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USE OF HIGH STRENGTH CEMENT IN HYBRID FIBER FOAM CONCRETE WITH FLY ASH AND SILICA FUME

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Abstract - *In this study foam concrete was prepared by fully replacing sand by fly ash and partially replacing cement (15%) by silica fume. The foam concrete was prepared to a density of 1400 kg/m³ and 1600 kg/m³ with addition of Polypropylene fiber and copper fiber with varying percentage of fiber (0%, 0.1%, 0.2% and 0.3%) and was used to study the behavior of physical and mechanical properties of foam concrete. From the results we can conclude that addition of fibers upto a certain dosage gives optimum results by enhancing the Compressive strength, Flexural strength and Split tensile strength. From the outcome of the study it can be noticed that the relation between compressive strength and flexural strength, and compressive strength and split tensile strength is fulfilled by regression analysis. And as per the physical test results addition of different percentage of fiber causes minute effect of water absorption.*

Key Words: Mix proportion**,** Foam Concrete, Foam, Polypropylene fiber, Copper fiber.

1. INTRODUCTION

Concrete has been used since a very long as a material of construction, and has been utilized broadly in the development of many structures. Therefore there are many types of concretes invented according to the use, needs and the demands of the society.

One of the most used methods of reducing the density of concrete depends of introduction of air voids into the mix. The voids can be produced by air or by gas. Because the foaming agent produces a stiff air void, the concrete produced is called foam concrete.

Foam concrete is classified as lightweight concrete is either mortar or cement paste, where foaming agent entraps the air voids in mortar. It has low self weight, high flow ability, controlled low strength and good thermal insulating material properties. Foam concrete is also known as cellular lightweight concrete, foamcrete and reduced density concrete. The density of foamcrete varies from 400 kg/m³ – 1800 kg/m³. These densities can be achieved by controlled dosage of foam and can be used for application to partition, insulation and filling grades.

It is been found that foamcrete has many advantages over normal conventional concrete in terms of economy, properties and design. Hence there is a high demand of further experimentation on foamed concrete are happening across the world.

2. Properties of foam concrete

Fresh state properties

The conduct of cement is judged in its both fresh and solidified state. Both fresh and solidified properties are similarly vital for cement to satisfy its essential attributes of quality and durability. It is for the most part watched that properties of foam are simple streaming, self levelling and self compacting. The foamed concrete that has expansive measure of entangled air has brilliant usefulness. Its consistency is in the same class as fluid. It is pourable and homogeneous blend. The steadiness of such a concrete is high with insignificant draining and isolation. In fresh state property two stages are assessed i.e., consistency and stability of foam concrete

Consistency

The increase in the volume of foam in the mix reduces the consistency which may be attributed as (1) Greater cohesion and reduced self weight resulting from more air content. (2) Adhesion between solid particles and air bubbles in the mix increases the stiffness of mix.

Stability

Stability is between the factors of workability and consistency in concrete. It is the facility to restrict segregation. Segregation assumes vital part in estimating instability. Light weight foam concrete is incredibly flowable and having low cementitous material, it assumes a key part to guarantee an adequate air void framework. Henceforth void framework requires to remain stable during the procedure of interference, arrangement and setting. The strength of foam concrete is the consistency at which the thickness proportion is almost one with no segregation and bleeding

3. Procedure for mixing

- The calculated amount of cement for required densities of 1400 kg/m³ and 1600 kg/m³ is taken in a tray.

- Then fly ash is added to as per calculated. (Cement: Fly ash = 1 : 0.85)
- Silica fume is then added to the tray. (Cement : Silica fume = 1 : 0.15)
- The quantities are hand mixed in a tray thoroughly and then transferred to the mixer and then the fibers are added to the mix.
- Mixer is turned for about 5 – 8 min until mixed properly.
- Then calculated amount of water is added to the mixer and mixer is turned on.
- Then the mixer is stopped and hand mixing is done for about 30sec and again the mixer is turned on.
- Then the foam is added in the mixer and continued for 5 – 8 min until a homogeneous is obtained.
- The foamcrete mixture is the taken for casting of specimens.

