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Use of Ultrafine Materials for Cellular Concrete Blocks

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Abstract: ***In these modern technology constructions, the height of structure is moving longitudinally higher. For the requirement of safe structure it is necessary to transmit the load from top floor to the foundation of the structure. Due to higher structural building, size of foundation is increasing and sometimes tends to do combined footing which leads to critical design of the foundation. Thus to tackle with this situation, it is necessary to minimize the load of structure. In this modern technology, there are few research has been conducted on cellular light weight concrete block which is need of future. With this concept, in this project few trials are conducted where cementitious material is replaced by foaming agent, like synthetic foaming agent by 0%, 25%, and 50 % in which the cementitious material is used as a combination of 50% OPC &50% slag, 30%OPC &70% slag and Ground Granulated Blast Slag has been replaced by 3% of alccofine in both cementitious combination. Specimens are casted for testing of compressive strength, water absorption and water sorptivity test. It is observed that 50% OPC and 50% slag with 3% of Alccofine is replaced by 50 % of foaming agent gives better result when compared to other combinations.***

Keywords: Alccofine, foam concrete, GGBS, Cellular light weight concrete block.

1. Introduction

Masonry construction has been used for at least 10, 000 years in a variety of structures homes, private and public buildings and historical monuments. The masonry of ancient time's involved two major materials: brick manufactured from sun-dried mud or burned clay and shale; and natural stone. The first masonry structures were unreinforced and intended to support mainly gravity loads. The weight of these structures stabilized them against lateral loads from wind and earthquakes. Masonry construction has progressed through several stages of development. Fired clay brick became the principal building material in India during the middle1800s. Concrete masonry was introduced to construction during the early 1900s and, along with clay masonry, expanded in use to all types of structures.

Historically, "rules of thumb" (now termed "empirical design") were the only available methods of masonry design. Only in recent times have masonry structures been engineered using structural calculations. In last 45years , the introduction of engineered reinforced masonry has resulted in structures that are stronger and more stable against lateral loads, such as wind and seismic.

Masonry consists of a variety of materials. Raw materials are made into masonry units of different sizes and shapes, each having specific physical and mechanical properties. Both the raw materials and the method of manufacture affect masonry unit properties. The word "masonry" is a general term that applies to construction using hand-placed units of clay, concrete, structural clay tile, glass block, natural stones and the like.

2. Literature Review

Set A. K. Marunmale, A.C.Attar, "Designing, Developing and Testing of Cellular Lightweight Concrete Brick (CLC) Wall built in Rat-Trap bond" [1]

Researchers conduct study on an innovative technique for efficient brick work system with many advantages over the conventional brick work system which "CLC brick in Rat-Trap bond". It reduces the use of material (natural river sand and red soil) and uses the waste material (fly-ash), hence it is green construction material. CLC brick was designed specially to build wall in Rat-Trap bond as efforts had not yet been made to design CLC brick in Rat Trap bond. The test results on CLC brick were satisfactory and it can be used for non load bearing exterior and interior wall. Also the light weight of CLC brick in Rat-trap reduces the dead load on the structure and provides good thermal insulation. Thus this CLC brick in Rat trap bond had a very good future scope for its development as a commercial product.Aniket Gupta, Mukul Rathore, "Comparative Study and Performance of Cellular Light Weight Concrete". [2]

In this paper researchers present a comparative study of CLC with equal strength of brick having lower density as compared to bricks. They analyzed the economical savings in structural design requirements as per the deduction in dead load of the whole structure, so this also includes an overall capital reduction. Also found that savings in steel due to use of CLC blocks in terms of weight of beam member were found to be 8.635kg. The amount of steel reinforcement used in the CLC block was found to be 1513.53 mm2 whereas the amount of steel reinforcement required for brick masonry was 1681.64 mm2.

