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Experimental Investigation on Concrete using Foaming Agent in Concrete Mass

Rajvijeta[1], Prof. Vedant Shrivastava[2]

[1]*M Tech Student,* [2]*Assistant Prof., Department of Civil Engineering, GGITS, Jabalpur, India*

***Abstract*-- The foam concrete mixture becomes too stiff with lower content, causing bubbles to break, whereas the mixtures becomes too thin to hold the bubbles with high water content, leading to the separation of bubbles from the mixture, water-cement (w/c) ratio usually ranges from 0.4–1.25. Foam concrete can be designed to have any density within the dry density range of 300–1850 kg/m3. In this investigation two foam concrete mixtures (foam type 2) are produced with and without foaming agent and attempts have been made for selecting the proportions of foam concrete mix in the range of 5-10% for the target concrete. Cube specimens are prepared and tested for mixtures, then their physical (Density) as well as specific structural (Compressive Strength) properties were investigated, Specific Strength and Percentage Strength gain for foamed concrete is compared with normal weight concrete and the results are reported.**

***Keywords*-- foamed concrete, aerated concrete mass, strength –properties, foaming agent, density, target strength.**

I. INTRODUCTION

Lightweight concrete plays important role in the construction industry. There is a general trend to use lightweight concrete. Use of lightweight concrete as an alternative to ordinary concrete in construction works can decrease the building's own weight which lead to use thinner section, smaller size structural members, less reinforcing steel and lower foundation costs. One of the methods of reducing the weight of concrete depends on the introduction of stable voids within the hardened concrete.

A foaming agent introduces the air voids in the concrete while the concrete produced is called foamed concrete. The amount of foam added to the basic cement and sand mixture controls the density of foamed concrete. Foamed concrete is classified as a lightweight concrete with random air voids created by using foaming agents in mortar. Lightweight foamed concretes have a wide range of concrete densities (400–1900 kg/m3). Foamed concrete doesn't contain coarse aggregate. Moreover, Foamed concrete is known as its high flow ability, low cement content, low aggregate usage.

Foamed concrete is recognized for some attractive characteristics like, flow ability; self-compacting, self-leveling nature, low dimensional change and ultra-low density. The main use of foamed concrete is to reduce the dead load of concrete structures which leading to reduce size of columns, beams, foundations and other load bearing elements. Moreover, it is an economical, environmentally friendly and it enhances the fire resistance, thermal conductivity.

Brick is the common building unit used in construction since ancient times. Production of conventional bricks and hollow or solid concrete blocks causes depletion of natural resources and create environmental pollution, which have led the researchers to find a more sustainable solution. Formed concrete (FC) offers a viable solution to overcome the ill effects of brick making, since large quantities of industrial wastes can be utilized for its manufacture. FC is a special type of light weight concrete in which stable foam is used as one of the ingredients.

II. METHODOLOGY

In this chapter, we will discuss about the methodology used in this work. The material was collected from different locations and the information about the material has been obtained. A view on these materials has been given and the properties of these are shown.

Sieve Analysis (Is: 2720 Part 4-1985)

This test is done to determine the particle size distribution of aggregate(fine and coarse) as per IS: 2720 (Part 4) – 1985. The apparatus required to do this test:- i) A set of fine IS Sieves of sizes – 4.75mm, 2.36mm, 1.18mm, 600µ, 425µm, 300 µm, 212µm, 150µm and 75µm (refer Figure) And a set of coarse IS Sieves of sizes – 63mm, 40mm, 20mm, 12.5mm, 10mm, 8mm, 6.3mm, 4.75mm.

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Fineness Modulus Of Cement

To determine the fineness of cement by dry sieving as per IS: 4031 (Part 1) – 1996.The principle of this is that we determine the proportion of cement whose grain size is larger then specified mesh size. The apparatus required to do this test:

i) 90 µ IS Sieve
ii) Balance

Specific Gravity Test (IS: 2720 PART 3-1980)

Specific gravity G is defined as the ratio of the weight of a given volume of solids at a given temperature to the weight of an equal volume of distilled water at that temperature, both weights being take without air. The Pycnometer is used for determination of the specific gravity of fine grained and coarse grained particles and specific gravity bottle are used to determine specific gravity of fine materials. The specific gravity of aggregate is determined using the relation:

$$\mathbf{G = \frac{M2 - M1}{(M2 - M1) - (M3 - M4)}}$$

Slump Cone Test

This is a test used extensively in site work all over the work. The slump test does not measure the workability of concrete although ACI 116R – 90 describes it as a measure of consistency, but the test is very useful in detecting variations in the uniformity of a mix of given nominal proportions. The slump test is prescribed by IS: 456 (2000), ASTM C 143 90A and BS 1881 Part 102:1983.

Table 1.1
magnitude of slump

Description of workability	Slump in mm
No slump	0
Very low	5 – 10
Low	15 – 30
Medium	35 – 75
High	80 – 155
Very high	160 to collapse

Compaction Factor Test

The degree of compaction, called the compaction factor, is measured by the density ratio i.e. the ratio of the density actually achieved in the test to the density of the same concrete fully compacted. The test, known as the compacting factor test, is described in BS 1881: Part 103: 1993 and in ACI 211.3-75 (Revised 1987) (reproved 1992), and appropriate for concrete with a maximum size of aggregate up to 40mm.