Figure 3.1 Procedure For Making Of Light Weight Foam Concrete

4. TEST RESULTS AND DISCUSSIONS

This section presents the results of the various tests carried out on foam concrete with fibers (Polypropylene and copper) and without fiber specimens in the laboratory. The results include a summary of water absorption and mechanical properties such as compressive strength, split strength and flexural strength. We also performed a regression analysis to compare the compressive strength and flexural strength for 28 days, as well as the test is performed to compare the compressive strength and tensile strength of rupture for 28 days.

4.1 Result of Water Absorption Test

Table 4.1.1 Water Absorption Test Result at 28 Days for Density 1400 Kg/m3

Sl no.	Density in kg/m³	Fiber dosage in %	Saturated weight in kg	Oven dry weight in kg	Water absorption in %	Average of water absorption (w) in %
1	1400	0	4.7	4.05	13.72	13.57
			4.68	4.05	13.53	
			4.72	4.08	13.48	
		0.1	4.71	4.11	12.72	12.7
			4.69	4.09	12.58	
			4.71	4.1	12.8	
		0.2	4.72	4.18	11.42	11.4
			4.72	4.18	11.28	
			4.71	4.16	11.5	
		0.3	4.69	4.18	10.78	10.83
			4.7	4.19	10.82	
			4.71	4.19	10.89	

Table 4.1.2 Water Absorption Test Result at 28 Days for Density 1600 Kg/m3

Sl no.	Density in kg/m3	Fiber dosage in %	Saturated weight in kg	Oven dry weight in kg	Water absorption in %	Average of water absorption (w) in %
2	1600	0	5.44	4.88	10.12	10.09
			5.38	4.84	9.97	
			5.4	4.84	10.2	
		0.1	5.35	4.86	9.03	9.16
			5.42	4.91	9.28	
			5.4	4.91	9.03	
		0.2	5.31	4.89	7.83	7.94
			5.38	4.94	8.03	
			5.36	4.93	7.96	
		0.3	5.43	5.03	7.36	7.27
			5.37	4.98	7.17	
			5.41	5.01	7.28	

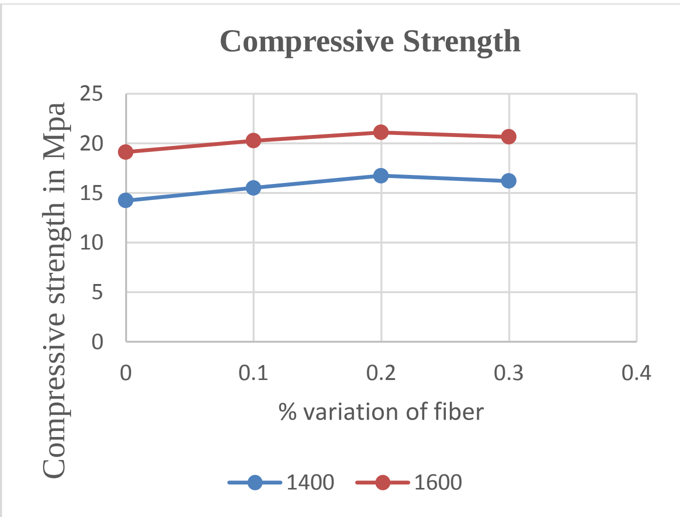
4.2 Result of Compressive Strength Test

Table 4.2.1 Compressive Strength for Different Percentage of Polypropylene fiber and Copper Fiber, test Result at 28 Days

Sl no.	Density in kg/m3	Fiber dosage in %	Compressive strength (Mpa)	Average compressive strength (Mpa)
1	1400	0	13.98	14.23
			14.45	
			14.28	
		0.1	15.34	15.5
			15.57	

