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STUDY OF FOAM CONCRETE SLABS WITH REINFORCED MESH

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ABSTRACT

Foamed concrete, Foamed concrete, also known as foamed concrete or lightweight concrete, the composition mainly are water, cement, fine aggregate, fly ash, etc. It is made by processing various admixture materials. When making, the materials are processed through physical or chemical methods. Light-weight aerated concrete (LAC) is produced by addition of a gas-forming admixture like aluminium powder (AP) to a wet mortar mixture. In concrete during curing, AP will react with the calcium hydroxide in the mixture to form hydrogen. The amount of gas-forming is dependent on the mechanical properties' requirements. Because of its light weight, good thermal insulation performance, sound insulation and fire resistance, good overall performance, low elasticity and shock absorption, strong waterproof performance, convenient production and processing, good environmental performance, convenient construction, etc. it is mostly used as slope-finding for roof insulation, ground insulation cushion, foundation pit feeling of upturn beams, precast wall a, infill panels and wall pouring. The study with lightweight slabs is investigated in three cases - (1) LWC slabs with steel wire mesh reinforcement, (2) LWC slabs with fiber mesh reinforcement, (3) LWC slabs with combined fiber mesh and glass fiber. In this study, performance of slabs in different mesh reinforcement is monitored. This study is focusing on the formation of lightweight slabs with suitable and sustainable reinforcement.

Keywords - Light Weight Aerated concrete (LAC), Aluminium powder (AP), Mesh reinforcement, Glass Fiber.

1. INTRODUCTION

Light weight foam concrete is normally a slurry of cement, sand, water, other substitutes and foaming agent for light weight mixes. The density is normally controlled by substituting fully or part of fine aggregate with foam. The density of foam concrete normally varies from 400 kg/m^3 to 1600 kg/m^3. Usage of ingredients like fly-ash and silica fume is partial replacement for normal aggregates.

The main benefits of foam concrete is the lightweight properties, thermal & sound insulation properties, fire resistance. Another main advantage of using foam concrete is due to good workability. The thermal insulation mainly depends on the density of concrete. Up to 1600 kg/m^3 density mix produces low strength properties and increased densities provide high strength properties. The low-density foamed concrete is meant for non-structural purposes. And high densities might be used for structural purposes. There are more types like ultra-low density used in cavities, channel underground, excavations, and holes as filling material. It is also used as slope-finding for roof insulation, ground insulation cushion, foundation pit etc.

The strength of foam concrete depends upon dry density and also water / cement has a high impact in this. Here for improving mechanical properties also maintaining low density and light weight use of short glass fiber is established. During the mixing time these fibers were randomly poured in the cement paste. This will reduce drying shrinkage along with increasing the strength properties. The use of wire mesh reinforcement and fiber mesh reinforcement is established to improve the tensile property of foam concrete.

The main objectives are:

- To conduct an experimental investigation on foamed concrete.
- To understand the behavior of LAC slab using different reinforcements.
- To develop lightweight slabs with sufficient strength properties.
- To develop structures with minimum loss from earthquake impact.

1.1 Goal of the paper and research significance

This paper's objective is to describe a series of experimental findings from four-point bending tests carried out on a smaller scale foamed concrete slabs with a low-to-medium density range. A bi-directional grid of glass fibres is inserted into the tensile zone of the specimens to reinforce them and boost their flexural strength. Short polymer fibres are incorporated into the cementitious paste during the mixing process in a different diffused reinforcement layout that has been studied in addition to the aforementioned bi-directional reinforcing mesh.

There are many foaming agents used in foam concrete, we are using aluminium powder as foaming agents. Whereas there are many studies in the literature that focus how fibre reinforcement grids can increase flexural capacity, the distinct contributions of this study work include the following aspects, (1) use of steel wire mesh as reinforcement in foam concrete, (2) use of glass fiber mesh and short glass fiber as reinforcement in foam concrete, (3) use of steel wire mesh and short glass fiber as reinforcement in foam concrete.

3. METHODOLOGY

3.1 Mechanism

The introduction of a gas-forming material aluminium powder (AP) reacts with the Ca(OH)2 formed on the hydration of Portland cement to obtained hydrogen gas and a final result to produce the large pores structure of the concrete**.**

$$2Al + 3Ca(OH)_2 + 6H_2O \rightarrow 3CaO.Al_2O_3.6H_2O + 3H_2$$

Foam concrete is made using a process that creates bubbles by reacting aluminium powder with sodium hydroxide. There are different aerated concrete (AC) types are produced by addition or generating bubbles voids within the mortar mixes and the voids or cell structure having a homogeneous distribution in the cement and fine sand mix.

3.2 Preliminary

Several mix designs are carried out to find the best and optimum foam concrete mix. By varying different parameters will results in different density mixes. Mainly cement, fine aggregate, aluminium powder, fly ash, water content etc. Some of the main trial mixes carried out were listed,

Table 3.1. Mix Proportion

SL. NO	CEMENT: FINE	AL POWDER	FLY ASH	WATER CEMENT RATIO	WEIGHT OF CUBE (KG)	DENSITY (kg/m3)
1	1:2	1.2%	22 %	.65	.606	1722.12
2	1:1	1.2%	22 %	.65	.565	1605.61
3	1.5:1	1.2%	20 %	.65	.510	1449.31
4	2:1	1%	20 %	.65	.470	1335.6
5	2:1	1.2%	20 %	.65	.430	1244.7

3.3 Casting and Curing

Three set of cube, beam and cylinder were cast to determine the compressive strength, flexural strength and tensile strength of the concrete. The specimens are then subjected to immersed curing for 28 days.

