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An Experimental Study on Foam Concrete by Partial Replacement of Cement using Rice Husk Ash and Silica Fumes

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Abstract

A type of lightweight aerated concrete called foam concrete lacks coarse particles, making it comparable to aerated mortar. Foam concrete is created when slurry and pre-formed foam are combined. The foam's job is to create air pockets in the slurry made of cement. The foam is made separately with a foam generator by diluting the foaming ingredient with water and aerating it. The slurry forms a shell surrounding the bubbles of foam, and as the foam begins to break down, the paste's strength keeps it in place around the air holes. The ratio of water to cement (w/c) typically varies from 0.4 to 1.25. As the quantity decreases, the foam concrete mixture becomes excessively rigid, which breaks the bubbles, However, when the combination's water content increases, it becomes too thin to support the bubbles, which causes the bubbles to separate from the mixture. You can make foam concrete with any dry density between 300 and 1850 kg/m3. In this experiment, there are two foam concrete mixtures created using silica fumes and rice husk ash, and efforts have been produced to choose the foam concrete mix's proportions. A collection of 36 cube specimens is created and subjected to mixture testing. Following this, their actual state (density) and particular structural (compressive strength) qualities are examined, with the findings being reported.

Important terms: *Foam Concrete, Foaming Agent, Rice Husk Ash, Silica Fumes, Density.*

I. INTRODUCTION

When foam concrete solidifies, it transforms into a robust, light-weight substance with millions of evenly spaced, consistently sized air bubbles or cells. It is composed of particular foam, water, fine sand, and cement. The density of FC is determined by the quantity of foam added to the basic combination of cement and sand. Foam-based concrete is fire and water resistant. It boasts outstanding impact and airborne sound absorption capabilities in addition to excellent thermal insulation. Foam concrete is equivalent to traditional concrete because it employs the same ingredients. However, one way that foam concrete is not like traditional concrete is that it doesn't require aggregates. A foam aeration agent is used to absorb humidity when the product is exposed to the atmosphere, which helps the cement hydrate and continue to gain strength.

The utilization of aggregate is not present in foam concrete; instead, homogenous air-created cells in the form of tiny bubbles that rely on a stable air cell structure in place of traditional aggregates are what distinguish foam concrete from regular concrete. Because of its greater pore count, it falls within the category of cellular material. Foam concrete is immediately recognizable as cellular material due to its shape, and it must behave similarly to cellular solid behaviour.

When you include foam into a slurry consisting of cement, foam concrete is created. To make foam, after diluting the foaming ingredient with water, it is aerated. The slurry or cement paste envelops the foam bubbles, and when the foam begins to break down, the paste's strength allows it to keep its shape around the spaces. The foam's quality is a determining element in the foamed concrete's quality, making the foam an indispensable component. Pre-foaming, in which the foaming liquid is aerated prior to being introduced to the combination, is advised to guarantee that the appropriate proportion of air is entrained in the mixture.

II. LITERATURE REVIEW

Khawaja et al (1) "Eco-friendly incorporation of sugarcane bagasse ash as a partial substitution of sand in foam concrete". In this study, the author used sugarcane bagasse instead of sand to make foam concrete. The microstructural, thermal, fresh, physic mechanical, and bagasse ash integration characteristics of foam concrete are provided in this study in contrast to control foam concrete. It appears that 10% bagasse ash of sugarcane was added to the foam concrete mixture. The compressive strength increased the most (14.50%) and heat conductivity decreased the least (10.76%) in comparison to the control mix.In order to replace sand in foam concrete in an environmentally conscious way without losing its ability to function mechanically, sugarcane bagasse ash is used.

Namsonea et al (2) "Durability Properties of High-Performance Foamed Concrete". The author of this paper discussed low density, excellent thermal characteristics, and moderate strength. Another type of cellular concrete is FC. Depending on the application, a variety of densities can be achieved by aerating cement mortar with foaming agents and controlling the ratios of cement, sand, water, and foaming agent. FC is created with cement mortar, a foaming agent, and no additional heat processing. It is crucial to take FC durability into consideration, particularly in cold and damp environment conditions. Mechanical strength, water absorption, and frost resistance are key factors in durability. Additionally, shrinkage (including shrinkage from carbonation) must be considered. Carbonation processes are sped up by a material's low density and high open porosity.

Habsya et al (3) "Physical, mechanical and thermal characteristics of fly ash-based lightweight foamed concrete". The aim of this study is to investigate the effects of fly ash content on lightweight foamed concrete (LFC) properties, including density, water absorption, compressive strength, and thermal conductivity. This LFC is composed of cement, water, sand, fly ash (FA), and foam. LFC is made with a ratio of 1:1 water to cement and a ratio of 1:4 cement to aggregate. The aggregates were composed of sand and FA and ranged in weight from 0% to 30%. Between thirty and forty percent of the mortar's volume was composed of foam. As the quantity of foam increases, LFC's density, thermal conductivity, and compressive strength all decrease. But it absorbs more water because of that, FA content influences compressive strength, density, and thermal conductivity in addition to reducing water absorption.

