Development Of Light-Weight Concrete Using Non - Autoclaved Aerated Concrete (Naac) With Palm Shell

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Abstract- *Now-a-days demand of the materials required for the construction works are increasing day by day. The technology has improved a lot in case of construction of any structure. The earlier structures were constructed with heavy materials, but at present time the light-weight materials like AAC block, hollow block, and light weight panels are also used to decrease the dead load of a building. In unusual concrete sets, lightweight concrete is considered as one of the most important substances in those sets. It has utilized for many years in architecture and insulation field of work. This research illustrates a new procedure used to generate structural light-weight concrete by utilizing oil palm shell (OPS) as a kind of an agriculture solid waste. This paper presents the experimental study on the utilization of oil palm shell in light weight concrete block as a replacement with fine aggregate in different propositions.The characteristic strength of compressive strength, water absorption and density of cellular concretes were determined at the age 14days and the results were observed.*

Keywords- Cement, fly ash, Palm shell, Aluminum powder.

I. INTRODUCTION

The aerated concrete is a one type of lightweight concrete and which is also well-known as a cellular concrete. It can be divided into two main types according to the method of production. The background of foamed concrete began much later than lightweight aggregate concrete. Foamed concrete is not a particularly new material, it is first recorded use date back to the early 1920s. The application of foamed concrete for construction works was not recognized until the late 1970s. Beside the Autoclaved Aerated Concrete (AAC) began approximately 100 years ago. In 1914, the Swedes first discovered a mixture of cement, lime, water and sand that was expanded by adding aluminum powder to generate hydrogen gas in the cement slurry.

The most basic definition of foamed concrete is that, it is mortar with air bubbles in it. The air content of foamed concrete may be up to 75% air by volume. In general terms foamed concrete can be described as a light weight, free flowing material which is ideal for a wide range of applications. It can have a range of dry densities from 400kg/m³ to 1600 kg/m³.Foamed concrete can be placed easily by pumping if necessary and does not require compaction, vibrating or leveling. It has excellent resistance to water and frost and provides a high level of both sound and thermal insulation. It is very versatile since it can be tailored for optimum performance and minimum cost by choice of a suitable mix design the fact that foamed concrete can be made using different mix designs means that it is not a single product. With the exception of pre-cast units, foamed concrete cannot be bought off the self-foamed concrete is nearly always made on site and it is made using a mix design specifically selected for each application or job.

II. MATERIALS

A.Cement:

Cement is an important binding material for the production of concrete. For using cement in important and major works it is incumbent on the part of the user to test the cement to confirm the requirements of the Indian Standard specifications with respect to its physical propertiesgiven in Table1. In thisresearch work,the Ordinary Portland Cement of 43Grade confirming to IS 8112:1989 was used. The specific gravity and the fineness modulus of used cement are 3.15 and 1.1% respectively.

Table 1- Physical Properties of Cement

Physical Properties	
Normal Consistency	33%
Initial Setting Time (min)	30
Final Setting Time (min)	240
Specific Gravity	3.15
Fineness	1.1
Density (kg/m^3)	1060

B. Oil Palm Shell:

Oil Palm Shell (OPS) were collected from a localpalm oil mill.It wasobtained after the oil extraction in the factory from fresh fruit bunch.It can be used as a good replacement of fine aggregate to produce structurallightweight concrete. The physical properties of OPS were presented in Table 2.

Table 2- Physical Properties of OPS

Physical Properties	
Specific Gravity	1.15
Fineness	6.31
Density(Kg/m3)	669
Water absorption	17.53

C. Fly ash:

Fly ash is a fine gray powder consisting mostly of spherical, glassy particles that are produced as a byproduct in coal-fired power stations. Fly ash has pozzolanic properties, meaning that it reacts with lime to form cementitous compounds. It is commonly known as a supplementary cementitous material.

