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Flexural behaviour of light weight concrete panel using Ferro cement

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Abstract: A type of ultra light foamed concrete (FC), which can be used as a new energy-conservation and environmental-protection building material and is particularly suitable for the thermal-insulation engineering of building external walls, was produced, Ferro cement is a highly versatile form of composite materials made of cement mortar and layers of wire mesh. Light weight concrete is prepared by mixing foam in concrete and the ratio of foam added is 40% of cement volume and the cement sand ratio is 1:1.5 and to increase the tensile property of the concrete steel square mesh is placed in-between the concrete, the influence of single layer mesh and double layer mesh used were reported and it is being compared with normal Ferro cement panel.

Keywords: Foamed concrete, Ferro-cement, steel square mesh, Foaming agent.

I. INTRODUCTION

Foamed concrete (FC) belongs to the broader category of cellular concrete in which air-voids are trapped in the mortar matrix using a suitable aerating agent. It is lightweight and has moisture protection, fire protection, sound insulation, and good heat insulation; therefore, it has been successfully applied in oil-well cementing projects, used as a backfill material in excavation projects, and used for sound and heat insulation in building panels, fire-protection wall, energy-absorbing pads in roads, road sub base, structural fill, foundations, and geotechnical and mine fill applications. The light weight concrete has a density 800Kg/m³ and to increase the tensile property of the concrete square mesh is used in the concrete. This light weight concrete panel is applicable to all non-load bearing structures.

II. LITERATURE REVIEW

Zaher Mundher,Ravinesh C..Deo,Ameer ilal has done a research using a machine learning mode namely extreme learning machine (ELM) is proposed to predict the compressive strength of foamed concrete. The potential of the ELM model is validated in comparison with multivariate adaptive regression spline, the lightweight foamed concrete is produced via creating a cellular structure in cementations matrix during the mixing process, and is widely used in heat insulation, sound attenuation, roofing, tunnelling and geotechnical applications.

Karel mikulica, Rudof hela used foam concrete for the interlayer between the support and load distribution parts of the floor and ceiling structure during their rehabilitation.

Ameer A Hilal, Nicholas H. Thom, Andrew R. Dawson done an experimental study of an enhancemnt of pre-formed foamed concrete, by utilizing two types of additives, silica fume and fly ash to partially replace Portland cement and fine aggregate .

Nur kamaliah Bniti Mustaffa has described the reduction of self weight using a foam concrete in construction. This study investigates the structural behaviour of foamed concrete slab reinforcement with welded wire mesh. A model using layered elasto-plastic beam functional non-lined finite element analysis to predict behaviour strength of reinforced foam concrete panel.

Md Azreeothuman Mydin in this paper LFC is cementations materials integrated with mechanical entrained foam in mortar shall which can produce a variety densities ranging from 400-1600kg/m³. This study investigates the potential of using LFC in building construction as non-load bearing participation of high weight load bearing structural members. Extensive compressive and bending test at elevated temperature were performed for LFC and density of 650 and 1000 kg/m³.