Hashim et al (4) "Comparative study on the performance of protein and synthetic-based foaming agents used in foamed concrete". In this research, the author conducts an empirical investigation of the impact of different foaming agents, such as protein-based versus synthetic-based foaming agents, on the properties of foamed concrete. The foam stability, compressive strength, and drying shrinkage of the foam-filled concrete specimen were investigated experimentally and analysed. To gain a better understanding of how the foaming agent influences the properties of foam concrete, the microstructure—that is, the size and distribution of the pores—has also been described in this work. The compressive strength of both types of foamed concrete rose as density increased, but the protein-based foamed concrete outperformed the synthetic foamed concrete, outperforming it by 13% at a density of 1200 kg/m3. It was demonstrated that protein-based foamed concrete shrank at a density of 1200 kg/m3.

Mohd et al (5) "Applications of Foamed Lightweight Concrete". Based on the author, foamed concrete has densities ranging from 400 to 1600 kg/m3, and as workability and bond adhesion improve, so does flexural and tensile strength. The strengths of foamed concrete range from 100 to 15000 kg/m3. Additionally, it is utilized in prefabrications, cast-in-place walls, and housing applications for both load-bearing and non-load-bearing constructions.

Hameed et al (6) "Experimental Study on Foam Concrete". The author of this work examined the effects on the mechanical properties of foamed concrete by substituting fly ash at percentages of 0%, 10%, and 20% for cement, as well as by adding fiber at 1% and 1.5%, It has been found that when fly ash is added to cement at a dosage of 10%, the foamed concrete's compressive strength increases by about 5N/mm2, and the fiber presence improves the split tensile strength in comparison to a usual mix.

Song et al (7) "Collaborative disposal of multisource solid waste: Influence of an admixture on the properties, the durability and pore structure of foam concrete". In this the author substituted by using three-factor and three-level orthogonal tests, samples of fly ash, furnace slag, and mineral powder are used to examine how admixtures affect the characteristics, pore structure, and durability of foam concrete. In light of the results, foam concrete may possess a variety of mechanical and thermal insulating qualities depending on the admixtures used. Foam concrete can have a compressive strength of 3.90 MPa and a thermal conductivity of 0.1347 W/M-k. Inorganic solid waste from multiple sources can be used sustainably and cleanly with the help of the advice in this paper.

Fallian et al (8) "Experimental investigation on the foamed concrete compressive strength" Effects of cement type, foaming agent, dry density, and curing conditions. This paper presents the preliminary results of an ongoing experiment using foamed concrete. Here, the effects of cement type, water content, dry density, curing conditions, and—above all—the foaming agents in the cement paste on compressive strength are examined. More than 100 foamed concrete specimens with fixed water/cement ratios, two types of cement, three foaming agents (synthetic or protein), and curing conditions in water at 30 C, air, and inside a cellophane sheet at ambient temperature are included in this experimental study. The specimens' dry densities range from approximately 350 to 850 kg/m3. It is shown that when protein foaming agents are incorporated into the mix design.

Johnpaul et al (9) "High Strength Lightweight Foam Concrete". This study aims to create foam concrete with high strength and low weight. The primary goal of the study is to use readily accessible resources to strengthen foam concrete. For practical construction in civil engineering applications, foam concrete is a creatively applied science. Only trial mixtures are used to carry out the complete ratio. For 7, 14, and 28 days, the cube has been prepared. The cube should not be submerged in water because there is foam present; only dry curing has been done. According to the compressive strength results, the ratio with the maximum compressive strength can be used to make (Cellular Light Weight Concrete) CLC Blocks as well as fill concrete.

Mohammad et al (10) "Flexural Strength of Lightweight Foamed Concrete Polypropylene Fiber Inclusion and a 3:1 Cement to Sand Ratio". This paper describes the examination of LFC's compressive and flexural strengths when combined with polypropylene fibers. The ratio of cement to sand in this investigation was 3:1. Every sample was analysed at the targeted density of 1500.Polypropylene fiber mixes with volume fractions of 0.25% and 0.40% are now included in LFC design. The foamed concrete's goal was to achieve the intended result by volume proportion of Different polypropylene fibers with cure durations of seven, twenty-eight, and sixty days are used.