			15.59	
		0.2	16.55	16.73
			16.68	
			16.97	
		0.3	16.07	16.20
			16.23	
			16.30	
2	1600	0	19.22	19.11
			19.00	
			19.11	
		0.1	20.33	20.25
			20.44	
			20.00	
		0.2	21.11	21.1
			21.33	
			20.88	
		0.3	20.81	20.65
			20.54	
			20.62	

Figure 4.2.1 Variation of Compressive Strength and Fiber Content for Density 1400and 1600 Kg/m³

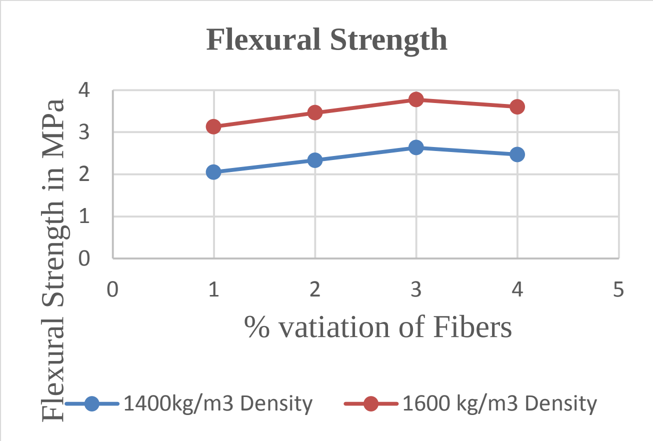


4.3 Result of Flexural Strength Test

Table 4.3.1 Flexural Strength for Different Percentage of Polypropylene Fiber and Copper Fiber, test Result at 28 Days

Sl no.	Density in kg/m3	Fiber dosage in %	Flexural strength (Mpa)	Average flexural strength (Mpa)
1	1400	0	2.07	2.05
			2.00	
			2.09	
		0.1	2.28	2.33
			2.32	
			2.41	
		0.2	2.77	2.63
			2.61	
			2.52	
		0.3	2.51	2.47
			2.43	
			2.47	
2	1600	0	3.17	3.13
			3.25	
			2.98	
		0.1	3.52	3.46
			3.48	
			3.39	
		0.2	3.67	3.77
			3.89	
			3.76	
		0.3	3.78	3.60
			3.45	
			3.58	

Figure 4.3.1 Variations in the Flexural Strength and Fiber Content For Density 1400and 1600 Kg/m³

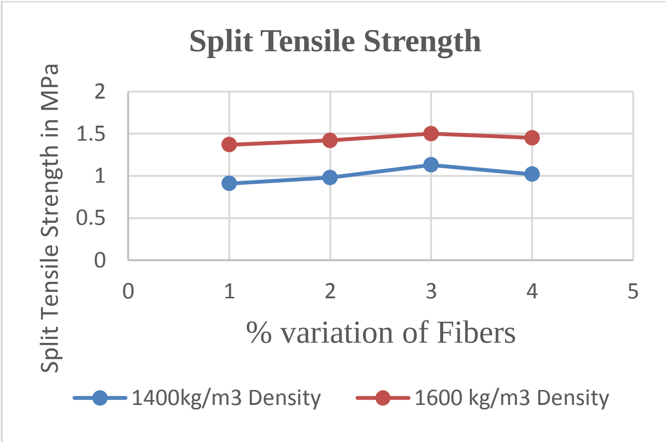


4.4 Result of Split tensile Strength Test

Table 4.4.1 Split Tensile Strength for Different Percentage of Polypropylene Fiber and Copper Fiber, test Result at 28 Days

Sl no.	Density in kg/m3	Fiber dosage in %	Split tensile strength (Mpa)	Average split tensile strength (Mpa)
1	1400	0	0.89	0.91
			0.92	
			0.93	
		0.1	1.05	0.98
			0.97	
			0.93	
		0.2	1.18	1.13
			1.07	
			1.15	
		0.3	1.00	1.02
			1.06	
			1.02	
2	1600	0	1.4	1.37
			1.35	
			1.38	
		0.1	1.44	1.42
			1.41	
			1.43	
		0.2	1.5	1.50
			1.49	
			1.53	
		0.3	1.43	1.45
			1.49	
			1.45	

