# AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF LADLE FURNACE SLAG AUTOCLACEVD AREATED CONCRETE BLOCKS

**ELAVARASAN A [1], GOBINATH T [2], GOPI P [3] DINESHRAJ A[4]**

Student, Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, India [1]
Student, Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, India [2]
Student, Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, India [3]
Student, Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, India [4]

***Abstract*** — At present, construction works, such as high-rise buildings or offices and residential houses, in many countries are growing very fast every year. Concrete has mainly been used as fundamental construction material for most of residential building because of its outstanding mechanical properties, low cost, and availability. However, structure and foundation of buildings tend to become larger due to an increase in their scale, leading to much more time consumption and cost. In monsoon region, the ambient condition is hot and humid so that accumulation of heat and moisture in building wall plays an important role in its maintenance and energy conservation. As a result, ventilating fans and air-conditioners have been employed to remove heat for providing comfortable environment for residents.

***Index Terms*—Ladle furnace, concrete blocks, experimental investigation, energy conservations.**

## I. INTRODUCTION

Aerated Concrete is an important construction material for architects, engineers and builders. Also, it is an appropriate material with high energy efficiency, fire safety, and cost effectiveness. AC is a versatile light weight concrete and they are generally used as blocks. AC is produced by adding in a predetermined amount of ladle furnace slag and other additives into slurry of ground M-sand, cement, lime powder, water. Aerated concrete (AC) is a popular building material which is used all over the world. It has a history of 50 successful years can be used in all environments for all types of buildings (Wittmann, 1983, 1992). Since then, the production and use of aerated concrete have spread to more than 40 countries of all continents, including North America, Central and South America, Europe, the Middle East, the Far East and Australia. This wide experience has produced many case studies of the use in different climates and under different building codes.

## II. PROCEDURE FOR PAPER SUBMISSION

### *A. Review Stage*

### 1.1 MATERIALS USAGES

The materials used for manufacturing AAC are as follows,

- Ordinary Portland cement
- M-sand
- lime
- gypsum
- ladle furnace slag

• water

**1.5.1CEMENT**

In this experimental investigation ordinary Portland cement of 43 grade is used. Cement is one of the most important among the ingredients of concrete. In this work, Ordinary Portland Cement of grade 43 is used. Test for cement such as consistency tests, setting time test, specific gravity was done to study the properties of the cement as per IS specifications.

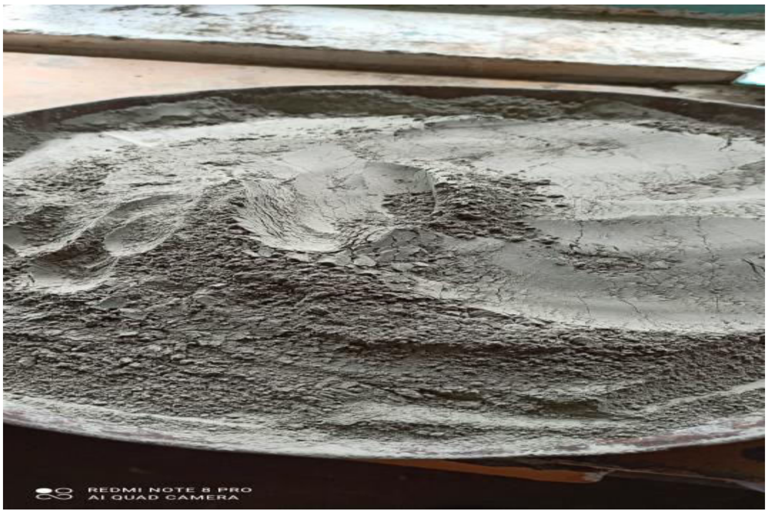



**Fig 1.5.1 CEMENT**

**1.5.2. PROPERTIES OF CEMENT**

**1.5.2.1 SETTING TIME**

For convenience, initial setting time is regarded as the time elapsed between the moments that the water is added to the cement, to the time that the paste starts losing its plasticity.

