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Performance of Foam Concrete

C.Sivasanthosh[1], S. Karthik[2], D. Samuel Abraham[3]

[1,2,3] Assistant Professor, Department of Civil Engineering, Sri Shakthi Institute of Engineering and Technology, Coimbatore.

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ABSTRACT

This project work which has been carried out to study about the performance of foam concrete in order to analyse the strength properties of this concrete. Because the advanced and modern materials which plays a major role in these concrete industry. So we have tried to analyse the performance of these foam concrete by analysing the strength properties of these concrete by adding foaming agent and different composition. By doing the same these properties and result obtained from the tests which are compared with the strength properties of ordinary Portland cement concrete has been done to understand the nature. The project aims to investigate the mechanical properties like compressive strength and split tensile strength for grade of concrete. The specimens were tested at 7 days and 28 days. In general concrete in strong in compression and weak in tensional property. The different applications of foam concrete where discussed in this study some of the advantages are thermal insulated, fire resistant, light weight etc,. To augment the properties of materials and improving their performances different materials which are need to be introduced, in which the foam concrete which has a light, strong, fire resistant, weather resistant ,attractive, impermeable material as needed.

KEYWORDS: Foaming Agent, Thermal insulated, light weight, acoustic , foam concrete.

1. INTRODUCTION:

A type of lightweight concrete called foam concrete is created by mixing cement, sand or fly ash, water, and the foam. Foamed grout or foamed mortar are examples of foam concrete. A cementitious mixture that contains at least 20 percent foam mechanically entrained into the plastic mortar is referred to as foam concrete. Foamed concrete's dry density can range from 300 to 1600 kg/m^3. Foam concrete's compressive strength, which was evaluated after 28 days, ranges from 0.2 to 10N/mm^2 or higher. **Foamed concrete** refers to blown-out concrete grade. Foamed concrete consists of cement agent, silicic component, water and structure-forming additives. Porous structure is achieved by foam injection into mortar. In terms of the amount of air entrained, foam concrete is distinguished from air entrained concrete. Concrete with air entrained aggregates absorbs 3 to 8% air. Due to the same factor of the percentage of air entrained, it also differs from aerated concrete and retarded mortar. It ranges from 15 to 22 percent in the case of retarded mortar systems. In the case of aerated concrete, the bubbles are chemically created.

2. LITERATURE REVIEW:

The idea of a concrete mixture that can be consolidated into every corner of a formwork, purely by means of its own weight and without the need for vibration, was first considered in 1983 in Japan, when concrete durability, constructability and productivity became a major topic of interest in the country. During this period, there was a shortage of number of skilled workers in Japan which directly affected the quality of the concrete. The research in the field of Foam concrete has an accelerated growth in the recent years. The study on the various stages of Foam concrete are studied by many researchers, reveal the facts about Foam concrete, thus making it a practically wide applicable. Many research papers were published by various researchers, which show the engineering significance of Foam concrete are studied workability of concrete.

Maheshkumar H. Tharkrele [1], revealed conducted experimental study on foam concrete investigation two foam concrete mixtures are produced with and without sand and attempts have been made for selecting the proportions of foam concrete mix for the target plastic density of 1900 kg/m^3. 18 cube specimens are prepared and tested for mixtures, then their physical (Density) as well as specific structural(Compressive Strength) properties were investigated, Specific Strength and Percentage Strength gain for foamed concrete is compared with normal weight concrete and the results are reported.

Hameed et al., 2021. "Experimental Study on Foam Concrete" In this study, the author examined the effects of replacing cement with flyash at percentages of 0%, 10%, and 20% as well as the inclusion of fibres at dosages of 1% and 1.5% on the mechanical properties of foamed concrete. When cement is replaced with flyash at a dosage of 10%, it was shown that the compressive strength of foamed concrete is around 5N/mm^2, and the addition of fibres increases the split tensile strength when compared to standard mix.

Fallian and coworkers (2018) [8] Experimental research on foamed concrete's compressive strength: Effects of curing circumstances, cement type, foaming agent, and dry density. This paper presents the preliminary results of an ongoing foamed concrete experiment. Here, it is investigated how factors

such as cement type, dry density, water content, curing circumstances, and, most importantly, the cement paste's foaming agents effect compressive strength.

