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Strength Characteristics of Preformed Foam Concrete

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Abstract: ***The study deals with the usage of perforated foam of various percentages to that of coarse aggregate to produce light weight concrete. With the day to day increase in industries and civilization's expansion it has become very much necessary to produce structures with proficiently lesser weight. Its usage has become more proficient in construction of building in earthquake prone areas. This experimental investigation deals with the study of strength parameters of light weight concrete by performing various strength test and its various behavior s such as compression, tensile and flexure are studied by adding preformed foam at various proportions of 0%, 2%, 5%, 10%, 20% and 40%. All these strength parameter test are performed on 7th day, 14th day and 28th day respectively from day of casting.***

Keywords**:** ***foaming agent, light weight concrete, strength parameters, compression. Tensile, flexure***

I. INTRODUCTION

Light weight concrete has become a global trend due to the increase in demand in coarse aggregate and also light weight concrete construction in earthquake prone areas. The introduction of light weight concrete goes back to the ancient period were light weight materials has been used to construct lighter building structures. There are various materials being used to produce concrete of lighter structure but none have been proven more effective then the usage of preformed foam to produce lighter concrete. it also reduce the usage of coarse aggregate to certain extent such that bulk of the weight due to it gets reduced. But the right proportion of usage of foam in concrete as replacement for coarse aggregate seems to be still under experimentation. This study revolves around in not only finding the right proportion of foaming agent to produce light weight concrete but also the right proportion at which the preformed foaming agent enhances the strength of concrete.

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II. MATERIALS USED

A. Cement

Ordinary Portland cement of 53 grades has been used in casting of specimen. This cement plays a major role in the hydration process of concrete and helps to bind the aggregates together to produce a firm and hardened concrete.

B. Fine aggregate

Aggregate passing through the 4.75 mm sieve and retained in 75 micron sieve are termed as fine aggregate. This fine aggregate helps to fill in the pores of the concrete. Natural river sand with fractional passing through 2.36mm sieve is used and tested as per IS: 2386-Part 1.

C. Coarse aggregate

Coarse aggregate are solid inert materials that solidifies the concrete. It occupies the large portion of concrete and imparts strength to it. Coarse aggregate of nominal size of 20mm is used to produce a concrete of uniform grading.

D. Water

Portable water free from any organic matters and impurities are used for mixing and curing of concrete. The ph level of water also should not be much acidic or basic in nature. It should not alter any of the physical properties of the concrete thereby reducing its strength.

E. Foaming agent

Foaming agent plays a key role in producing light weight concrete. Foaming powder of proper chemical proportion based on literature survey is bought reputed chemical factor such that it does not alter any of the concrete physical properties. It is mixed well with small portion of water used for mixing of concrete using a mechanical stirrer operated on a motor. Once the foams disappear it is added to the fresh concrete mix. the foaming agent is bought in powdered from and it consist of aluminum, calcium hydroxide, sodium carbohydrates and magnesium hydroxide are the major chemical constituents.

Fig. 1. Preparation of preformed foam

II. EXPERIMENTAL SETUP

A. Compressive Strength Test

The compressive strength of the concrete is tested using a compression testing machine of 1000 KN capacities. The samples are tested up to failure and there compressive stress is determined based on the test specimen dimension and the load sustained.

Fig. 2.Compressive strength test setup

B. Split Tensile Strength Test

Concrete is casted in cylinders of 100mm diameter and 300mm length and are tested in an CTM of 1000KN capacity. Tensile load is applied on the faces of the cylinders and tested up to failure. The tensile stress is calculated based on the load sustained and circumferential area of the cylinder.

Fig. 3.Split Tensile strength test setup

C. Flexural Strength Test

In order to study the flexural behavior of the concrete there are casted in to prism of standard dimension. The beams are tested under two point loading mechanism and tested up to failure in an UTM of 400 KN capacity. Based on distance of crack formed to the nearest support the flexural behavior of the concrete is calculated.

Fig. 4.Flexural strength test setup

III. RESULT AND DISCUSSION

After the casted specimen have been cured for 7, 14 and 28 days, they are taken out and let to dry and are tested for various strength test. The test results are plotted in a bar chart and are analyzed for further discussion.

A. Compressive Strength Test

The compressive strength test results shows that concrete with foaming agent at 10% seems to have higher strength after 7 days of curing. But the concrete after the 14 and 28 days of curing shows higher compressive strength with 2 and 5 % of foaming agents. There is a 20% increase in concrete compressive strength after 28 days of curing when compared with conventional mix at 2% of foaming agent.