Marcin Kozłowski (11) The indicated goal density is 400–1400 kg/m3. It makes use of fly ash. Use is made of the commercial foaming agent. Compared to FCA, FC has a 20% higher density. 15% lower values indicate the specimen's strength to withstand freeze-thaw cycles. When the density of the foamed concrete decreases, the compressive strength, modulus of elasticity, and flexural strength all fall. The foamed concrete's modulus of elasticity, flexural strength, and compressive strength all decrease with a 5% addition of fly ash.

Yanbin Fu (12) Properties of the material and production processes, such as pore structure, stability, compressive strength, and drying shrinkage, are discussed in this study. According to the experimental findings, FC's compressive strength rises with confining pressure and density. Surfactants based on proteins and synthetics are employed. Fibers including polypropylene, glass, and polypropylene and palm oil are employed, together with steel, coconut, waste paper cellulose, and carbon, at mixture volumes of 0.2% and 1.5%. Ultimately, it is determined that foam concrete exhibits good mechanical and thermal qualities due to its evenly dispersed closed circular air pores.

Maheshkumar H. Tharkrele (13), an experimental study on foam concrete was undertaken. Two foam concrete mixtures, one with and one without sand, were generated, and efforts were made to choose the foam concrete mix's proportions in order to achieve the desired plastic density of 1850 kg/m3. Cube specimens were made and mixed, after which their specific structural (compressive strength) and physical (density) qualities were examined. The specific strength and percentage strength gain of the foamed concrete were compared to that of regular weight concrete, and the findings were documented.

Bhagyashree Raj., et al (14) The mechanical and durability properties of hybrid fiber-reinforced foam concrete were studied. The mechanical, functional, and long-term characteristics of hybrid reinforced foam concrete were investigated in this study. Sand is substituted with bottom ash, and the samples are made to hold 1600 kg/m3. Three volume fractions of poly vinyl alcohol—0.3, 0.4, and 0.5—were added. The most used type of foaming agent is RH. The ratio of foaming agent to water is 1:30. A shrinkage research was carried out 3, 7, 14, 28, and 56 days after casting. The result is a 76% increase in compressive strength. Concrete's tensile strength has increased by 27%. This experiment showed that compared to PVA mixes, Coir fiber combinations had lower drying shrinkage and heat conductivity.

Eva Namsone., et al (15) studied the High-Performance Concrete's Durability Properties. This paper provided us with a variety of facts. The inclusion of foam causes the mixture's dry density to drop from 7% to 20% when fly ash is substituted for sand. Furthermore, for the percentages of 20% to 50%, the 28-day compressive strength increased from 10.7-1.23 MPa to 17.8-1.96 MPa. Artificial foaming ingredient ranging from 0.35 to 0.6% of the weight of cement. Utilizing turbulent mixing techniques and pozzolanic admixtures results in the creation of foam concrete that is more durable and water-resistant.

Falliano, Devid (16) Foaming C, a protein-based foaming agent, was used. The three dry densities that are being pursued are 400, 600, and 800 kg/m3. Three distinct fiber contents—0.7%, 2%, and 5%—were examined. The flexural strength increases with each additional 2 or 5% of fiber.

Aswathy M (17) has emphasised that Smouldered Brick is vital in the construction industry. The nation is focused more on finding natural solutions to promote a greener environment. Foam has excellent thermal and acoustic properties, and foamed cement is the most prevalent low-density cement used in developing countries. Lightweight concrete blocks offer a sustainable solution for the construction industry while supporting environmental conservation. The production process involves creating a slurry of cement, fly ash, and water, which is then mixed with pre-foamed stable foam in a conventional concrete mixer under ambient conditions. This paper discusses the preparation of design mixes for 4", 6", and 8" concrete blocks and the results obtained in concrete development.

Saand et al. (18) examined the impact of partially replacing cement with rice husk ash (RHA) at varying percentages: 0%, 2.5%, 5%, 7.5%, 10%, 12.5%, and 15%. The study found that the compressive and split tensile strengths increased with RHA replacement up to 10%. However, when the RHA content exceeded 10%, both strengths began to decline. The highest compressive and split tensile strengths were achieved at 10% RHA replacement, measuring 4.4 MPa and 0.53 MPa, respectively.

Kunchariyakun et al. (19) conducted a study using rice husk ash (RHA) as a partial replacement for sand in autoclaved aerated concrete (AAC). They experimented with replacement percentages of 25%, 50%, 75%, and 100%, and analyzed the mechanical properties of the AAC samples under autoclaving conditions at 180°C and 12 bar pressure. The samples were assessed after 8 hours and 18 hours of autoclaving. The study found that the optimal sand replacement with RHA was at 75%. However, it also noted that the increased water requirement due to RHA replacement negatively impacted the compressive strength of the AAC.