3. MATERIALS USED:

The materials which are used in this project which are based on mix design. The mix design has been done as per IS10262 2009, code book. The mix design is calculated for M30 concrete.

TABLE 1: CONSTITUENTS OF MATERIALS USED and mix rations:

MATERIAL	BRAND	Mix ratio(m^3)
cement	OPC 53	1
FA	R Sand	2.49
CA	Passing 12.5 mm sieve	2.73
Chemical Admixture	Super Plasticizer Conplast SP320	1%
Foaming Agent	hydrogen peroxide and plant surfactant RH Foaming Agent 701	0.14%
Mineral Admixture	Flyash	0.43
W/P	River Water	0.43

3.1 FOAMING AGENT:

A foaming agent, often known as a surfactant or a foaming agent, is a substance that promotes foaming. Small amounts of a surfactant can lower a liquid's surface tension (lessen the effort needed to create foam) or raise the colloidal stability of a substance by preventing bubbles from coalescing.

3.1.1: Properties of foamed concrete:

- **Low heat transfer.** Foamed cement concrete walls and floors do not require additional insulation because of the porous structure's effective insulation.
- **Good acoustic insulation.** Foamed concrete provides low noise transmission. This feature is necessary for making acoustical blanket on floor slabs made of structural concrete.
- **Ecological properties.** Foamed concrete is one of the most eco-friendly and non-hazardous materials, also it doesn't educe any harmful substances in operation. It is inferior in environmental compatibility only to wood, but at the same time foamed concrete has longer lifetime and is more reliable.
- **Fire safety.** Due to low heat transfer foamed concrete secures from fire and it is highly recommended for fire-resistant constructions.
- **Long time performance.** Foamed concrete is resistant to moistness and doesn't decay.
- **Comfort operation conditions.** In foamed concrete buildings , thermal loss in cold seasons is minimized, and summer conditioning costs decrease.

3.1.2: ADVANTAGES OF FOAM CONCRETE:

It's light in weight. It has low heat conductivity, which is not present in ordinary concrete, and good sound insulation capabilities, which are not present in ordinary concrete. It also has great freeze and thaw resistance.

• Because foam concrete is a free-flowing material, it may be installed without being compacted. Foam concrete can be poured into foundations or excavations and will follow every subgrade contour.

• Foam concrete may be easily pumped over a long distance with only moderate pressure.

• Foam concrete is a very durable substance. The durability of foam concrete is comparable to that of rock, and it does not degrade.

3.1.3: APPLICATIONS:

walls and partitions in low-height buildings, Exterior and enclosure structures in monolithic house-building, acoustic and heat insulation of inter-floor construction, roofs winterization, heat insulation of pipelines and process equipment, voids filling (shafts preservation), construction blocks, beams, wall panels and floors manufacturing.

4. RESULT:

The testes which has been done to determine the strength properties of foam concrete are Compressive, split-tensile and flexural strength.

The concrete cubes which has been prepared as per following mix proportions.

1. CC – Cement + F.A + C.A + Water
2. FC – CC + Fly ash + Superplastizer
3. FC1 – FC + 0.6 % of Foam agent
4. FC2- FC+ 0.7% of foam agent
5. FC_3 – FC + 0.8% of foam agent.

For each tests 3 samples were prepared and its average was considered. The tests which has been done at the intervals of 7 days, 14 days and 28 days.

4.1 COMPRESSIVE STRENGTH TEST:

Compressive strength of different concrete strengths Because concrete is primarily designed to endure compressive loads, the determination of compressive strength has drawn a lot of attention. The three different forms of compression test specimens used to calculate compressive strength are cubes, cylinders, and prisms. The typical dimensions of cubes are 100 or 150 mm on each side, cylinders are 150 mm in diameter and 300 mm high, and French prisms are 100 x 100 x 500 mm in size. According to the standards established for these tests, the specimens are cast, cured, and tested. When using cylinders, they must be properly sealed before tests; this step is not necessary when using other types of specimens.

