Seven Days Compressive Strength of Cellular Lightweight Concrete using Marble Stone Dust

Mr. Rikesh R. Bharatkar [1]
Department of Structural Engineering,
B. D. C. O. E, Sevagram,
Wardha-442001, Maharashtra, India

Prof. P. L. Naktode [2]
Department of Civil Engineering,
B. D. C. O. E, Sevagram,
Wardha-442001, Maharashtra, India

Prof. M. R. Nikhar [3]
Department of Civil Engineering,
B. D C O E, Sevagram,
Wardha-442001, Maharashtra, India

***Abstract*— This research focuses on the intersection between material composition and form in the Development of a new type of concrete. As concrete is the most widely used building material in the world, innovation in this material has more potential to effect change in our built environment than innovation in any other. With the objective of minimizing raw material consumption and energy use, this work attempts to develop methods for creating a cellular lightweight concrete with variable density that can be cured at room temperature. Most aerated concretes traditionally require high temperature and high pressure curing; the goal of this research is to create a lower embodied energy product through the use of room temperature curing, while at the same time maximizing performance through variation of the density of the material through its section-essentially locating stronger material where it is needed. This more durable and versatile concrete product will be able to compete with traditional lightweight concretes, which provide benefits such as insulation, as well as normal-weight concrete, which is harder and stronger. The research aims to capitalize on the inherent heterogeneity of the material by producing a substance whose internal properties can be varied based on the needs of a specific part of a building.**

I am interested in replacing the concept of the "assembly" of materials to gain a desired function with a more unitary concept, the manipulation of a single material to meet a building's multiple needs. A desired outcome of the work is to reconceive how we put buildings together, not as assemblies of discrete elements but as monolithic yet malleable wholes.

Keywords—Cellular Light Weight Concrete; Marble stone dust; Foaming agent; Compressive strength; Percentage of foam.

I. INTRODUCTION

Industrial by-products are waste material produced from industries as result of production. Day by day by-product waste materials are increased in the environment and damages to the society. An economically practicable expedient to this problem should include utilization of these waste materials for novel product particularly in construction application which is deflect minimizes the heavy encumbrance on the nation’s landfills, save natural resources, energy, curtail air and water pollution and also reduces green gasses emission.

Cellular lightweight concrete maintains its large void and not forming weak layer of cement and aggregate when placed on the wall. Not everyone knows that density and compressive strength can be controlled. In the light weight concrete this is done by introducing air through the proprietary foam process which enables one to control density and strength precisely. Normal concrete has a density of 2400 kg/m^3 while densities range from 1800, 1700, 1600 down to 300 kg/m^3. Compressive strengths range from up to 40 Mpa down to almost zero for the really low densities. Generally it has more than excellent thermal and sound insulating properties, a good fire rating, is non-combustible and features cost savings through construction speed and ease for handling. The technology is the result of over 20 years of R&D, fine tuning the product and researching the possible applications. It is used in over 40 countries worldwide today and has not reached the end of its possible uses.

II. LITRATURE REVIWE

A. Mohd Ismail [1]

In this research paper the initial findings have shown that the lightweight concrete has a desirable strength to be an alternative construction material for the industrialized building system. The strength of aerated lightweight concrete is low for lower density mixture. This resulted in the increment of voids throughout the sample caused by the foam, thus the decrease in the compressive strength of the concrete. The foamed lightweight concrete is not suitable to be used as non-load bearing wall as the compressive strength is 27% less than recommended. Nevertheless the compressive strength is accepted to be produced as non-load bearing structure.

B. P. S. Bhandari [3]

In this research paper 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.

C. R. S. Kedar [4]

In this research paper The compressive strength of concrete is increased with addition of waste marble powder up to 50% by weight in place of sand and further any addition of waste marble powder the compressive strength decreases. The split tensile strength of cylinders is decreased with addition of waste marble powder, from control mix to 100% replacement of sand. However, the tensile strength at 25% replacement of sand is coming nearly equal to the tensile strength at control mix. Thus, 25% sand replacement with waste marble dust can also give better tensile strength. The flexural strength of beams is also increased with addition of waste marble powder up to 50% sand replacement and then gradually decreases. Thus, we found out the optimum percentage for replacement of sand with marble powder in concrete is almost 50%.

D. *T. G. Cooke* [7]

In this research paper contribution within the field of building construction materials. In addition, his present potential applications and extensions of the initial variable density casting methods developed. Ongoing and future experimental work is also discussed. In the most general sense, this work is concerned with the development of variable density concrete. There are two fundamental motivations for this work. First, as described in chapter 3, there is an immediate and real need for creating better concrete products for the construction industry. The ability to produce precast concrete building components that incorporate variations in internal composition has immediate application within existing production models. By being able to vary the internal material properties of a precast element, one can create more resource and energy efficient building products. These new precast elements have the potential to easily replace existing systems widely in use today. Elements have the potential to be easily produced based on a modified precast aerated concrete production model. Blocks, beams, columns and panelized systems are the most obvious application for this type of material. Essentially, these elements would be a hybrid of lightweight aerated concrete filling the majority of the interior volume of an element, with the surface regions of the component containing dense and hard concrete. The second broad motivation for the work has been to think more speculatively about the implications of being able to control the internal distribution of material within a monolithic substance. Though not immediately realizable, the concept of being able to cast a single material that can integrate all of the performance requirements for a building is an exciting conceptual proposition. Mainly as a thought experiment, he is interested in speculating about alternative ways of conceiving of architecture, not as something that is constructed in the sense of assembling and building-up, As is the tradition in modern architecture and construction, but as something that is generated or manipulated into being.