Yang et al. (20) utilized phosphogypsum in the production of non-autoclaved aerated concrete (NAAC). Their findings indicated that the compressive strength of the concrete increased as the percentage of Na2SO4 was raised from 0 to 1.6%, but it decreased when the Na2SO4 content exceeded 1.6%. Additionally, an increase in aluminium powder in the mix led to a reduction in specimen density. The optimal mix ratio for preparing NAAC with phosphogypsum was determined to be 15% cement, 30% ground granulated blast furnace slag (GGBFS), 55% phosphogypsum, 7% quick lime, 1.6% Na2SO4, 0.074% aluminium powder, and a water-to-cement (w/c) ratio of 0.45. The ideal steam curing temperature for the samples was found to be 90°C.

III. SCOPR AND OBJECTIVE OF THE RESEARCH

The scope of this research is:

- In this experimental study, it is necessary to concentrate on how rice husk ash affects compressive strength in lightweight foam concrete.

- Cubes with dimension of 150 x 150 x 150mm are being given consideration for this project. Sample with 10%, 20%, 30%, 40% of rice husk ash within replacement for cement mass were casted.

- Foam concrete was created using researched mix designs, ranging in density from 800 kg/m^3 to 1400 kg/m^3. Every sample underwent water curing.

- The specimens utilized to assess compressive strength were cubical samples that were 7 and 28 days old.

The objective of this research is:

- Using the proper mix percentage is the aim while making foamed concrete.
- To evaluate foamed concrete's density and compressive strength in relation to regular concrete.
- To make lightweight concrete having specified strength so that it can wear the load of building structure.
- To comprehend the real behaviour of concrete upon the inclusion of foaming agents to ascertain the concrete's strength—one of its most crucial characteristics.
- To lower the structure's cost.

IV.MATERIALS

CEMENT

The OPC grade of 43 with a specific gravity of 3.15 was employed in the experimentation. The characteristics of the cement were ascertained by an assortment of experiments. It functions as a bonding agent, joining several project elements to create a compacted assembly. It functions as a bonding agent, joining several project elements to create a compacted assembly. Cement is actually a good precipitate, which previously assorted with water experiences chemic variation and there after permitted to set and harden is actually proficient of binding masses or fragments of sound stuff in concert to yield a mechanically difficult concrete. Cement could be cast off as binding considerable with h_2o, for bonding tough devices of several sizes as bricks, aggregate or stones to create a monument. Cements used in construction of buildings additionally civil company functions enclose mixtures of lime, alumina and silica as their chief ingredients and could be called as composite substances. Portland cement is regarded as the public form of cement in overall usage. It's a fundamental part of concrete, plaster and putty.

RICE HUSK ASH

The tough protective shells that rice grains should be separated from their grains during the milling process are called rice husks. In every country that produces rice, rice husk is Easily accessible waste material that has between 30% and 50% organic carbon. During a standard milling procedure, the husks are separated from the raw grain to reveal complete brown rice. White rice is then produced by further milling the rice to remove the bran layer.

SILICA FUMES

Silica fumes is a finely divided mineral admixture obtained as the by-product of silicon and alloys of silicon. Silica fume responds with lime exhibit in glue lattice. Lime is considered as an unsafe, as it responds with different synthetics causing extension. Silica fume mortar has a superior pore structure which endlessly lessens porosity. It enhances final strength of concrete. Silica fume Silica fume is actually made during the high heat reduction of pets in an electrical Arc furnace where the primary item is actually Ferro Silicon or maybe Silicon.

WATER

It was portable water that was employed in the trials. The water was pure and was not contaminated with organic matter. Water that is free from injurious materials is actually utilized in blending just curing of concrete. It must be drinkable and plays a vital part in the creation of concrete. Yes, the concrete is workable. The standards of water must be taken in to consideration since the cement gel is made by it and imparts the power to the concrete. The water must be confined to some extent or perhaps else the separation of place is taken by particles and additionally, there is no bond development, the concrete strength decreases, and it bleeds together. The municipality tap water must be utilized and this needs to have Indian criteria the pH ranges from 6.5-8.

MANUFACTURED SAND

An alternative to river sand is manufactured sand. There is a severe shortage of adequate river sand in most of the world due to the rapidly expanding construction sector. The usage of synthetic sand has expanded due to the depletion of high-quality river sand for construction purposes. The cost and accessibility of M-sand transportation are further factors in its adoption. Manufactured sand can be easily obtained locally, negating the need for transportation from distant river sand beds, as it is derived from hard granite rocks. Thus, using synthetic sand as an alternative building material can help keep construction costs under control.

FOAMING AGENTS

Good quality foam was created by blending the foaming agent since the quality of the foam is essential to the stability of foamed concrete and will impact the strength and rigidity of the finished product. Foaming agent, we had used is CLC (cellular lightweight concrete) foaming agent. It is prepared with raw material in presence of $Ca\ (OH)_2$ and a small portion of $NaHS0_3$. For improving the stability, it is modified with the addition of several kinds of gel and surfactants.