Table 3- Physical Properties of Flyash

Physical Properties	
Specific Gravity	2.08
Fineness	3.5
Density(kg/m^3)	1043

D. Aluminum powder:

The aluminum reacts with calcium hydroxide or alkali which liberates hydrogen gas and forms bubbles. The success of the final aerated concrete products is based on the speed at which the gas bubbles were formed

$$2Al+3Ca(OH)_2+6H_2O \longrightarrow 3CaO.Al_2O_3.6H_2O+3H_2$$

III. MIX DESIGN

The process of selecting suitable ingredients of concrete and determining theirrelative amounts with the objective of producing concrete of requireddensity, strength andwater absorption,as economically as possible which is termed as the concrete mix design. In this study,concrete mix was designed as per IS 2185-4 (2008) part IV to achieve a minimum compressive strength of 3.5MPa. Design mix proportions of light-weight concrete block are tabulated in Table 4.

Table 4 – Mix Proportions

Materials	**Trial 1**	**Trial 2**	**Trial 3**
Cement (gm)	395	395	395
Fly Ash (gm)	836	805	774
Oil Palm Shell(gm)	247	262	278
Aluminum powder (gm)	1	1	1

IV. EXPERIMENTAL PROGRAMME

A. Water Absorption

Water Absorption is an important character which affects the durability of concrete. The test procedure involves casting of concrete blocks. Then the specimen was cured for 28 days. Then the specimen was oven dried and the weights of concrete blocks were measured. The cubes were immersed in water for 24 hours. After that, the cubes were taken out and the weight was measured. The increase in weight as a percentage of original weight is expressed as its absorption (in percent). The average absorption of the test samples shall not be greater than 5% with no individual unit greater than 7% (As per IS 2185 (Part 4): 2008) which is calculated by the given formula. The average value of water absorption for three trials was obtained as 9.74 % for the taken concrete blocks.

$$\text{Water absorption} = \frac{W2 - W1}{W1} \times 100$$

Where,W1 = Weight of dry brick (gm), W2 = Weight of saturated brick (gm).

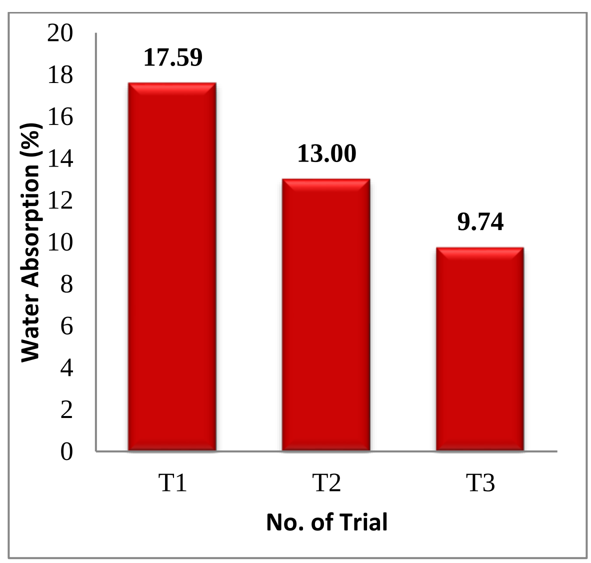

Fig. 1 The results of Water Absorption test

B. Dry Density Test

It is the mass of unit volume of homogenous material. Density of a material greatly influences its physical material. i.e., the density is the ratio of mass to the volume. From the observed results, the trials 1, 2 and 3, the concrete weighs as 1478 kg, 1462 kg and 1447 kg respectively. Also observed that, the density obtained as 914.04 kg/m^3, 904.14 kg/m^3 and 894.87 kg/m^3 for Trials 1, 2 and 3 respectively as shown in Fig. 2.

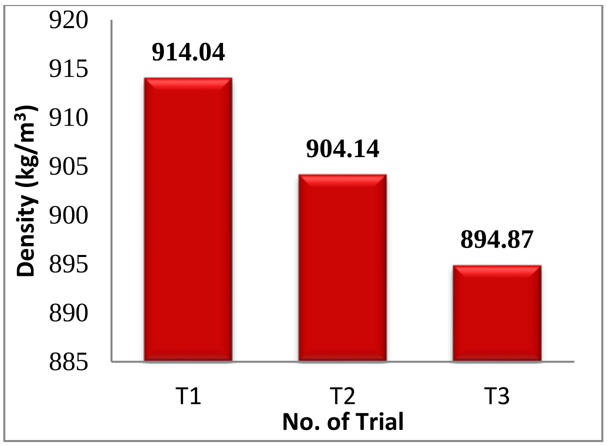

Fig. 2The results of Density arrived

C. Compressive Strength

Specimen shall be placed with flat faces horizontal and mortar filled face upward between three plywood sheets each of thickness 3mm and carefully centered between plates of the testing machine. Plaster of Paris can also be used in place of plywood sheets to ensure a uniform surface. Load shall be applied carefully axially at uniform rate of 14 N/mm^2 per minute till the failure of the specimen occurs (As per IS 2185 (Part 4),Fig. 3). The compressive strength of each specimen shall be calculated in N/mm^2 as under:

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (in N)}}{\text{Area of specimen (in Sq.mm)}}$$

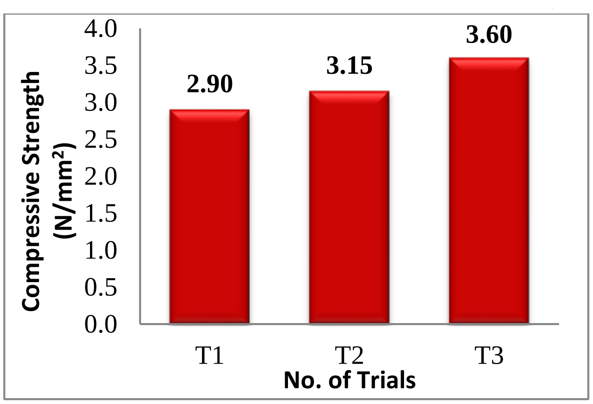

Fig. 3The Test result of Compressive Strength

From the results it is revealed that, the compressive strength was increased from Trial 1 to 3 with replacement of fine aggregate by OPS and corresponding strength for block specimen with T1, T2, and T3 have the compressive strength of 2.90N/mm^2, 3.15N/mm^2 and 3.60 N/mm^2 respectively.

V. CONCLUSION

The following conclusions are drawn from the present investigation,

- Water absorption decreased by with replacement of fine aggregate by Oil Palm Shell. The water absorption of NAAC blocks is 9.74% for 895 kg/m3
- The density of concrete produced has decreased with increase in the percentage of OPS substitution with conventional fine aggregate. From the results, the maximum density of concrete was obtained as 914 kg/m^3 for Trial 1 mix.
- From the results it is revealed that, the compressive strength increased forTrial3 with the value of 3.60N/mm^2.
- Light weight sample for Trial 3 shows anequivalent result than a third class block (i.e. higher than 3.5N/mm^2).
- The Oil Palm Shell can beusedformaking of light weight concrete which induced to reduce the weight of a concrete block.

REFERENCES

[1] K.Krishna Bhavani Siram Cellular Light-Weight Concrete Blocks as a Replacement of Burnt Clay Bricks, International Journal of Engineering and Advanced Technology (IJEAT) 2012, Vol-2, Issue-2, pp: 2249 – 8958

[2] NageshMustapure, H.Eramma, Experimental investigation on cellular lightweight concrete blocks for varying grades of density, International Journal of Advanced Technology in Engineering and Science 2014, Vol. 2 (8), pp: 2348 – 7550.

[3] K.KrishnaBhavaniSiram, K.Arjun Raj, Concrete + Green = Foam Concrete, International journal of civil engineering and technology (IJCIET) 2013, Vol. 4 (4), pp: 179-184.

[4] Darshan S. Shah, JayeshkumarPitroda, An experimental study on durability and water absorption properties of pervious concrete, International Journal of Research in Engineering and Technology(IJRET) 2014, Vol. 3 (3), pp: 2321-7308

[5] IS: 2185 (Part 3), 1984, Autoclaved cellular (Aerated) concrete blocks.

[6] IS 2185-4, (Part 4), 2008, Preformed foam cellular concrete blocks.

[7] Arunima V R, Sreelekshmi S, Effects on compressive strength on using Palm oil clinker as partial replacement of

fine aggregate in concrete, 2015, International Journal of science and research(IJSR), pp: 2319-7064

[8] Samar Abu Ameereh, Hassan Abu Ameereh, DialaAtiyat, Aseel MatarAl Balqa'a,Utilizing Oil Palm Shell to Produce Light Weight Concrete, European Journal of Academic Essays, 2015, Vol. 2(7), pp: 63-67.