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Cellular Lightweight Concrete Using Fly Ash

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ABSTRACT: Cellular Light weight Concrete (CLWC) is not a new invention in concrete world. It has been known since ancient times. It was made using natural aggregates of volcanic origin such as pumice, scoria, etc. The Greeks and the Romans used pumice in building construction. In this paper, parametric experimental study for producing CLWC using fly ash is presented. The performance of cellular lightweight concrete in term of density and compressive strength are investigated. From the result, it can be seen that compressive strength for cellular light weight concrete is low for lower density mixture. The increments of void throughout the sample caused by the foam in the mixture lowers the density. As a result, compressive strength will also decrease with the increments in void. As strength increases its density also increases. The test result shows that the compressive strength of replacement mixture with 1% of foam is higher than of 1.4% foam. Compressive strength of mixture with 1.2% foam is slightly higher than that of 1.4% foam. In this experimental study, two grades of cement such as 53 and 43 grade cement are used. Compressive strength of 53 grade cement is slightly higher than 43 grade cement.

KEYWORDS: cellular light weight concrete, CLWC, fly ash, volcanic, pumice, foam, Compressive strength.

I. INTRODUCTION

Concrete is most important construction materials. Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as an aggregate that is bonded together by cement and water.

In upcoming years there has been an increasing worldwide demand for the construction of buildings, roads and an airfield which has mitigate the raw material in concrete like aggregate. In some ruler areas, the huge quantities of aggregate that have already been used means that local materials are no longer available and the deficit has to be made up by importing materials from other place. Therefore a new direction towards Cellular Lightweight Concrete in building and civil engineering construction is used.

The origin of the CLWC is difficult to assess, it would not be an exaggeration to say that its roots are from the ancient period. With the increase in the demand of CLWC and the unavailability of the aggregates, technology for producing lightweight aggregates has been developed. Lightweight concrete is the type of concrete which includes an expanding agent in that it increases the volume of the mixture and lessened the dead weight. It is lighter than the conventional concrete. It was first introduced by the Romans in the second century where 'The Pantheon' has been constructed using pumice. It is most common type of aggregate used in second century. CLWC can be achieved by omitting the finer sizes of the aggregate or replacing them by a light weight, cellular or porous aggregate. Particularly, lightweight concrete can be categorized into three groups:

i) No-fines concrete.
ii) Lightweight aggregate concrete.
iii) Aerated/Foamed concrete/cellular concrete/gas concrete. (Hjh Kamsiah Mohd, et al.)

II. MATERIALS

Cellular lightweight concrete is slurry of cement, sand, water, fly ash and preformed stable foam generated by foam generating machine. 53 and 43 grade Ordinary Portland Cement is used. In this mix, one part of cementious material (i.e. cement and fly ash) and 3 part of sand is used. This dry material is properly mixed in a concrete mixer. After dry mixing, water is added and mixed it until homogeneous mix is formed. While mixing, 1% foaming agent (of

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cementious material) are added and mixed it. Due to foaming agent and mixing process, air voids are generated resulting decrease in density. Then this material is poured in a concrete mould and after 24 hours put it for curing. Compressive strength is determined for 3 days, 7 days and 28 days. Three samples are prepared for each test and average of these three is taken.

Materials Used:

1) Ordinary Portland cement: –53 grade and 43 grade cement is used
2) Sand: - Sand passing through 2.36 mm IS sieve.
3) Water: - Potable water as per IS 456:2000 is used.
4) Fly ash: - Pozzolona fly ash is taken from ash-silo Khaperkheda Thermal power plant, Nagpur.
5) Foaming agent: - Foam generating admixture by SIKA AER is used.