V. METHODOLOGY

In this experiment, a foam concrete combination with various material constituents is used. Prior to determining the relationship between these variables, the physical properties of foam concrete mixtures (such as density) as well as a particular structural property (such as compressive strength) were obtained. In a college laboratory, foam concrete cubes are made and tests are conducted.

Cubes of length, thickness, and width of 150mm x150mm x 150mm is actually utilized at the experiment and casted with various proportions and cured for seven and twenty-eight days. After curing the cubes were tried in CTM based on IS: 516 1959 for cubes.

The several parameters used in the concrete design are as follows:
1. Mix Proportion Ratio = 1:1 & 1:2

2. (W/C) Ratio =0.60

3. Mineral Admixtures:

Rice Husk Ash: 10%, 15% and 20% of the cement's weight.

Silica-fume: 10% of the total weight of cement is always the same.

Cement (Kg)	Sand (Kg)	RHA (Kg)	SF (Kg)	Water (Kg)	FA (Kg)	FA/W	SF (%)	RHA (%)
250	750	225	150	150	15	1:2	10	10,15,20
RHA: Rice Husk Ash, SF: Silica Fumes FA: Foaming Agent, FA/W: Foaming agent-to-water ratio								

MAKING OF FOAM

The water used to make foam is drinkable, and it should not be heated above 25^0C for optimal results. We used 250ml foam agent with 500ml of water i.e., (1:2) ratio. Of course, the recipe can be changed, by changing the dosage of foaming agent.

MAKING OF SLURRY

The cement we used for the slurry is Ordinary Portland Cement. We partially replace the rice husk ash to cement by 10%,15%,20% and so on by the weight of cement. Sand is specified in the mix design ideally it should be fine with 2mm-5mm maximum size 60 to 90% passing through a 600- micron sieve. First, we dry mix the sand and cement after which water is added into it. The water: cement ratio of the slurry is usually between 0.5 and 0.6.

 

MIXING OF FOAM AND SLURRY

Generally, foamed concrete is produced from a slurry of cement, sand, and rice husk ash; however, for extremely light mixes, some vendors advise using just pure cement and water along with the foaming ingredient. In a concrete mixing facility, this slurry is combined with synthetic aerated foam. A foaming agent is combined with water and generator-generated air in order to create the foam. The chosen foaming agent needs to be able to create very stable air bubbles that can withstand the physical and chemical changes that occur when combining, putting, and hardening. A foamed concrete mixture can be injected directly into structural components or poured or pumped into moulds. The foam enables the slurry to flow freely because of the thixotropic behavior from the foam bubbles, allowing it to be easily filled in the chosen form or mould. The viscous material requires up to 24 hours to solidify (or as little as two hours if steam cured with temperatures up to 70^{o}c to accelerate the on variables including ambient temperature and humidity. Once solidified, the formed produce may be released from its mould.

MIXING PROCEDURE

First, the component parts were weighed, then the cement, rice husk ash, and sand were mixed by hand. After fully mixing this in a concrete mixer, water was gradually added to create a workable mixture. One minute was spent on the mixing procedure. The hand mixer is used to mix the necessary amount of foam, which is then added to the wet mix and blended once more. If you mix for an extended period of time after adding foam, the foam will break down. After that, they were placed within 150 x 150 x 150 mm cube moulds.

CASTING OF THE SPECIMENS:

After proportioning mix design casting process is carried out. As discussed earlier need for compression test for the experiment is tested. In order to find those casting of cubes have been manufactured. The cubes of size 150 x 150 x 150 mm have been casted. Proper mixing and tamping are maintained throughout.

CURING OF THE SPECIMENS:

Curing of specimens is taken care precisely to maintain required moisture for the strength increase of concrete. After the curing period the cubes are dried and taken out for testing.

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VI.TESTS AND RESULTS

DENSITY

The dimensions of the test specimens (cubes) cast for this investigation are 150 x 150 x 150 mm. Casting density, or the initial density of the specimens as determined during manufacture, can be compared to intended density, or the goal density. Test specimens are demoulded 24hours after casting, and each specimen is then cured for 7 or 28 days in a room with a constant temperature. Test density is the density that was measured once more when the compressive strength was determined.