Figure 4.4.1 Variation Of Split Tensile Strength and Fiber Content For Density 1400and 1600 Kg/m³



4.5 Regression Analysis between Compressive strength and Flexural strength.

Table 4.5.1 Regression Analysis between Compressive strength and Flexural strength

Density in kg/m3	Fiber dosage in %	Actual compressive strength (N/mm²)	Actual flexural strength (N/mm²)	Predicted flexural strength (N/mm²)
1400	0	14.23	2.05	1.989
	0.1	15.5	2.33	2.306
	0.2	16.73	2.63	2.614
	0.3	16.2	2.47	2.481
1600	0	19.11	3.13	3.209
	0.1	20.25	3.46	3.494
	0.2	21.1	3.77	3.706
	0.3	20.65	3.6	3.594

Figure 4.5.1 Relation between Compressive strength and Flexural strength.

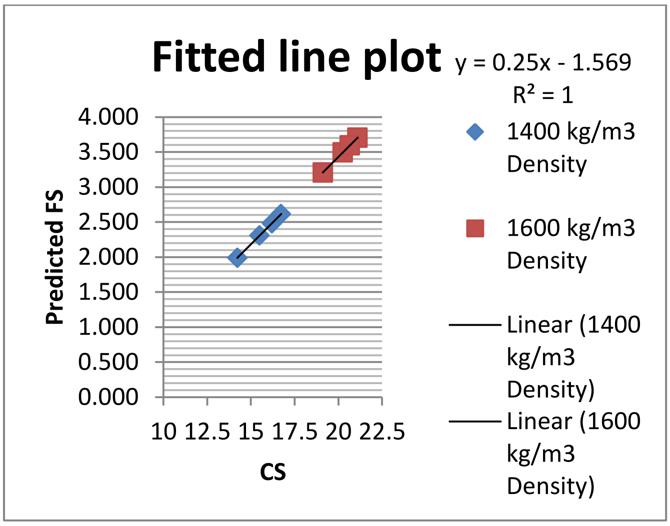
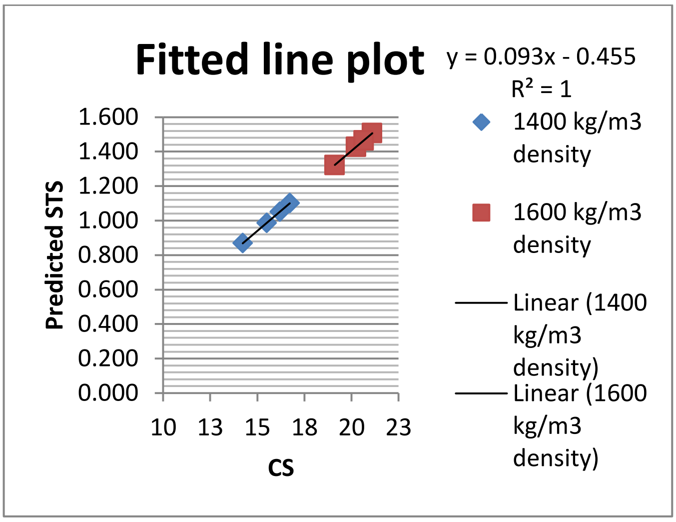


Figure 4.6.1 Relation between Compressive strength and Split tensile strength.