III. MATERIAL USED

1. Ordinary Portland cement: IS: 8112-1989 conforming to 43 Grade OPC cement. The properties of the cement tested ware Normal consistency 32.5 %, Fineness (90 Micron Sieves) 5.48 %, Initial and Final setting time 170 minute and 360 minute and after curing (28 Days) compressive strength 49.35 Mpa.

2. Water: Water conforming to as per IS: 456-2000 SECTION 2, Clause:5.4 was use for mixing and curing clean and free from injurious amount of oil, acid, alkalis, salt, sugar and other substance deleterious to concrete specimens.

3. Protein based Foaming Agent: It made to form light weight concrete and other concrete materials. Foam produce no reaction on concrete but it serves as a layer which is air trapped and forms no fumes or toxic. Protein based foaming agent requires comparatively more energy to make foam. It is prepared with raw material in presence of Calcium Hydroxide ($Ca(OH)_2$) and a small portion of Sodium Bisulfite ($NaHSO_3$). For improving the stability of foaming agent it is modified with the addition of several kinds of gel and surfactants. Few significant improve the workability of foaming agent such as addition of alkyl benzene sulfonate.

TABLE I. PHYSICAL PROPERTIES OF FOAMING AGENT

Appearance	Liquid
Colour	Dark Brawn
Density	1.15 +0.02 Kg/lit
pH	6 – 7.5
Freezing Point	-15ºC

Figure 1: Foaming Agent

4. Marble Stone Dust: Marble dust collected from the marble shop at Nagpur. It is used in project work. The specific gravity has 2.67

Figure 2: Marble Stone Dust

IV. METHODOLOGY

In order to study the behavior of cellular lightweight concrete, normal concrete testing was done to determine the material and structural properties of each type of cellular lightweight concrete and how will these properties differ according to a different type of mixture and its composition. Once concrete has hardened it can be subjected to a wide range of tests to prove its ability to perform as planned or to discover its characteristics. For new concrete this usually involves casting specimens from fresh concrete and testing them for various properties as the concrete matures.

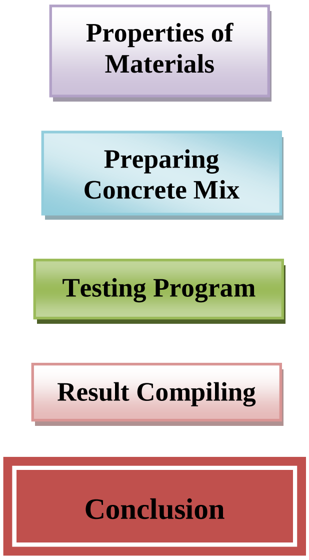

Figure 3: Methodology Flow Chart

Test procedure:

The 150 mm size conforming to IS: 10086-1982 concrete cube was used as test specimens to determine the compressive strength. The test specimen at the end of 7 days and 28 days were subjected to compressive load by compressive testing machine until failure.

V. RESULT

Compressive strength tests ware conduct in accordance with IS: 516-1959 on all cubes of mixed ratio at 7 days and 28 days curing. The compressive strength test result is shown in figures.