COMPRESSION TEST:

Compressive strength = breaking load/Area of cube in N/mm^2

Major test to be carried out is compressive strength test. It is done using compressive testing machine. Presently put the solid blocks into the testing machine. (Centrally). The most extreme load at which the example breaks is taken as a compressive load. 7 and 28days Strength is computed. and tabulated accordingly. the shift in concrete's compressive strength brought on by fluctuations in silica fumes and rice husk ash. RHA percentage used are 10%, 15%, and 20%. Silica fumes maintained 10% constant for all ratios. Water to binder ratio used is 0.60

After ± 24 hours, the 150 mm cubes are taken for the test out from the steel mould. After that, it was stored for curing in a chamber with a consistent temperature until the testing day. The cubes were broken using a press that is more sensitive than the one that is typically used for regular concrete (a compression testing equipment). The power of the combination is decided by averaging the three crushed cubes made of the same foamed concrete mixture. It shall be noted what the compressive strength is. For 28 days, the foamed concrete's compressive strength will be monitored.

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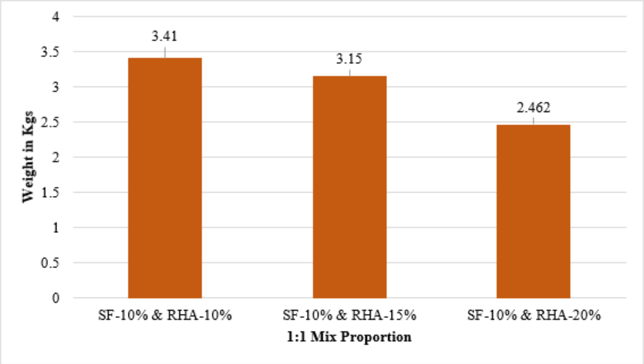
Experimental result for Density and Compressive strength

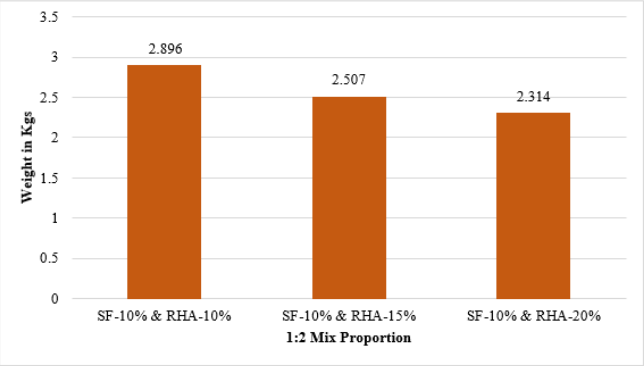
Density test for 7day (1:1) proportion

SI. No	Mix Ratio	SF & RHA (%)	Sample	Weight in Kg	Average Weight in Kg
1	1:1	SF-10% RHA-10%	1	3.638	3.410
			2	3.339	
			3	3.255	
2	1:1	SF-10% RHA-15%	1	3.228	3.150
			2	3.143	
			3	3.080	
3	1:1	SF-10% RHA-20%	1	2.466	2.462
			2	2.390	
			3	2.531	



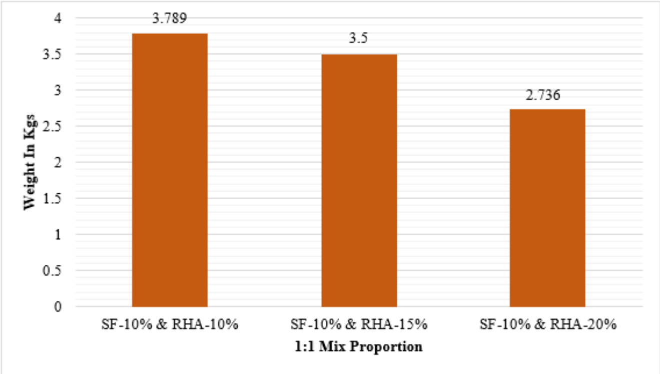
Density test for 7day (1:2) proportion

SI. No	Mix Ratio	SF & RHA (%)	Sample	Weight in Kg	Average Weight in Kg
1	1:2	SF-10% RHA-10%	1	2.855	2.896
			2	2.932	
			3	2.901	
2	1:2	SF-10% RHA-15%	1	2.752	2.507
			2	2.359	
			3	2.411	
3	1:2	SF-10% RHA-20%	1	2.301	2.314
			2	2.351	
			3	2.291	



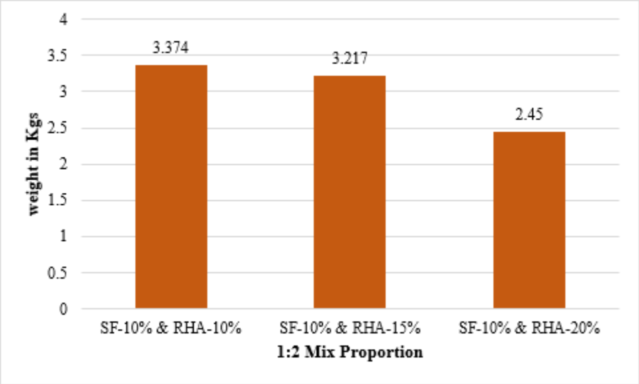
Density test for 28day (1:1) proportion

SI. No	Mix Ratio	SF & RHA (%)	Sample	Weight in Kg	Average Weight in Kg
1	1:2	SF-10% RHA-10%	1	4.042	3.789
			2	3.710	
			3	3.617	
2	1:2	SF-10% RHA-15%	1	3.587	3.500
			2	3.492	
			3	3.422	
3	1:2	SF-10% RHA-20%	1	2.740	2.736
			2	2.656	
			3	2.812	