4.6 Regression Analysis between Compressive strength and Split tensile strength.

Table 4.6.1 Regression Analysis between Compressive strength and Split tensile strength

Density in kg/m3	Fiber dosage in %	Actual compressive strength (Mpa)	Actual split tensile strength (Mpa)	Predicted split tensile strength (Mpa)
1400	0	14.23	0.91	0.868
	0.1	15.5	0.98	0.987
	0.2	16.73	1.13	1.101
	0.3	16.2	1.02	1.052
1600	0	19.11	1.37	1.322
	0.1	20.25	1.42	1.428
	0.2	21.1	1.5	1.507
	0.3	20.65	1.45	1.465

5. CONCLUSIONS

In this particular study we have tested different densities of foam concrete with varying percentage of fibers. Important conclusions for the study are as follows:

- As the density of the foam concrete increases the Compressive strength, Flexural strength and Split tensile strength also increases.
- Addition of fibers upto 0.2% (Copper fiber- 0.2% plus polypropylene fiber- 0.2%) increases the strength of foam concrete thereafter addition of fiber will consecutively decrease the strength of foam concrete.
- Strength of foam concrete increases much greatly with increase in density, than compared to addition of fibers.
- Compressive strength for fibers dosage of 0.2% after 28 days of curing, maximum values was 21.1Mpa and 16.73Mpa for densities of 1600 kg/m^3 and 1400 kg/m^3 respectively. Further addition of fiber decreases the Compressive strength of foam concrete.
- Flexural strength for densities of 1600 kg/m^3 and 1400 kg/m^3 was 3.77MPa and 2.63MPa respectively at 0.2% dosage of fibers after 28 days of curing. Further addition of fiber decreases the Flexural strength of foam concrete.
- Split tensile strength was highest for 0.2% dosage of fiber. The strength for densities of 1600 kg/m^3 and 1400 kg/m^3 was obtained as 1.50MPa and 1.13MPa respectively. Further addition of fiber decreases the Split tensile strength of foam concrete.
- Water absorption is inversely proportional to density. As the density increases the water absorption decreases.
- Water absorption also decreases as the percentage of fibers in foam concrete increases.

- Water absorption for 0% fiber for densities of 1600 kg/m^3 and 1400 kg/m^3 was recorded as 10.09% and 13.57% respectively.
- The relation was found by regression analysis between compressive strength - flexural strength and compressive strength - split tensile strength. It was found that the values of regression analysis are almost similar or nearer to the actual values.

REFERENCES

1) Chen Bing, Ph.D; Wu Zhen; and Liu Ning Ph.D, *"Experimental Research on Properties of High Strength Foamed Concrete"*, Journal of Materials in Civil Engineering ASCE- January 2012.

2) Rita Nemes, Zsuzsanna Józsa, *"Strength of Lightweight Glass Aggregate Concrete"*, Journal of Materials in Civil Engineering ASCE – October 2006.

3) Hanizam Awang, Muhammad Hafiz Ahmad, *"Durability Properties of Foamed Concrete with Fiber Inclusion"*, World Academy of Science, Engineering and Technology, International Journal of Civil and Environmental Engineering Vol:8, No:3, 2014.

4) Vasser M. Hunaiti, *"Strength of Composite Sections with Foamed and Lightweight Aggregate Concrete"*, Journal of Materials in Civil Engineering ASCE – May 1997.

5) Li Yue, Ph.D; and Chen Bing, Ph.D, *"New Type of Super Lightweight Magnesium Phosphate Cement Foamed Concrete"*, Journal of Materials in Civil Engineering ASCE – 2015.

6) Aqeel Hatem Chkheiwer; Mazen Dewanabbdullah; Mazinabdulimam Almazeni, *"Properties of Lightweight Aggregate Cellular Concrete with Polypropylene Fiber"*, International Journal of Advances in Mechanical and Civil Engineering, Volume-4, Issue-5 – October 2014.

7) M.A.O. Mydin; N. Md. Sani; M.A. Mohd Yusoff; S. Ganesan, *"Determining the Compressive, Flexural and Splitting Tensile Strength of Silica Fume Reinforced Lightweight Foamed Concrete"*, MATEC Web of Conferences 17, published by EDP Sciences – 2014.

8) Nur Nabilah Farhana Mohammad Fathilah; Cher Siang Tan, *"Flexural Strength of Lightweight Foamed Concrete using cement to sand ratio 3:1 with Inclusion of Polypropylene Fiber"*, International Journal of Advances in Mechanical and Civil Engineering.