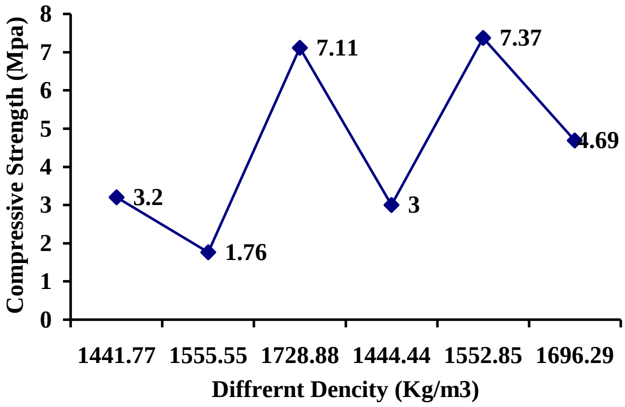

Figure 4: Compressive Strength at Different Density

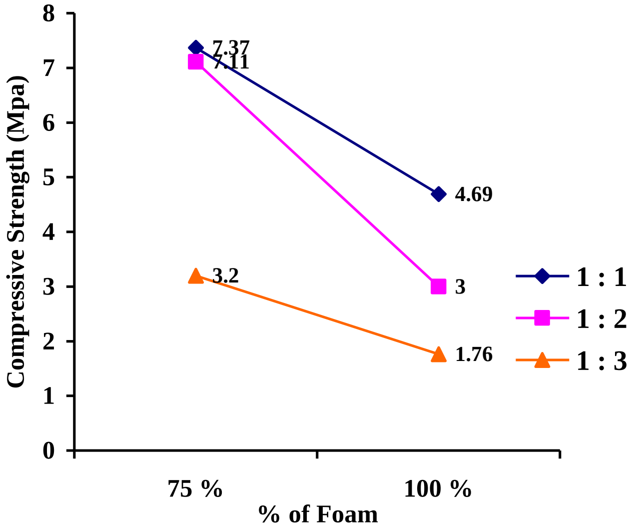

Figure 5: Compressive Strength at Different Percentage of Foam

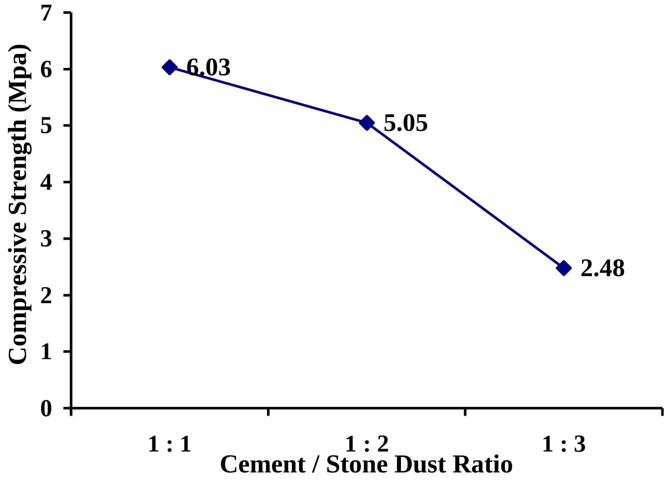

Figure 6: Compressive Strength at Different Cement / Marble Stone Dust Ratio

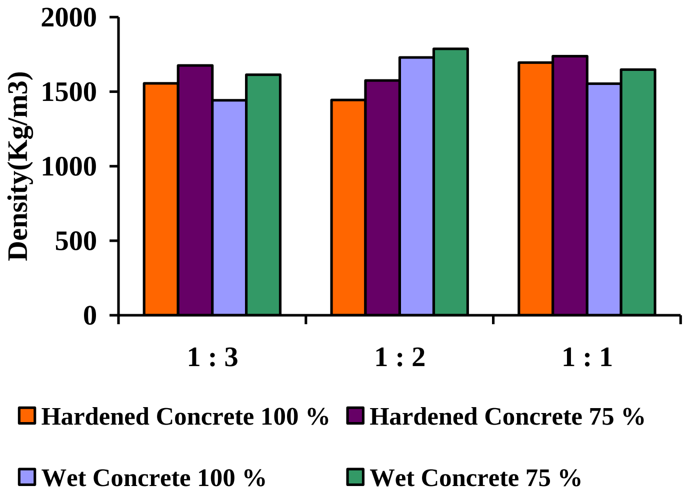

Figure 7: Density at Wet and Hardened Concrete

VI. CONCLUSION

The marble stone dust waste material was technically fulfills the need in the cellular lightweight concrete. But by the use of marble stone dust manufactured lightweight concrete was unable to resist load bearing from wall.

Compressive strength of cellular lightweight concrete was reduced according to reducing to density of concrete by producing air pocket in concrete by using foaming method.

Seven day compressive strength of cellular lightweight concrete greater than minimum requirement of strength of brick.

REFERENCES

[1] Hjh Kamsiah Mohd, Mohamad Shazli Fathi,Norpadzlihatun bte Manaf **"**Study of lightweight concrete behavior", Vol No : 71908.

[2] Deborah O. Olanrewaju, and Akinpelu, "Light Weight Concrete Using Local Industrial By-Product", Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 5(8): 183-186 (ISSN: 2141-7016).

[3] P.S.Bhandari[1], Dr. K.M.Tajne[2], "Cellular Lightweight Concrete Using Fly Ash" International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 11, November 2014.

[4] Aalok D. Sakalkale[1], G. D. Dhawale[2], R. S. Kedar[3], "Experimental Study on Use of Waste Marble Dust in Concrete", Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 10(Part - 6), October 2014, pp.44-50

[5] Shan Somayuji (1995), Text book of "Civil Engineering Materials", N.J Prentice.

[6] Shetty M S (2003) Concrete Technology, S. Chand and Company Ltd, New Delhi.

[7] T. G. Cooke, "Lightweight Concrete: Investigations into the Production of Variable Density Cellular Materials", Massachusetts Institute of Technology June 2012.

[8] IS: 456-2000 "Plain and reinforced concrete code of Practice" (Fourth Revision).

[9] IS: 516-1959 "Methods of tests for strength of concrete" (Incorporating Amendment Nos. 1 & 2).

[10] IS: 10086-1982, "Specification for Moulds for Use in Tests of Cement and Concrete". (Second Reprint December 1995)

[11] Hemant K. Sarje, Amol S,"Consequences of Protein Based Foaming Agent on Lightweight Concrete" International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-3 Issue-5, November 2014.

[12] IS: 8112-2013, "Ordinary Portland Cement 43 Grades –Specification".