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III. METHODOLOGY

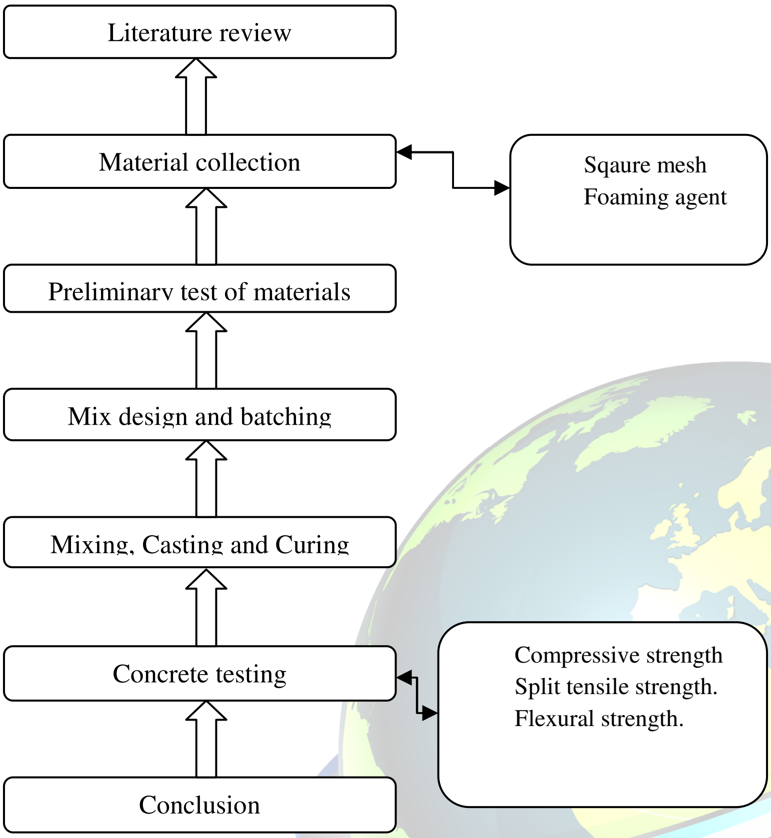

Fig.1 Methodology Flow chart

1. Preparation of foam

The total volume of the foam in the concrete is 40% and 1L of foaming agent is capable of producing 1000L of foam while mixing it by mechanical equipment. The total amount of foam needed is calculated and the mix ratio of water is mixed and well stirred to produce foam.

Fig. 2 Generation of foam.

2. Preliminary Test on Materials

2.1 Cement

Ordinary Portland Cement(OPC) of 53 grade having specific gravity of 3.16 is used.

2.2 Fine aggregate

River sand belongs to Zone II having specific gravity of 2.668 is used.

2.3 Water

Locally available potable water is used.

2.4 Foaming agent

Liquid chemical foaming agent is used .

3. Mix Design and Batching

We designed a mix for M25 grade concrete for the following datas.

a. Grade designation : M25
b. Type of cement : OPC 53 grade
c. Minimum cement content : 320 kg/m^3
d. Maximum water-cement ratio : 0.50
e. Exposure condition : Moderate
f. Method of placing : Manual
g. Degree of supervision : Good
h. Type of aggregate : fine aggregate
i. Maximum cement content : 450 kg/m^3

4. Mixing, Casting and Curing

4.1 Mixing

The mixing involves, mixing of foam in concretes. The specimens without foam are also used for comparison purpose. Light weight concrete panel and a normal Ferro cement using mortar is compared.

4.2 Casting

The casting involves, casting of cube of size 150mmx150mm and Cylinder of diameter 150mm and length 300mm, and panel size 600mmx200mmx50mm.

4.3 Curing

Curing of concrete panel is done by completely immersing it in water.

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5. Concrete Testing

5.1 Compressive Strength Test

A total of 9 cubes were tested for Compressive Strength. Compressive strength of 7 days, 14 days and 28 days curing were tested.

5.1.1 Compressive strength of cubes at 7 days curing

S. No.	NAME	WEIGHT	LOAD	COMPRESSIVE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	5.338	100	4.44	4.48
2.		5.326	102	4.53	
3.		5.296	101	4.48	

Table 1 Compressive strength of cubes at 7 days

5.1.2 Compressive strength of cubes at 14 days curing

S. No.	NAME	WEIGHT	LOAD	COMPRESSIVE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	5.400	107	4.75	4.88
2.		5.234	111	4.93	
3.		5.433	112	4.97	

Table 2 Compressive strength of cubes at 14 days

5.1.3 Compressive strength of cubes at 28 days curing

S. No.	NAME	WEIGHT	LOAD	COMPRESSIVE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	5.368	140	6.22	6.26
2.		5.296	144	6.40	
3.		5.486	139	6.17	

Table 3 Compressive strength of cubes at 28 days

5.2 Split Tensile Strength Test

A total of 45 Cylinders were tested for split tensile strength including both the specimens of with and without bacteria. In this test, concrete cylinder is subjected to compression load along two axial lines which are diametrically opposite. The test was carried out by placing cylindrical specimen horizontally (using plates) along the loading surface of compression testing machine.