The final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

The temperature of molding room, dry materials and water shall be maintained at 27 ± 2°C. The relative humidity of the laboratory shall be 65 ± 5 percent.

Vicat apparatus should confirm to IS: 5513-1976. It consists of an arrangement to hold the plunger of 10 mm diameter and two other needles which are made to freely fall into a mold filled with the cement paste and the amount of penetration of the needles of plunder can be noted using the vertical graduations from 0 mm to 50 mm.

**1.5.2.2 CONSISTENCY**

The consistency is measured by the Vicat apparatus using a 10mm diameter plunger. A trial paste of cement and water is mixed and placed in the mold having an inside diameter of 70mm at the base and 60mm at the top, and a height of 40mm. The plunger is then brought into contact with the top surface of the paste and released. Under the action of its weight the plunger will penetrate the paste. The depth depending on the consistency.

**1.5.2.3 SOUNDNESS**

When referring to Portland cement, "soundness" refers to the ability of a hardened cement paste to retain its volume after setting without delayed expansion.

This expansion is caused by excessive amounts of free lime (CaO) or magnesia (MgO). Most Portland cement specifications limit magnesia content and expansion.

The cement paste should not undergo large changes in volume after it has set. However, when excessive amounts of free CaO or MgO are present in the cement, these oxides can slowly hydrate and cause expansion of the hardened cement paste. Soundness is defined as the volume stability of the cement paste.

**1.5.3 M-SAND**

Full form of M Sand is Manufactured sand also known crushed sand or manufactured fine aggregate.

It is manufactured by crushing rocks, quarry stone or larger aggregate pieces into sand size particle in a factory or query. Crushed sand has a cubical and angular shape. It has a size of less than 4.75 mm.

In order to reduce the economy of the project and also due to the increase in demand of availability of river sand, an alternative material, m-sand is used in this work.

M-sand is obtained by washing and screening of stone dust obtained during quarrying operation. It satisfies the criteria of well graded or uniformly graded material. Extracting river sand from the river is harmful to the environment it reduces the groundwater level and river water gets dried up.

Water table level gets reduced due to dragging of the sand from the river and the roots of the tree may not be able to get the water in the absence of sand in river water get evaporated due to direct sunlight.

It is recommended to use crushed sand. It is an economical and eco-friendly alternative of natural sand.

Crushed sand can be used in construction for all item except plaster and waterproofing work and for bedding under the stone. For hardscape work 50% M-sand and 50% rivers and should be used for better result.

**M-SAND**

### *B. Final Stage*

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

1. Mixing of raw materials.
2. Addition of expansion agent.
3. Pre curing, cutting.
4. Curing process with autoclave.
5. Packing and transporting.

After raw material preparation, next step of AAC blocks manufacturing process is doing and mixing.

Process of doing and mixing means the quality of final products. Maintaining ratio of all ingredients as

- M-sand 69%
- Sand 20%
- Lime8%
- Gypsum 3 %
- Ladle furnace slag 0.08% of total dry materials
- Water ratio 0.60-0.65

### *C. Figures*

The photographic view of the AAC blocks,


Length = 24 inches
Height = 8 inches
Breath = 6 inches

Concert blocks specimens (24 x 6 x 8) were casted for computing compressive strength. And flexural strength test of blocks. All the specimens were cured for a period of 28 days before test.


**Specimen preparation**


**Water Curing**


**Compression test on AAC blocks**

## III. Math

Minimum blocks compressive strength =0.8 x compressive strength cube )10 cm x 10 cm(.The concrete specimens are generally tested at ages 7 days,14 days and 28 days.

$$\textbf{FLEXURAL STRENGTH} = \frac{LOAD}{AREA}$$

Where,

Load is in 'N'

Area is in '$MM^2$'