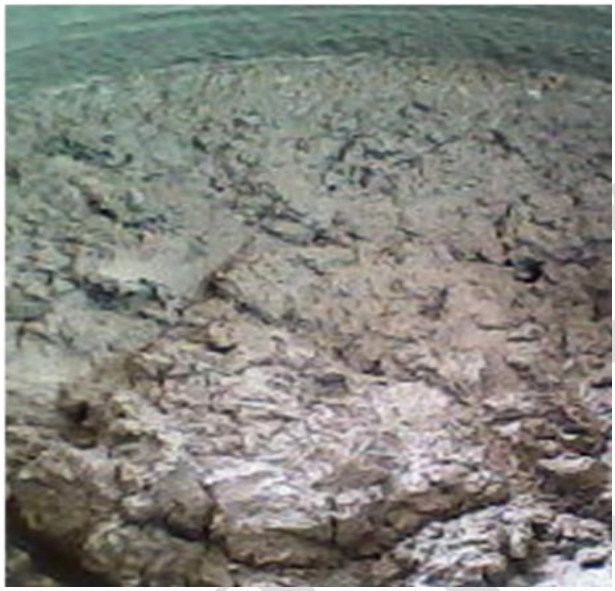

FIG.1 SHOWS MIX PREPARED

FIG.2 SHOWS CUBES PREPARED FOR TEST

III. TEST RESULTS

In this section, discussions are focused on the performance of lightweight concrete. The results presented are regarding the compressive strength test and density for 53 and 43 grade OPC mix for Cellular lightweight concrete.

Table1shows 28 days compressive strength and density for 53 OPC

53 grade OPC	Avg.compressive strength in MPa	Avg. density in kg/m^3
1	14.73	1850
2	13.72	1822.10
3	13.69	1820
4	10.96	1819
5	10.47	1817

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6	10.03	1817
7	9.64	1816
8	9.45	1815
9	9.45	1814.45
10	6.68	1649.27
11	6.38	1620.11
12	6.20	1615.15
13	6.18	1615.15
14	6.20	1613
15	5.07	1507.58

From Table 1, it can be seen that compressive strength for cellular lightweight concrete is low for lower density mixture.

Table2 shows 28 days compressive strength and density for 43grade OPC

43 grade OPC	Avg.compressive strength in MPa	Avg.density in kg/m^3
1	13.78	1828.58
2	11.09	1811.60
3	10.84	1810
4	9.43	1808
5	8.35	1801.31
6	8.39	1801.26
7	8.61	1790.82
8	8.23	1788.23
9	6.58	1651.31
10	6.07	1607.58
11	5.41	1561.80
12	5.38	1532.65
13	4.89	1461.35
14	4.41	1449.27
15	4.84	1423.65

FromTable2, it can be seen that compressive strength for cellular lightweight concrete is low for lower density mixture.

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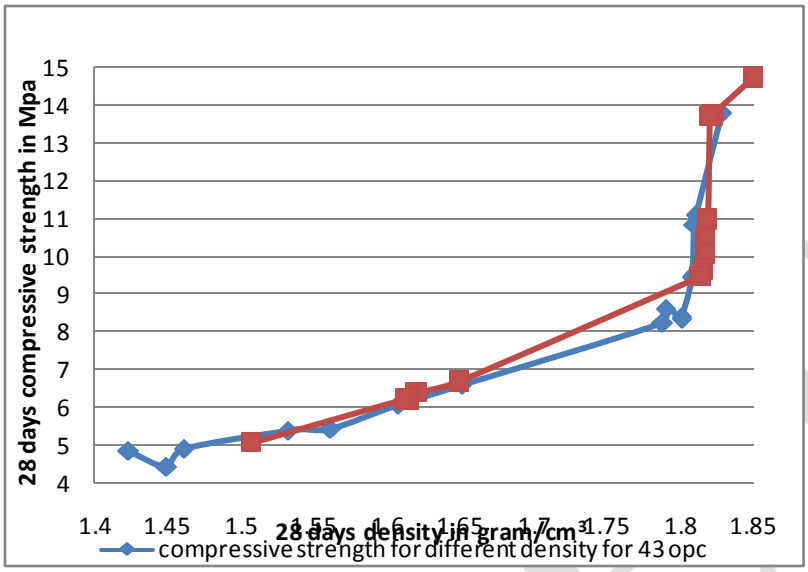

Graph (1) shows the comparison of compressive strength and density for 53 and 43 grade OPC

From Graph1, it can be found that Compressive strength of 53 grade cement is slightly higher than 43 grade cement, but as strength increases its density also increases.

III. CONCLUSION

The purpose of this experiment study is to identify the performance of cellular lightweight concrete in term of density and compressive strength. The results are presented in Table No. 1, 2 and graphical representation of compressive strength and density is illustrated in Graph (1). Based on result it can be seen that compressive strength for cellular lightweight concrete is low for lower density mixture. The increments of voids throughout the sample caused by the foam in the mixture lower the density. As a result, compressive strength also decreases with the increment of those voids. Compressive strength of 53 grade cement is slightly higher than 43 grade cement, but as strength increases its density also increases. Cellular lightweight concrete is acceptable for framed structure. Cellular light weight concrete can be suitable for earthquake areas.

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