Experimental Investigation on Light Weight Concrete using EPS

Gunasheela P
Department of Civil engineering
R R Institute of Technology, VTU
Bangalore , India

Priyadarshini H P
Department of Civil Engineering
R R Institute of Technology, VTU
Bangalore, India

***Abstract*—Concrete is the most consumed material on this earth next only to water. It is very difficult to imagine any civil engineering structure without the use of concrete and reinforcement. The weight of concrete material is one of the major concerns in design of high rise. Very few carried out study on predicting the properties of light weight concrete from the knowledge of its mixture proportions. In this project, EPS beads replaced with coarse aggregate in 0, 0.25, 0.5, 0.75 and 1% and aluminum powder is replaced with cement 0, 0.25, 0.5, 0.75 and 1%. Mechanical properties like compressive strength, Split Tensile strength is studied. The study shows slight decrease in strength compared to conventional concrete but weight of the concrete member decreased. Hence, it can be used in the light weight concrete, infill walls, non-load bearing walls and also it is cost**

Keywords—Light weight concrete; EPS Beads;, aluminum powder; concrete; compressive strength; foam concret

I. INTRODUCTION

In construction project the main use of lightweight cement block is to reduce the dead load of block structures resulting in reduction in the size of columns, beams, foundations and other load bearing elements. Cellular (aerated) cement block is a lightweight material composed of cementations mortar surrounding disconnected bubbles which are a result of either physical or chemical processes during which either air is introduced into the mortar mixture or gas is formed within it. Although aerated cement block is known as an insulation material, its structural features are also of considerable interest. Indeed, the future need for construction materials which are light, durable, economic and environmentally sustainable has been identified by many groups around the world. With the possibility of producing a wide range of densities (400- 1800) kg/m3. Light concrete is a special concrete which weighs lighter than conventional concrete. Expanded polystyrene beads(EPS) is a rigid, closed cell, thermoplastic foam material. Light weight concrete is a mixture of cement, fine sand, water and special foam which once hardened results in a strong and lightweight concrete. Light weight concrete is both fire and water resistant.It possesses high (impact and air-borne) sound and thermal insulation properties.

II. OBJECTIVES

- First, To determine the compressive strength and split tensile strength of the light weight concrete.
- To determine the mechanical properties of light weight concrete using A.p= 0%, 0.25%, 0.5%, 0.75% and 1%.
- To determine the mechanical properties of light weight concrete using EPS beads =0.25%.

III. MATERILAS AND METHODOLOGY

A. Materials

1. Cement
2. Fine Aggregate
3. Aluminum powder
4. Water
5. EPS Beads

1. Cement: Among many brands of cement available at Bengaluru, one which is more popular, the Ultra Tech cement of 53 grades OPC has been used in the study.
2. Fine aggregate: The locally available natural river sand is procured and is found to be conformed to grading zone-II of Table of IS 383- 1970. Various tests have been carried out as per the procedure given in IS 383(1970) from them it is found that.
   - Specific Gravity of fine aggregate is 2.66
   - Fully compacted density of fine aggregate is 1670 kg/m3
   - Partially compacted density of fine aggregate is 1500 kg/m3
   - Fineness Modulus of Fine Aggregate is 3.2
3. Aluminum powder: properties
   - Molecular Formula:
   - Al Form: Powder Color: Silver
   - Melting point: 6600C (12200F)
   - Boiling point: 24670C (44730F)
   - Density: 2.7g/ml at 250C (770F)
   - Ignition Temperature: 7600C(14000F)
   - Auto Ignition Temperature: Catches fire spontaneously if exposed to air. Oder: Odorless
4. Water: Water that is potable is generally fine for use in the mix.
5. EPS Beads: Expanded Polystyrene. Expandable polystyrene eps foam beads (Expandable Poly Styrene) is a lightweight, rigid, plastic foam insulation material produced from solid particles of polystyrene. The gas expands under the action of heat, applied as steam, to form perfectly closed cells of EPS. EPS has a reduced thermal conductivity, with a density of about 28-45kg/m3. It therefore acts as an insulator keeping products cold or warm depending on the application.

B. CUBE COMPRESSIVE STRENGTH OF CONCRETE

- For each percentage of aluminum powder, 3 cube specimens have been cast. In all cubes of size 150 mm x 150 mm x 150 mm have been cast

C. SPLIT TENSILE STRENGTH

For each percentage of Aluminum powder, 3 cylindrical specimens have been cast. In all cylinders of size 150 mm diameter and 300 mm height, have been cast.