**WATER ABSORPTION = ((w2-w1)/w1) X 100**

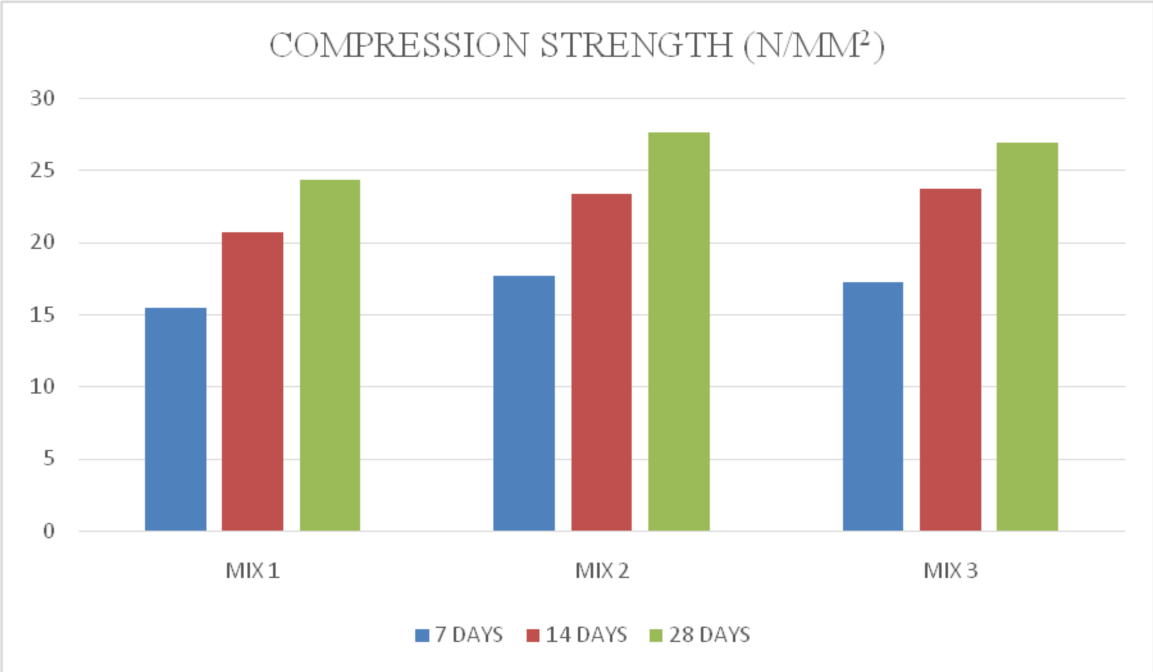
## IV. Units

| S . NO | PROPORTION | COMPRESSION STRENGTH($N/MM^2$) | | |
|---|---|---|---|---|
| | | 7 DAYS | 14 DAYS | 28 DAYS |
| 1 | MIX 1 | 15.47 | 20.68 | 24.29 |
| 2 | MIX 2 | 17.65 | 23.36 | 27.63 |
| 3 | MIX 3 | 17.24 | 23.74 | 26.92 |

