2

The compressive strength of specimen after 28 days curing is 6.33N/mm^2

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0.15 % REPLACEMENT

Compression test is carried out on specimen cubical in shape. The cube specimen is of the size of 200*200mm.

S.No	Size Of Cubes	Compressive Strength @ 14days In N/Mm^2	Compressive Strength @ 28days In N/Mm^2
1	200*200	3.91	8.41
2	200*200	3.89	8.42
3	200*200	3.91	8.44
		3.9	8.43

RESULT:

The compressive strength of specimen after 14 days curing is 3.90N/ m m^2
The compressive strength of specimen after 28 days curing is 8.43N/mm^2

0.20 % REPLACEMENT:

Compression test is carried out on specimen cubical in shape. The cube specimen is of the size of 200*200mm.

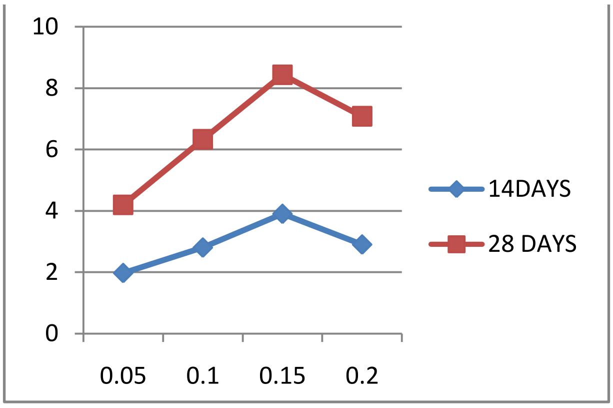
S. No	Size Of Cubes	Compressive Strength @ 14days In N/Mm^2	Compressive Strength @ 28days In N/Mm^2
1	200*200	2.8	7.23
2	200*200	2.6	6.91
3	200*200	2.7	7.12
		2.9	7.08

RESULT:

The compressive strength of specimen after 14 days curing is 2.9N/ m m^2
The compressive strength of specimen after 28 days curing is 7.08N/mm^2.

COMPARISION ON COMPRESSIVE STRENGTH

S.No	Aluminium Powder %	Compressive Strength @ 14days In N/Mm^2	Compressive Strength @ 28days In N/Mm^2
1	0.5%	1.97	4.20
2	0.10%	2.80	6.33
3	0.15%	3.90	8.43
4	0.20%	2.90	7.08



V. CONCLUSION

Compressive strength of AAC blocks is comparatively more than traditional clay brick. These are suitable for walls in RCC framed building. Utilization of fly ash leads to the reduction in the cement consumption in the product which results in reduction of green house gases. Density of AAC block is 1/3 that of traditional clay brick and there is no more change in wet condition. It helps in reducing dead load of structure. Cost of construction reduces by maximum up to 20 % as reduction of dead load of wall on beam makes comparatively lighter members. As both side face of AAC block

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wall are plane, thickness of plaster is very less, and so there is substantial reduction up to 50% in requirement of cement and sand for plaster work. AAC is manufactured from common and abundant natural raw materials, therefore it is extremely resource-efficient and eco - friendly. The energy consumed in the production process emits no pollutants and creates no byproducts or toxic waste products. The work ability of AAC helps to eliminate waste on the jobsite.

REFERENCE

[1]. Vivian, W. Y. , "Cost Effectiveness of using Low Cost Housing Technologies in Construction." 1877–7058 © 2011 Published by Elsevier Ltd.doi:10.1016/j.proeng, July, 2011.
[2]. Prakash, T.M., Dr.Naresh kumar, B.G., Dr. Karisiddappa. , "Strength and Elastic Properties of Aerated Concrete Blocks (ACBs)." International Journal of Chemical, Environmental & Biological Sciences (IJCEBS) Volume 1, Issue 2 (2013) ISSN 2320 –4087 (Online), 2013.
[3]. Otim, G., Nakacwa, F., Kyakula, M. , "Cost Control Techniques Used On Building Construction Sites in Uganda Second International Conference on Advances in Engineering and Technology, 2002.
[4]. Hebel, M.C., "Using modern methods of construction to build homes more quickly and efficiently on Autoclaved Aerated Concrete." Technical Sheet and Installation Guide, 2009.
[5]. K. Krishna BhavaniSiram, K. Arjun Raj "Concrete + Green = Foam Concrete", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 4, July – August 2013, pp. 179 - 184, ISSN Print:0976 – 6308, ISSN Online: 0976 – 6316.
[6]. E. Ikponmwosa, F. Falade, C. Fapohunda, "A Review And Investigationsof Some Properties Of Foamed Aerated Concrete", Nigerian Journal of Technology (NIJOTECH), Vol. 33. No.1, January 2014, pp. 1 – 9, University of Nigeria, Nsukka, ISSN: 1115-8443.
[7]. Dr. N. Arunachalam, V. Mahesh, P. Dileepkumar, and V. Sounder "Development Of Innovative Building Blocks (TNSCST- Sponsored Research Project)" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278 - 1684, p-ISSN: 2320 - 334X, PP 01-07.