The results of the compressive strength tests was mentioned in the table and its comparison is mentioned in the graph

Table 2: it shows the results of compressive strength test at 7,14 and 28 days of foam concrete cubes:

Average Compressive strength (Mpa)				
sample	c/s area(mm2)	7 DAYS	14 DAYS	28DAYS
CC	22500	23.39	28.36	32.36
FC		7.24	13.82	18.93
FC1		7.25	15.52	19.05
FC2		7.39	15.92	19.21
FC3		7.42	16.08	19.46

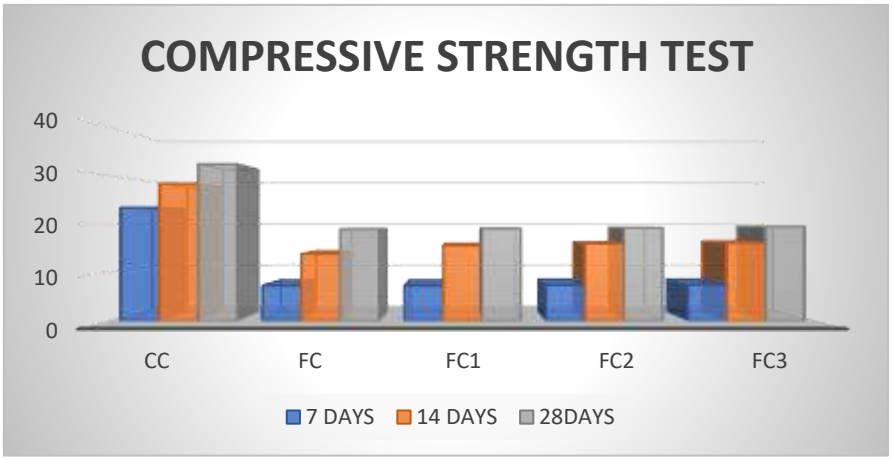

Figure 1: Shows the graphical representation of 7, 14, 28 days average compressive strength of foam concrete.

4.2 Split Tensile Strength test:

The tensile strength of the concrete is assessed using the split tensile test. In this project, fibre is added to the concrete to boost its tensile strength, which lowers post-crack formation. Concrete typically has a low tensile strength value. After 28 days of curing, remove the wet specimen from the water and wipe the specimen's surface dry. To make sure the specimen's two ends are in the same axial location, draw diametrical lines on each end. Keep in mind the specimen's weight and size. Set the required range for the compression testing device. Place the specimen and a plywood strip on the lower plate.

Table 3: it shows the results of split tensile strength test at 7,14 and 28 days of foam concrete cubes:

Avg Tensile strength Test				
sample	c/s area(mm2)	7 DAYS	14 DAYS	28DAYS
CC	50000	1.46	1.87	2.41
FC		1.22	1.63	1.89
FC1		1.24	1.66	1.82
FC2		1.26	1.54	1.98
FC3		1.25	1.69	1.75

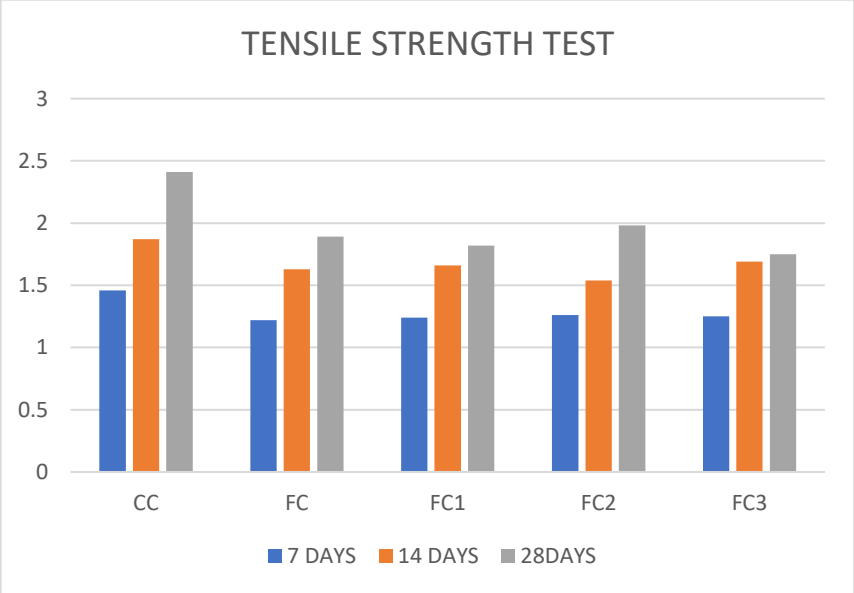

Figure 2: Shows the graphical representation of 7, 14, 28 days average split tensile strength of foam concrete.