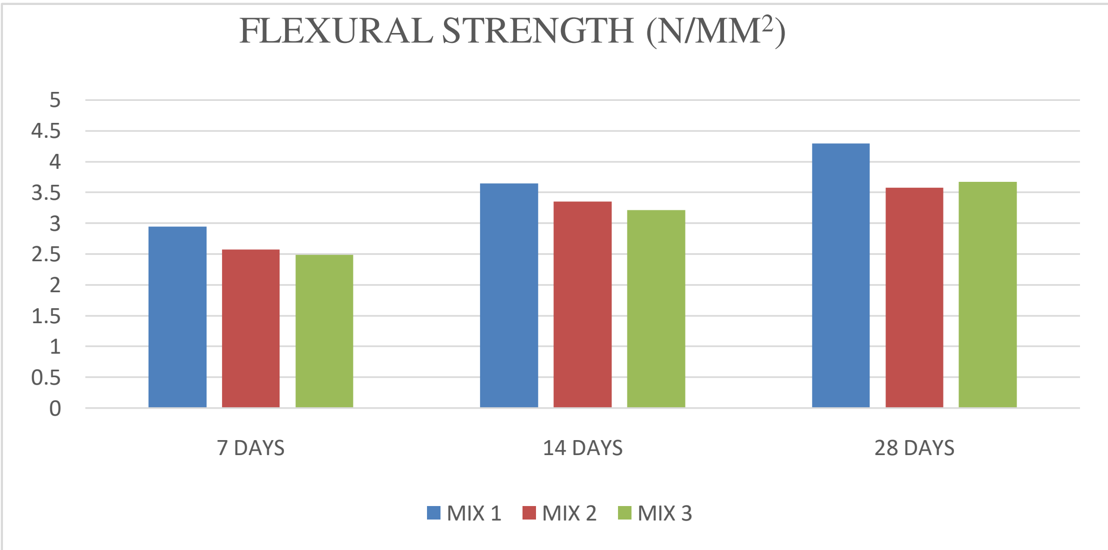
| S. No | PROPORTION | FLEXURAL TEST ON AAC BLOCK($N/MM^2$) | | |
|---|---|---|---|---|
| | | 7 DAYS | 14 DAYS | 28 DAYS |
| 1 | MIX 1 | 2.95 | 3.65 | 4.30 |
| 2 | MIX 2 | 2.58 | 3.36 | 3.58 |
| 3 | MIX 3 | 2.49 | 3.22 | 3.68 |

## V. Helpful Hints

*A. Figures and Tables*




**compression strength graph**




**Flexural strength graph**

## ACKNOWLEDGMENT

Foremost, we thank **Almighty** for showering abundant and gracious blessings of the completion of project successfully. The success of a work depends on the team and its cooperation. We are indebted to ravishing person our Founder and Honorable **Chairman Shri. A. SRINIVASAN AYYA** for providing us valuable academic support with pleasant infrastructure and peaceful environment to undertake this project. We wish to express our heartfelt thanks and deep sense of gratitude to **the Principal Dr. S. DURAIRAJ** for his generous help and continuous encouragement to bring out this project work. Special thanks should also be given to **Dr. K. SHUNMUGAPRIYA, Head of the Department**, **Civil** providing us with best facilities and motivation all the way through carrying the project work. We are very grateful to our vivacious project coordinator **Mrs. G. PREETHI SINDHU** for provision of expertise, and technical support in the implementation throughout my project work. We also honor to work under the guidance of **Mr. L.S. KALAISELVAN** for his encouragement and Technical suggestion that helped me for writing and editing of the project report. We also extend our thanks to all **Teaching** and **Non-Teaching Staff** of our department for their kind attitude towards our project work. Finally we thank our beloved **Family and Friends** who encourage us to proceed our project towards success.

## REFERENCES

[1] Robert, I. "Cost - Estimating Principles." The Journal of Construction Engineering and Management,Vol. 115, ©ASCE, ISSN 0733-9364/89/0004 0545/$1.00+ $.15 per page. Paper No. 24107, December, 1989.

[2] Choi, K.C., William Ibbs, C., "Costs and Benefits of Computerization in Design and Construction." The Journal of Computing in Civil Engineering, Vol. 4, ©ASCE, ISSN 0887-3801/90/0001-0091/$1.00 + $.15 per page. Paper No. 24285, 1, January.

[3] Sawhney, A., Mund, A., Syal, M.,"Energy-Efficiency Strategies for Construction of Five Star Plus Homes." The Practice Periodical on Structural Design and Construction, Vol. 7, 1, 2002. ©ASCE, ISSN 1084-0680/2002/4-174 –181/$8.00ƨ$.50 per page, 4, November.

[4] Hassan, R. "Viability of autoclaved aerated concrete walls for the residential sector in the United Arab Emirates." 0378-7788/$ – see front matter © 2011 Elsevier B.V. All rights reserved. doi: 10.1016/j.enbuild, April, 2011.

[5] 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.

[6] 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.

[7] 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.