Therefore savings obtained using CLC blocks was approximately 168.1 mm2 i.e. 8.635 Kg. Also there study showed that the use of fly ash in foamed concrete, can greatly improve its properties. Ashok Kumar, D. Buddhi, D. S. Chauhan, "Indexing of Building Materials with Embodied, Operational Energy and Environmental Sustainability with Reference to Green Buildings"[3]. Researchers considered Embodied energy, CO2 emissions and cost of raw materials associated the fire clay bricks and ash blocks for study. Cost of material with clay bricks and ash block was Rs 39413 and Rs 45869 respectively, however, embodied energy with clay bricks and ash block 15394 kWh and 6655 kWh were respectively. Cost of ash block structure was 16% higher as compared to fire clay brick structure but the embodied energy content for ash block structure was 57% less.

The paper focused upon comparison of two types of structures using fire clay bricks and ash blocks structure. Though ash blocks was 3 times costlier than fire clay bricks but the use of ash blocks had considerably reduced the size of air conditioning system, total usage of energy and finally the total cost of building due to its light weight and insulating nature. Hence, use of ash blocks had helped in conserving the natural resources, energy and environment. B. Surekha, M. N. Hegde, & K. S. Jagadish, "Energy And Building Materials"[4]. Researchers conduct study on embodied energy of Building materials. The energy intensity was calculated as per the data collected from manufactures in and around Bangalore City. Building materials include natural material, processed materials and Building elements. Embodied energy for alternative building materials and building elements was also presented. Burnt brick was the major contributor to the embodied energy of a building since it represents the largest volume in a building besides having a high energy value ranging between 4.63MJ to 6.13MJ per unit. Alternatives to brick like the stabilized Mud Block, Hollow concrete Block and cut sand stone lead to significant reductions in embodied energy.

3. Material

3.1 Material: Foam

Protein based foaming agent concentrate, is used to make the light concrete or foam concrete. First it is to diluted in water and then foam is produced in a concrete foam generator with compressed air. Foam produced has very fine and stable high quality foam. Stability and density depend on dilution & settings of the foam generator.

Protein based foaming agent gives high stability of the foam, successfully with standing the conditions when mixing, conveying (pump-able), pouring, casting and during the setting and hydration process.

3.2 Material: Cementitious

Fly ash one such material obtained by combustion of coal. It is finely divided residue and transported by fuel gas. India is a resourceful country for fly ash generation with an annual output of over 110 million tons, but utilization is still below 20% in spite of quantum jump in last three to four years. Availability of consistent quality fly ash across the country and awareness of positive effects of using fly ash in concrete are pre- requisite for change of perception of fly ash from 'A waste material' to 'A resource material'.

Now a day's due to strict control on quality of coal and adopting electrostatic precipitators, fly ash of consistent quality is separated and stocked, and it is gaining popularity as a good pozzolonic material for partial replacement of cement in concrete. UFGGBS Fly Ground Granulated Blast furnace slag (GGBS) is a byproduct for manufacture of pig iron and obtained through rapid cooling by water or quenching molten slag. If slag is properly processed then it develops hydraulic property and it can effectively be used as a pozzolonic material. However, if slag is slowly air cooled then it is hydraulically inert and such crystallized slag cannot be used as pozzolonic material.

3.3 Methodology

In this paper we have considered 3 cases.

Case i) Increasing the volume of foam by 0%, 25% and 50%, with 50% OPC and 50% GGBS.

Case ii) Increasing the volume of foam by 0%, 25% and 50% with 30% OPC and 70% GGBS.

Case iii) Increasing the volume of foam by 0%, 25% and 50% with 50% OPC and 47% GGBS and 3% Alccofine.

4. Test & Results

4.1 Compressive Strength

In this we have increased the volume of foam by 0%, 25%, 50% with 50% OPC and 50% GGBS. The compressive strength test for 54 number of specimen was casted and tested for 3, 7 and 28 days. The results are shown in figure 1 & 2.