4.3: Flexural Strength Test:

To determine the load at which the concrete members may crack, the flexural tensile strength must be determined. Flexure testing is used to calculate concrete's tensile strength because a direct tension test cannot be used to determine it. Thus, the modulus of rupture or the flexure tensile strength at failure is calculated and applied as needed. As flexural stress is essential in these situations, its knowledge is helpful in the construction of pavement slabs and airfield run ways. Standard test specimens of 150 mm x 150 mm x 700 mm over a span of 600 mm or 100 mm x 100 mm x 500 mm over a span of 400 mm are tested to determine the modulus of rupture under symmetrical two-point loading. As it is difficult to determine the tensile strength of concrete by carrying out a direct tension test, it is computed by flexure testing; the flexure tensile strength at failure or the modulus of rupture is thus determined and used as needed.

Table 4: it shows the results of flexural strength test at 7,14 and 28 days of foam concrete cubes:

Avg Flexural strength Test				
sample	c/s area(mm2)	7 DAYS	14 DAYS	28DAYS
CC	50000	2.46	2.85	3.63
FC		2.45	2.71	3.12
FC1		2.69	3.06	3.16
FC2		2.58	3.12	3.18
FC3		2.96	3.01	3.05

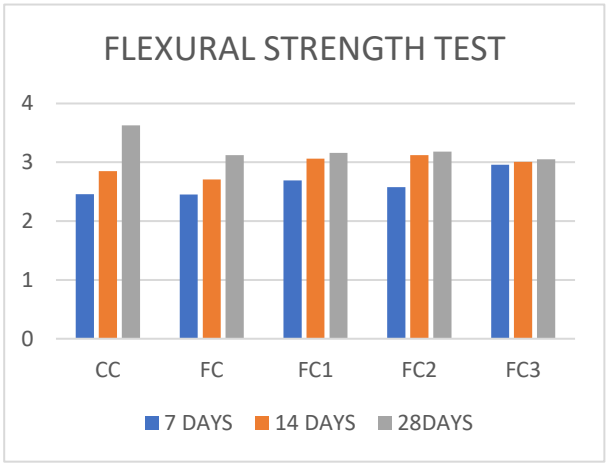

Figure 3: Shows the graphical representation of 7, 14, 28 days average flexural strength of foam concrete.

5. Conclusion:

The viability of foam concrete at different mix ratios is examined in this research project.

The compressive strength, flexural strength, and split tensile strength of foam concrete of different mix ratios are the main subjects of this study. The following conclusion was reached as a result of the analytical investigation and experimental results:

1. As foam concrete ages, its compressive strength and durability rise. However, in 28 days, the compressive strength of concrete mix was 41–44% lower than that of standard conventional concrete.
2. Age enhances the tensile strength and flexural strength of these concrete mixtures.
3. As the volume of the foaming agent increases, the workability of concrete falls correspondingly. The concrete mix we obtained is all usable even though the values decrease.
4. At 0.08% foaming agent added to concrete, the maximum compressive strength of 19.46 N/mm2 was achieved. The compressive strength has decreased comparison to the reference concrete.
5. When foaming agent was added to concrete at a rate of 0.07%, the maximum split tensile strength of 1.98 N/mm2 was achieved. The split tensile strength has less than over the reference concrete.
6. The addition of a foaming agent to the concrete at a rate of 0.07% produced the highest possible flexural strength of 3.18 N/mm2, Flexural strength has decreased compared to reference concrete.
7. From the results obtained we conclude that the foam concrete has efficient but not equal to the conventional concrete.
8. The results shows that conventional concrete has more strength next to that 0.07% addition of foam agent or 0.07% foam concrete has more strength.

6. Reference:

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