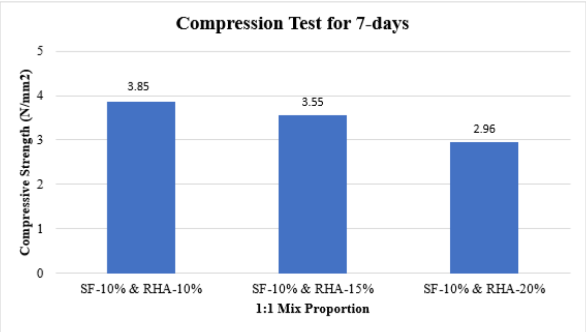
Density test for 28day (1:1) proportion

SI. No	Mix Ratio	SF & RHA (%)	Sample	Weight in Kg	Average Weight in Kg
1	1:2	SF-10% RHA-10%	1	3.422	3.374
			2	3.373	
			3	3.328	
2	1:2	SF-10% RHA-15%	1	3.172	3.217
			2	3.258	
			3	3.223	
3	1:2	SF-10% RHA-20%	1	2.447	2.450
			2	2.453	
			3	2.452	



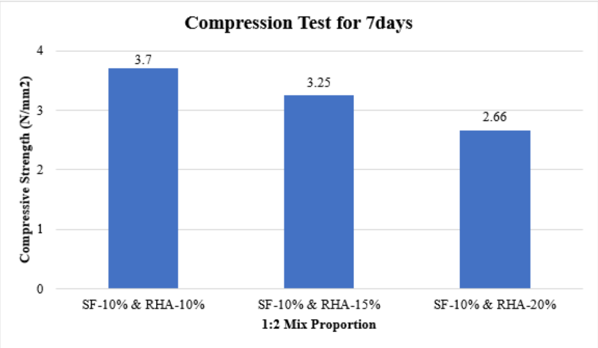
Compression Test for 7-Days
1:1 Proportion
SF-10% & RHA-(10%,15%,20%)

SI. No	Materials	Qty (Kg)	W/C ratio	S F (%)	RHA (%)	Sample	Compressive Load (KN)	Compressive strength (N/mm²)	Average Compressive strength (N/mm²)
1	Cement Sand	2.534 3.168	0.6	10	10	1	90	4.00	3.85
						2	90	4.00	
						3	80	3.55	
2	Cement Sand	2.376 3.168	0.6	10	15	1	90	4.00	3.55
						2	80	3.55	
						3	70	3.11	
3	Cement Sand	2.217 3.168	0.6	10	20	1	70	3.11	2.96
						2	60	2.66	
						3	70	3.11	



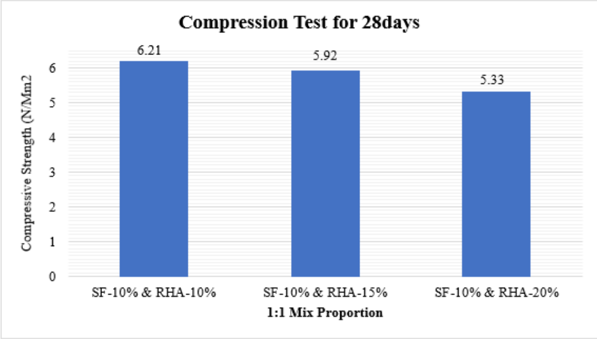
Compression Test for 7-Days
1:2 Proportion
SF-10% & RHA-(10%,15%,20%)

SI. No	Materials	Qty (Kg)	W/C ratio	S F (%)	RHA (%)	Sample	Compressive Load (KN)	Compressive strength (N/mm²)	Average Compressive strength (N/mm²)
1	Cement Sand	3.448 8.616	0.6	10	10	1	90	4.00	3.70
						2	80	3.55	
						3	80	3.55	
2	Cement Sand	3.231 8.616	0.6	10	15	1	70	3.11	3.25
						2	80	3.55	
						3	70	3.11	
3	Cement Sand	3.015 8.616	0.6	10	20	1	65	2.66	2.66
						2	65	2.66	
						3	65	2.66	