Fig 3.1. Casting and Curing of Specimens.

3.4 Testing and Results

Table 3.2. Test Results

PROPERTIES	M30	FOAM CONCRETE	FOAM CONCRETE WITH GLASS FIBRE
Weight(kg)	8.28	4.15	4.16
Density	2453.33	1229.6	1232.5
Compressive Strength(n/Mm2)	31.3	6.67	9.33

Split Tensile Strength(n/Mm2)	2.037	1.4	1.83

- The weight of M30 concrete is higher compared to foam concrete, both with and without glass fiber.
- Foam concrete has a significantly lower density compared to M30 concrete, which indicates its lightweight nature.
- M30 concrete has a much higher compressive strength compared to foam concrete, with or without glass fiber. This is because of the light weight of foam concrete.
- The split tensile strength of foam concrete with glass fiber is higher compared to foam concrete without glass fiber, although it is still lower than that of M30 concrete.

3.5 Experimental Investigation

To study the properties of light weight foam concrete slab, three types of slabs were casted.

- ❖ Slab Reinforced with Wire Mesh.
- ❖ Slab Reinforced with Wire Mesh and glass fibre.
- ❖ Slab Reinforced with Glass Fibre Mesh and glass fibre.

The dimensions of the slab are 60mm X 60mm X 10mm. A cover of 25mm is provided for all sides.

- ❖ Slab Reinforced with Wire Mesh.

Fig 3.2. Casting of Slab – I

- ❖ Slab Reinforced with Wire Mesh and glass fibre.

Fig 3.3. Casting of Slab – II

- ❖ Slab Reinforced with Glass Fibre Mesh and glass fibre.

Fig 3.4. Casting of Slab – III

Three set of each type of slab were cast to determine their properties. The slabs are then allowed to curing for 28 days.

3.6 Testing of Slabs

Four-point bending test is carried out to determine the structural characteristics and the flexural strength of the slab.

- ❖ Slab Reinforced with Wire Mesh.

Fig 3.5. Testing of Slab - I

- ❖ Slab Reinforced with Wire Mesh and glass fibre.

Fig 3.6. Testing of Slab – II

- Slab Reinforced with Glass Fibre Mesh and glass fibre.

Fig 3.7. Testing of Slab - III

4. RESULTS AND DISCUSSIONS

In general, compared to the unreinforced foamed concrete slabs, we achieve a significantly higher flexural capacity with every reinforcing configuration. the existence of the bi-directional glass fiber.

Four-point bending test is carried out to determine the flexural strength of the slab.

Table 4.1. Flexural Strength

Type	Ultimate Load (kN)	Flexural Strength (MPa)
Slab with wire mesh	13.2	1.32
Slab with wire mesh and glass fibre	18.86	1.88
Slab with glass fibre mesh and glass fibre	15.71	1.57

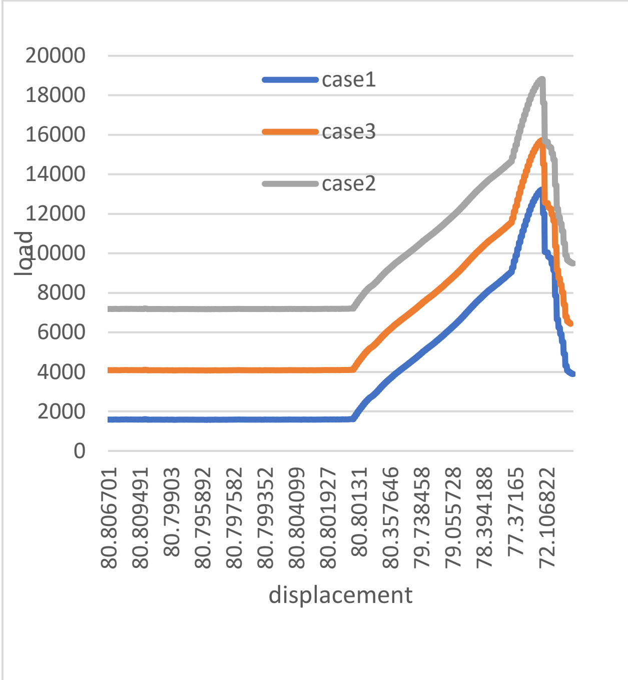

Fig 3.8 load vs. displacement graph

5. CONCLUSION

In this study, an experimental operation using foamed concrete slabs was run to test the possibility of increasing flexural strength using various reinforcing configurations.

- The addition of aluminium powder to the cement paste increases the total volume and will reduce required quantity of other constituents.
- when AP content increased, the density of foam concrete decreased, but its porosity increased.
- Incorporation of glass fiber increased the strength of concrete to large extent.
- If glass fiber exceeds the permissible limit, it will affect the foaming action.
- Foamed concrete with steel wire mesh and glass fiber has shown more flexural strength.
- The weight of slab is very low compared to normal concrete.

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