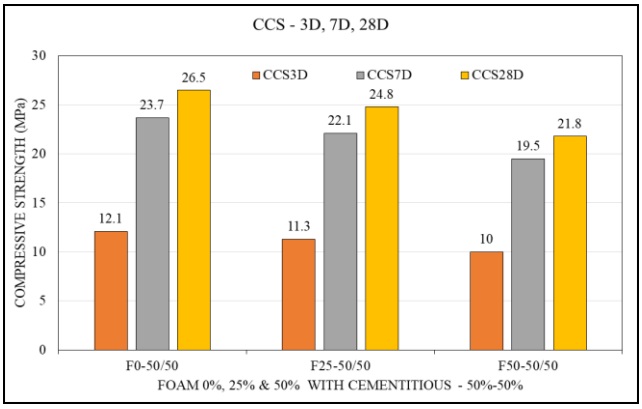

Figure 1: Foam 0%, 25%, 50% with cementitious material 50% OPC & 50% GGBS

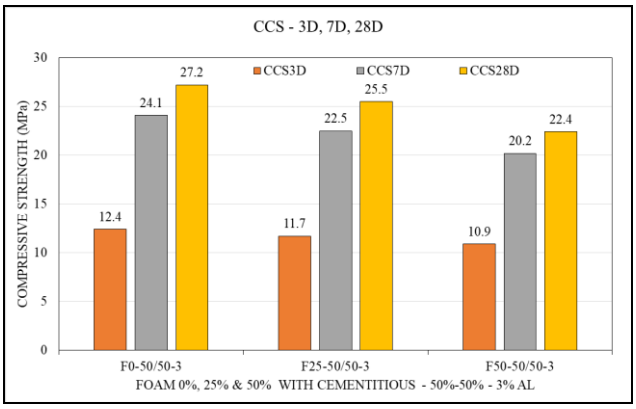

Figure 2: Foam 0%, 25%, 50% with cementitious material 50%OPC & 47%GGBS, 3%Alccofine.

4.2 Water absorption

The core cut of size 100mm diameter and 50 mm thick is cut through the cube casted for water absorption test. Total 18 specimen were tested and results are shown in graphical format below. Water absorption test was conducted on 28th day of casting. Graphical results showing in figure 3 & 4.

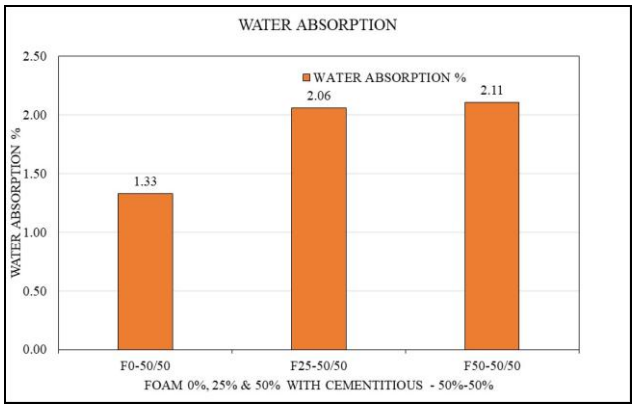

Figure 3: Foam 0%, 25%, 50% with cementitious material 50%OPC & 50%GGBS.

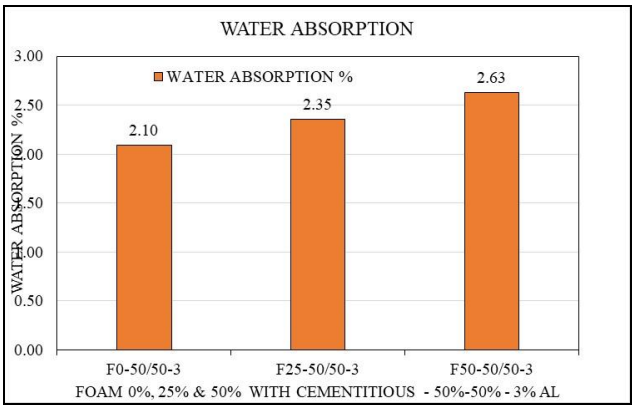

Figure 3: Foam 0%, 25%, 50% with cementitious material 50% OPC & 47% GGBS, 3% Alccofine.