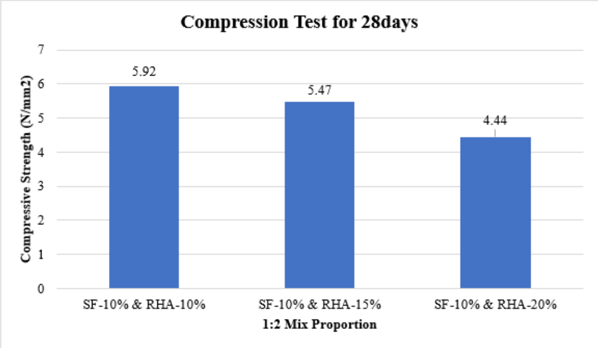
Compression Test for 28-Days
1:1 Proportion
SF-10% & RHA-(10%,15%,20%)

Sl. No	Materials	Qty (Kg)	W/C ratio	S F (%)	RHA (%)	Sample	Compressive Load (KN)	Compressive strength (N/mm²)	Average Compressive strength (N/mm²)
1	Cement Sand	2.534 3.168	0.6	10	10	1	150	6.66	6.21
						2	140	6.22	
						3	130	5.77	
2	Cement Sand	2.376 3.168	0.6	10	15	1	140	6.22	5.92
						2	130	5.77	
						3	130	5.77	
3	Cement Sand	2.217 3.168	0.6	10	20	1	120	5.33	5.33
						2	120	5.33	
						3	120	5.33	



Compression Test for 28-Days
1:2 Proportion
SF-10% & RHA-(10%,15%,20%)

Sl. No	Materials	Qty (Kg)	W/C ratio	S F (%)	RHA (%)	Sample	Compressive Load (KN)	Compressive strength (N/mm²)	Average Compressive strength (N/mm²)
1	Cement Sand	3.448 8.616	0.6	10	10	1	140	6.22	5.92
						2	130	5.77	
						3	130	5.77	
2	Cement Sand	3.231 8.616	0.6	10	15	1	120	5.33	5.47
						2	130	5.77	
						3	120	5.33	
3	Cement Sand	3.015 8.616	0.6	10	20	1	100	4.44	4.44
						2	100	4.44	
						3	100	4.44	



VII. DISCUSSIONS

- Foam concrete has a density of 300–1850 kg/m3, which is less than the standard concrete's, which has a density of 2200–2600 kg/m3.Consequently, a foamed concrete structure would undoubtedly have a much lower self-weight, which would lead to a large decrease in the quantity of reinforcement steel needed for the base and structural components.

- When LWC is used in place of regular concrete during construction, it can lessen the dead load of the building, the power that earthquake excitations apply on it, and the building's eventual collapse weight.

- It is evident from the results in Tables 6.5 and 6.6 for mix proportions of 1:1 & 1:2 for 7 days and Tables 6.7 and 6.8 for 28 days that foamed concrete has a low compressive strength for mixtures with lower densities and rises as density increases.

- The maximum compressive strength of foamed concrete is 6.21N/mm2 at 10% SF & 10% RHA mix percentage. Similarly, with a 1:2 percentage mix, strength is strong at 10% SF and 10% RHA, respectively, or 5.92 N/mm2. When comparing the 1:1 and 1:2 mixes, it is observed that the 1:1 mix produced better outcomes than the 1:2 proportion.

- The density will decrease due to the mixture's foam creating more and more voids throughout the sample. Compressive strength will therefore decrease as those voids increase.

- It's been noted that substituting cement in foam concrete with rice husk ash can significantly improve the material's qualities. Although the addition of fine aggregate to foamed concrete results in an increase in density, it also improves compressive strength and lowers construction costs.

- While de-moulding high density foamed concrete can be completed in as little as 24 hours, it is not possible to de-mould low density foamed concrete, which requires at least 3 days due to its extremely low strength and versatility.

VIII. CONCLUSION

- The initial findings are that to show that the mixing of the RHA and SF partially in cement in foam concrete to obtain a desirable strength to be an alternative construction material for the industrialized building system.

- Adding rice husk ash to the mixture of slurry results in foam concrete compounds that are less expensive and less harmful to the environment.

- With an increase in density, the blocks' higher compressive strength will rise.

- On the base of literature survey, it is found that adding foaming agent to concrete instead of course aggregate will reduce the weight of the concrete itself and lower construction and shipping cost.
- As per the discussions the strength gain is 6.21 N/mm^2 which is less, so it can be applied to the building of dividing walls.
- Although the product is thought of as concrete (since air bubbles have replaced aggregate), it is used for quite different purposes than traditional concrete because of its great thermal and acoustical insulating characteristics.

- It is additionally useful as Earth quake resistant due to lesser weight of building built using foam concrete walls in multi-story buildings.

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