IV. RESULTS

A. Compressive strength

TABLE 1: SHOWING COMPRESSIVE STRENGTH OF LIGHT WEIGHT CONCRETE FOR 7, 14 AND 28DAYS

Trial mix M20	Specimen sample	W/C ratio	LOAD	Aluminium Powder %	Compressive strength (N/mm^2)
7 days	S1	0.5	141	0	6.25
	S2	0.5	90	0.25	4
	S3	0.5	113	0.5	5
	S4	0.5	101	0.75	4.5
	S5	0.5	96	1	4.25
14 days	S1	0.5	439	0	19.5
	S2	0.5	270	0.25	12
	S3	0.5	360	0.5	16
	S4	0.5	337	0.75	15
	S5	0.5	286	1	12.75
28 days	S1	0.5	563	0	25
	S2	0.5	360	0.25	16
	S3	0.5	473	0.5	21
	S4	0.5	450	0.75	20
	S5	0.5	383	1	17

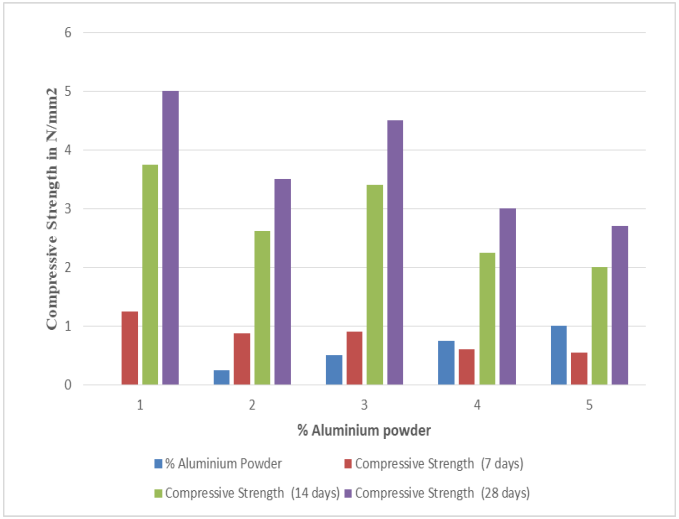

Fig 1: Graph showing compressive strength of Light weight concrete for 7, 14 and 28days

- Increase in percentage of Aluminium Powder and decrease in Compressive Strength after 28 days.

B. Splite tensile strength

TABLE 1: SHOWING SPLITE TENSILE STRENGTH OF LIGHT WEIGHT CONCRETE FOR 7, 14 AND 28DAYS

Trial mix M20	Specimen sample	W/C ratio	LOAD (P) in KN	Aluminium Powder %	Split Tensile strength (N/mm^2)
7 days	S1	0.5	141	0	1.25
	S2	0.5	62	0.25	0.875
	S3	0.5	64	0.5	0.9
	S4	0.5	42	0.75	0.6
	S5	0.5	39	1	0.54
14 days	S1	0.5	265	0	3.75
	S2	0.5	185	0.25	2.62
	S3	0.5	233	0.5	3.3
	S4	0.5	160	0.75	2.25
	S5	0.5	114	1	2
28 days	S1	0.5	353	0	5
	S2	0.5	247	0.25	3.5
	S3	0.5	318	0.5	4.5
	S4	0.5	212	0.75	3
	S5	0.5	191	1	2.7

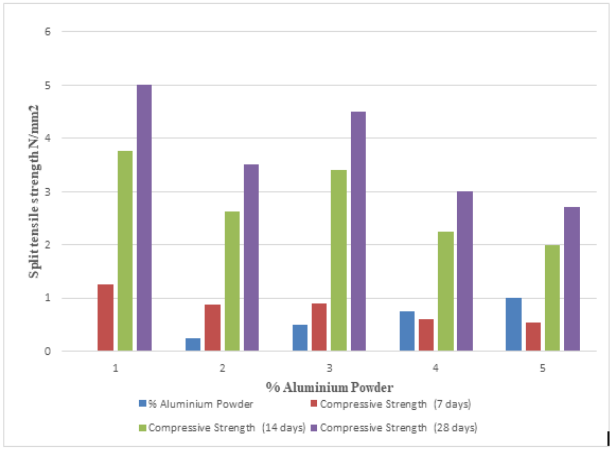

Fig 2: Graph showing split tensile strength of Light weight concrete for 7, 14 and 28days

C. *COMPRESSIVE STRENGHT COMPARISION BETWEEN LIGHT WEIGHT AND NORMAL CONCRETE OF 7 DAYS ,14 DAYS AND 28 DAYS*

W/C %	Weight in Kg	EPS + AP (%)	Compressive Strength N/mm^2 7days Curing	Compressive Strength N/mm^2 14days Curing	Compressive Strength N/mm^2 28days Curing
0.5	8.5	0	6.25	19.5	25
0.5	6.2	0.25+0.5	5	16	21

FIG 3: Graph Showing Compressive Strength Comparison Between Light weight and normal concrete 7 Days ,14 Days And 28 Days

D. *SPLITE TENSILE STRENGHT COMPARISION BETWEEN LIGHT WEIGHT AND NORMAL CONCRETE OF 7 DAYS ,14 DAYS AND 28 DAYS*

W/C %	Weight in Kg	EPS + AP (%)	Split Tensile Strength N/mm^2 7days Curing	Split Tensile Strength N/mm^2 14days Curing	Split Tensile Strength N/mm^2 28days Curing
0.5	12.5	0	1.5	3.75	5
0.5	9.18	0.25+0.5	0.9	3.4	4.5