The water absorption increases with the increase in foam percentage. With the use of ultrafine material water absorption reduction is observed when compared with normal cementitious material.

4.3 Water sorptivity

The core cut of size 100mm diameter and 50 mm thick is cut through the cube casted for water sorptivity test. Total 18 specimen were tested and results are shown in graphical format below.

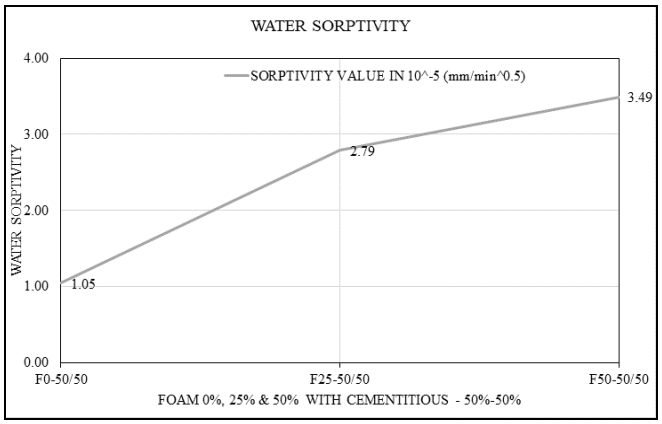

Figure 5: Foam 0%, 25%, 50% with cementitious material 50%OPC & 50%GGBS.

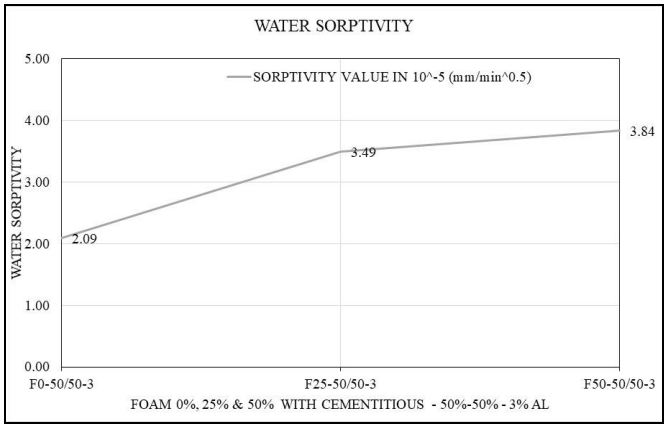

Figure 6: Foam 0%, 25%, 50% with cementitious material 50%OPC & 47%GGBS, 3%Alccofine.

The water sorptivity increases with the increase in foam percentage. With the use of ultrafine material water sorptivity reduction is observed when compared with normal cementitious material.

5. Conclusion

From the experimental work and results, we can conclude the early and later strength increases with the increasing finer materials like GGBS and Ultrafine GGBS. The durability of concrete is better with the reduction in water absorption and water sorptivity properties and these properties shows better results when the ultrafine materials are used. Replacement of cementitious material with foaming agent has great impact on concrete density as increase in foam percentage decreases the weight of concrete block. For the structural stability it is better to use CLC blocks as it reduces total weight on foundation, ultimately results in reduction of foundation sizes.