5.2.1 Split Tensile strength of cylinders at 7 days curing

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	8.445	55	0.78	0.76
2.		8.575	51	0.72	
3.		8.786	56	0.79	

Table 7 Split tensile strength of cylinders at 7 days

5.2.2 Split Tensile Strength of cylinders at 14 days curing

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	8.445	70	0.99	1.013
2.		8.575	74	1.04	
3.		8.786	72	1.01	

Table 8 Split tensile strength of cylinders at 14 days

5.2.3 Split Tensile strength of cylinders at 28 days curing

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight concrete	8.445	81	1.15	1.13
2.		8.575	78	1.10	
3.		8.786	82	1.16	

Table 9 Split tensile strength of cylinders at 28 days

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FLEXURAL STRENGTH TEST FOR PANEL

Flexural strength is one measure of the **tensile** strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending.

$$f = pl/bd^2$$

Fig. 3 Flexural test of specimen

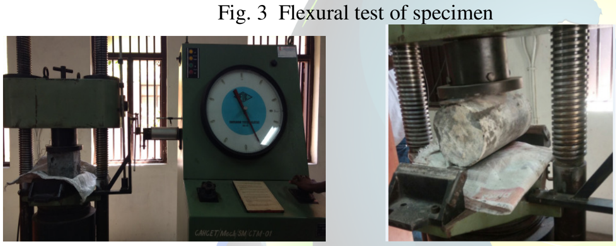

Fig. 4 Compression and Split Tensile strength test of specimen

5.2.4 . Flexural strength test of panel at 7th day:

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight panel single layered mesh	8.756	3	2.7	2.7
2.		8.848	3	2.7	
3.		8.944	3	2.7	
1.	Light weight panel double layered mesh	9.484	3.5	3.15	3.3
2.		8.993	3.5	3.15	
3.		8.839	4.0	3.60	
1.	Ferro-cement panel	14.230	6.5	5.85	5.7
2.		13.948	6.0	5.40	
3.		13.989	6.5	5.85	

Table 10 Flexural strength test of panel at 7th day

5.2.5 . Flexural strength test of panel at 14th day:

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight panel single layered mesh	8.396	4.5	4.05	4.05
2.		8.838	4.0	3.60	
3.		8.944	5.0	4.50	
1.	Light weight panel double layered mesh	9.564	5.5	4.95	5.10
2.		8.383	5.5	4.95	
3.		8.893	6.0	5.40	
1.	Ferro-cement panel	14.273	6.5	5.85	6.3
2.		13.948	7.5	6.75	
3.		13.899	7.0	6.30	

Table 11 Flexural strength test of panel at 14th day

5.2.6 Flexural strength test of panel at 28th day:

S. No.	NAME	WEIGHT	LOAD	TESILE STRENGTH	AVERAGE STRENGTH
		KG	KN	N/mm²	N/mm²
1.	Light weight panel single layered mesh	8.783	5.0	4.5	4.65
2.		8.793	5.5	4.95	
3.		8.984	5.0	4.5	
1.	Light weight panel double layered mesh	9.334	6.0	5.4	5.55
2.		8.973	6.0	5.4	
3.		8.839	6.5	5.85	
1.	Ferro-cement panel	14.930	8.5	7.65	7.65
2.		13.938	9.0	8.10	
3.		13.949	8.0	7.20	

Table 12 Flexural strength test of panel at 28th day

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6. Graphical Representation

6.1 Mean Flexural Strength

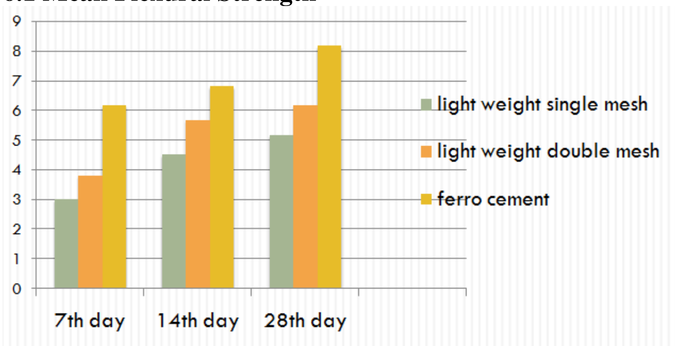

Fig. 5 Flexural strength of different specimens

IV. Conclusion

Based on the experimental investigation, we concluded the following results.

- The Flexural strength of the foam concrete obtained 75% of the Ferro cement panel .
- The flexural strength of the Ferro cement panel is 2.10 N/mm^2 higher than the lightweight panel.
- And the weight of Ferro cement panel is 5 kg higher than the light weight panel.
- By considering the weight and flexure strength the Ferro cement weighs more and gives 25% extra strength than the light weight panel, where as the light weight panel is 64% of Ferro cement panel and produces 75% of the flexural strength of Ferro cement panel.

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