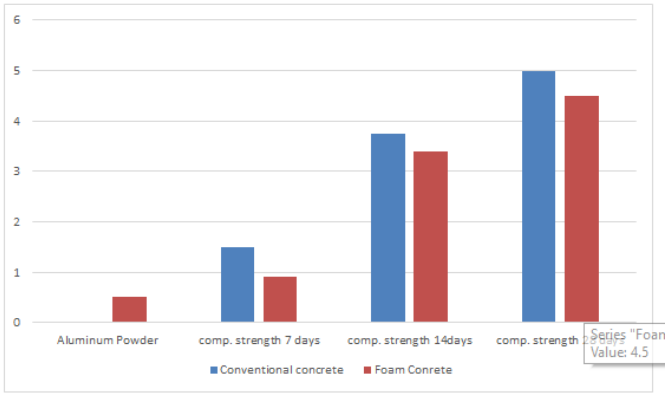

FIG 4: Graph Showing Split tensile Strength Comparison between Light weight and normal concrete 7 Days, 14 Days And 28 Days

V. CONCLUSION

After conducting the Project and various tests we found out the compressive strength of the Lightweight Foam Concrete after:

- 7th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 6.5 N/mm2) and decrease by 20%
- 14th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 19 N/mm2) and decrease by 18%.
- 28th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 26 N/mm2) and decrease by 16%.
- Increase in percentage of Aluminium Powder and decrease by 16% in Compressive Strength after 28 days.
- After conducting the Project and various tests we found out the Split Tensile of the Lightweight Foam Concrete after:
- 7th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 0.9 N/mm2) and decrease by 28%.
- 14th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 3.4 N/mm2) and decrease by 12%.
- 28th days: The strength is maximum when the Aluminum powder is 0.5% with W/C 0.5% and EPS 0.25% (i.e., 4.5 N/mm2) and decrease by 10%.
- Increase in percentage of Aluminium Powder and decrease by 10% in Split Tensile Strength after 28 days.
- The use of aluminium powder decreases the dead weight and the strength of the concrete as compared to normal concrete.
- Based on the results of these work it can be concluded that M20 shows overall good strength at 7 days,14 days and 28 days of compressive strength. As far as split tensile strength is concern M20, overall shows good tensile strength compare with other mixes.
- 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.

VI. FUTURE SCOPE OF PROJECT

- Light weight concrete seem can be used as a great option as building insulation
- GGBS and other mineral admixtures like fly ash can be replaced for the cement in various percentages and mechanical properties can be studied.
- The other foaming agent can also be used as a foaming agent. Aluminium Powder, sodium lauryl sulphate, EABASSOC.
- Other materials like glass powder, river sand, M-sand can be used for the partial replacement of fine aggregates.
- Fire resistance, thermal conductivity and other parameters of the light weight concrete can be studied

REFERENCES

[1] Research carried out by Dr. M. Shahul Hameed, Ms. A. Dhanalakshmi, Mr. B. Daniel Jeba kumar in 2021Experimental study on Foam concrete. Civil and Environmental Researchwww.iiste.org ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online) Vol.3, No.10,2021.

[2] Research carried out by – Murat Gocke & Burcin S Seker in the year 2020 Report on foam concrete- "Foam concrete"

[3] Research carried out by Sajan k Jose, Mini Soman, in the year 2020 "Experimental study on Foam Concrete", International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN(P): 2249-6866; ISSN(E): 2249-7978 Vol. 4, Issue 1, Feb2014.

[4] P. Ranapratap et al (2016), "Expanded Polystyrene as partial sand replacement in concrete a review", International Journal of Latest

Research In Engineering and Computing (IJLREC) Volume 5, Issue 2 , Page No. 13-16 March-April 2017.
[5] P. Aggarwal et al. (2015), "Expanded Polystyrene as partial sand replacement", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).
[6] Ameer A. Hilal, Nicholas H. Thom, and Andrew R. Dawson et al (2015), "The Use of Additives to Enhance Properties of Pre-Formed Foamed Concrete", IACSIT International Journal of Engineering and Technology, Vol. 7, No. 4, August2015.
[7] Ashish S. Moon, Dr. Vison Varghese, S. S. Waghmare et al (2015), "Foam Concrete as A Green Building Material", International Journal for research in emerging science and technology, E-ISSN: 2349-7610, Volume-2, Issue-9, September2015.
[8] P.S. Bhandari, Dr. K.M. Tajne et al (2014), "Cellular Lightweight Concrete Using Expanded Polystyrene", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 11, November2014.
[9] Building Materials and Constructions Books (Dr. B.C Punmia, Er. Ashok. K Jain, Dr. Arun Jain)
[10] Concrete and Construction Technology Books (A.M. Neville, J.J Brooks)
[11] I S:456-2000 -CODE BOOKS
[12] [12] IS:6042: Code of practice for construction of a Light Weight Concrete.