The compacting factor = weight of partially compacted Concrete/Weight of fully compacted concrete.

Compressive Strength Test

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test. Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

III. Results And Discussion

Sieve Analysis For Fine Aggregate

The Aggregate which is passing through 4.75mm sieve is known as fine aggregate. Locally available river sand which is free from organic impurities is used. Sand passing through 4.75mm sieve and retained on 150 micron IS sieve is used in this investigation.

The sample shall be brought to an air-dry condition before weighing and strivings this may be achieved by dryings at room temperature or by heating at a temperature of 100 ^{o}C to 110 ^{o}C, the air dry sample shall be weighted and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use. The test were conducted as per IS: 2386 – 1975 and result of sieve analysis and physical properties of fine aggregate.

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Properties of Fine Aggregate:

Fineness modulus of fine aggregate = cumulative percentage weight retained/100

Fineness modulus = 286.864/100= 2.86

Specific gravity = 2.69

Water absorption = 1.82%

Silt or clay content = 0.5%

Grading = well graded (zone II)

Sieve Analysis For Course Aggregate

The coarse aggregate used in this investigation in 20mm downsize crushed aggregate and angular in shape as per Indian Standard specifications IS: 383 – 1970 [16]. Its physical properties and sieve analysis results are shown in table as follows

Properties of Coarse Aggregate:

The coarse aggregate used in this investigation in 20mm downsize crushed aggregate and angular in shape as per Indian Standard specifications IS: 383 – 1970 [16]. Its physical properties and sieve analysis results are shown in table as follows

Fineness modulus of coarse aggregates = cumulative percentage weight retained/100

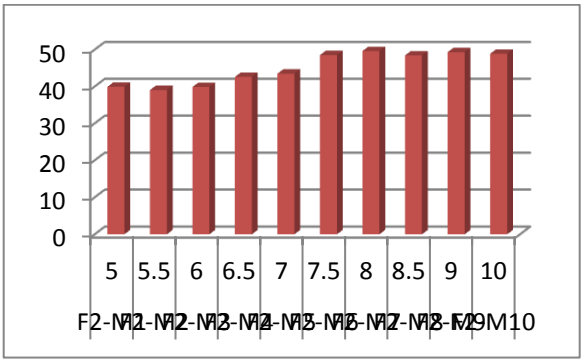
Fineness Modulus = 512.40/100= 5.12

SLUMP CONE TEST

This is a test used extensively in site work all over the work. The slump test is prescribed by IS: 456 (2000), ASTM C 143 90A and BS 1881 Part 102:1983.

Compressive Strength Test

The compressive strength of concrete is one of the most important Properties of concrete in most structural application concrete is implied primarily to resist compressive stress. This test give us a thought regarding every one of the attributes of cement. With the assistance of this test we can watch that if Concreting has been done appropriately. Furthermore, compressive strength is the capacity of material or construction to convey the heaps on its surface with no break or avoidance. A material under pressure will in general decrease the size, while in strain, size extends.



VARIATION IN COMPRESSIVE STRENGTH TEST VALUE OF M30 GRADE OF CONCRETE WITH DIFFERENT % OF FOAMING AGENT 2 FOR 28 DAYS

IV. Conclusion

The compressive strength of the substantial solid shape test gives a thought regarding every one of the attributes of cement. By this single test one appointed authority that if Concreting has been done appropriately. Concrete compressive strength for general development shifts from 15 MPa (2200 psi) to 30 MPa (4400 psi) and higher in business and mechanical constructions.

Compressive strength of cement relies upon numerous variables, for example, water-concrete proportion, concrete strength, nature of substantial material, quality control during the creation of cement, and so forth

Test for compressive strength is done either on a 3D shape or chamber. Different standard codes suggest a substantial chamber or substantial 3D square as the standard example for the test. American Society for Testing Materials ASTM C39/C39M gives Standard Test Method to Compressive Strength of Cylindrical Concrete Specimens.

Compressive strength formula for any material is the load applied at the point of failure to the cross-section area of the face on which load was applied.

For solid shape test two kinds of examples either blocks of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm relying on the size of total are utilized. For the majority of the works cubical molds of size 15cm x 15cm x 15cm are usually utilized. This substantial is poured in the form and suitably tempered so as not to have any voids. Following 24 hours, molds are eliminated, and test examples are placed in water for restoring.

The top surface of these example ought to be made even and smooth. This is finished by putting concrete glue and spreading easily all in all space of the example.

The water for relieving ought to be tried like clockwork and the temperature of water should be at 27+-2oC. Least three examples ought to be tried at each chose age. In the event that strength of any example shifts by in excess of 15% of normal strength, consequences of such example ought to be dismissed. Normal of three examples invigorates the pounding of cement. The strength necessities of cement.

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