6. Acknowledgement

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References

[1] A. K. Marunmale, A.C.Attar, "Designing, Developing and Testing of Cellular Lightweight Concrete Brick (CLC) Wall built in Rat-Trap bond", Current Trends in Technology and Science Vol.3, Issue: 4, June-July 2014, pp331-336
[2] Aniket Gupta, Mukul Rathore, "Comparative Study and Performance of Cellular Light Weight Concrete", Proceedings of International Interdisciplinary Conference On Engineering Science & Management, Goa, 17th - 18th December 2016, pp228-232
[3] Ashok Kumar, D. Buddhi, D. S. Chauhan, "Indexing of Building Materials with Embodied, Operational Energy and Environmental Sustainability with Reference to Green Buildings", Journal of Pure and Applied Science & Technology, Vol. 2(1), Jan 2012, pp. 11-22
[4] B. Surekha, M. N. Hegde, & K. S. Jagadish, "Energy And Building Materials", International Journal of Civil Engineering, Vol. 5, Issue 5, Aug - Sep 2016, pp13-24
[5] Deepak Bansal , Pooja Nandy, "Embodied Energy in Residential Cost Effective Units (Single Storied) Up to 50 Sqm Plinth area", International Conference on Sustainable Built Environment (ICSBE-2010), Kandy, 13-14 Dec. 2010, pp321-335
[6] Ghanshyam Kumawat, Dr. Savita Maru, "Analysis and Comparison of R.C.C. Structure Using CLC Block With Burnt Clay Bricks", International Journal of Engineering Research and General Science, Vol. 4, Issue 3, May-June. 2016, pp463-467
[7] Ghanshyam Kumawat, Savita Maru, Kamal Kumar Pandey, " Cost Comparison of R.C.C. Structure using CLC blocks with Burnt Clay Bricks", International Journal of Advanced Research (2016), Vol. 4, Issue 7, pp.1470-1475
[8] Jayeshkumar S. Jaina, R. R. Salgudeb, "Comparison of Carbon Emission & Embodied Energy between Brickwork & Waffle wall method for Industrial Building", International Journal of Innovative and Emerging Research in Engineering Vol. 2, Issue 6, 2015, pp1-4
[9] K.Krishna Bhavani Siram, "Cellular Light-Weight Concrete Blocks as a Replacement of Burnt Clay Bricks", International Journal of Engineering and Advanced Technology (IJEAT) Vol.2, Issue.2, Dec.2012, pp149-151
[10] K.Krishna Bhavani Siram, K.Arjun Raj, "Concrete + Green = Foam Concrete", International Journal of Civil Engineering and Technology, Vol. 4, Issue 4, July-August (2013), pp. 179-184
[11] K.Mahendran, T.Sivaram, M.Shahulhameed, R.Logaraja, "A Comparative Study on Various Building Blocks as an Alternative to Conventional Bricks", International Conference on Emerging Trends in Engineering and Managment Research , NGSPM'S Bramha Valley College of Engineering and Research Institute , Anjaneri, Nashik, March 2016 pp1097-1109
[12] Krishna A. Joshi, A.R. Kambekar, "Optimization of Energy in Public Buildings",
[13] International Journal of Research in Engineering and Technology, Nov-2013, pp423-427
[14] M. T. S. Lakshmayya, R. Chiranjeevi Rahul, "Comparative Study of Load Bearing Block Masonry Work in Housing", International Journal of Engineering and Technology, Vol. 8, No. 5, Oct-Nov 2016, pp 2137-2148.
[15] Marco Aurelio Gonzalez Stumpf et. al, "A case study about embodied energy in concrete and structural masonry buildings", Journal of Construction, 2014, 13(2), pp.9-14
[16] Margot Pellegrinoa , Biswajit Thakurb, Himadri Guhac, Marco Simonettid, "International Conference on Green Buildings and Sustainable Cities Energy efficient choice of brick façade in Kolkata, India", Procedia Engineering 21 (2011), pp.737 – 744
[17] IS 2185 (Part 1): 2005, "Concrete Masonry Units – Specification" Part 1- Concrete masonry unit hollow and solids blocks, 2005.
[18] IS 2185 (Part 2): 1983, "Concrete Masonry Units – Specification"" Part 2- Concrete masonry unit light weight hollow and solid blocks, 1983.
[19] IS 2185 (Part 3): 1984, "Concrete Masonry Units – Specification" Part 3- Concrete masonry unit autoclaved blocks, 1984.

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