Table- I: Compressive strength of concrete for different days of curing

Foam Content (%)	7 days test		14 days test		28 days test	
	Load (KN)	*Compressive Strength (N/mm^2)*	*Load (KN)*	*Compressive Strength (N/mm^2)*	*Load (KN)*	*Compressive Strength (N/mm^2)*
0	495	22	540	24	736	32.26
2	567	25.2	715	31.7	877	38.97
5	517	22.97	618	27.47	841	37.37
10	652	28.97	590	26.2	618	27.46
20	614	27.28	639	28.4	661	29.37
40	411	18.26	432	19.2	495	22

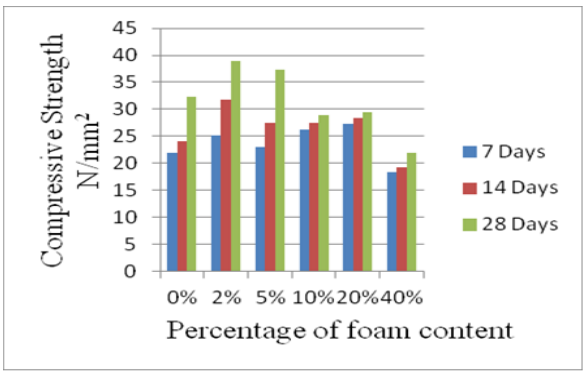

Fig. 5.Result analysis of compressive strength test

B. Split Tensile Strength Test

The concrete with foaming agent seems to show lesser resistance to tensile load. When compared with all other strength characteristics of concrete. The concrete with foaming agent of 10% seems to have better resistance to tensile load when compared with the other concrete mix with various proportion of foaming agent. There is marginal increase in concrete strength until 10% beyond which there reduction in concrete strength.

Table- II: Split tensile strength of concrete for different days of curing

Foam Content (%)	7 days test		14 days test		28 days test	
	Load (KN)	*Split tensile Strength (N/mm^2)*	*Load (KN)*	*Split tensile Strength (N/mm^2)*	*Load (KN)*	*Split tensile Strength (N/mm^2)*
0	198	2.8	212	2.99	219	3.1
2	240	3.39	233	3.296	233	3.29
5	219	3.098	226	3.19	247	3.49
10	254	3.59	240	3.39	261	3.7
20	233	3.296	233	3.296	240	3.39
40	176	2.489	190	2.68	198	2.8

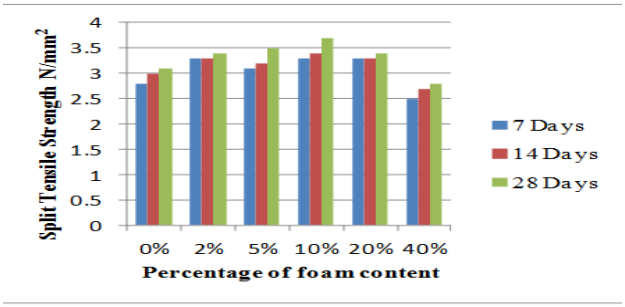

Fig. 6.Result analysis of split tensile strength test

C. *Flexural Strength Test*

Among the entire strength test preformed light weight concrete has better resistance to cracking under flexure. The concrete with 10% of foaming agent withstands more loads when compared with the others. There is steady increase in strength up to 10% addition of addition of foaming agent beyond which on further addition of foaming agent the strength reduces considerably. They concrete flexural strength increased by 15% at addition of 10% of foaming agent when compared with the conventional concrete mix.

Table- III: Flexural strength of concrete for different days of curing

Foam Content (%)	7 days test		14 days test		28 days test	
	Load (KN)	*Flexural Strength ($N/mm^{2)}$*	*Load (KN)*	*Flexural Strength ($N/mm^{2)}$*	*Load (KN)*	*Flexural Strength ($N/mm^{2)}$*
0	18.8	1.41	19.5	1.47	20	1.5
2	22.1	1.66	23.4	1.75	24	1.8
5	24.5	1.84	25.2	1.89	25.4	1.905
10	25.8	1.95	26.2	1.96	28.4	2.13
20	23.1	1.77	23.8	1.785	24.6	1.845
40	14.8	1.11	17.0	1.275	19.8	1.485

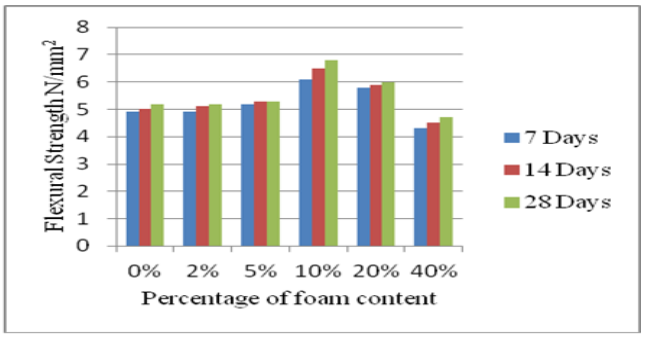

Fig. 7.Result analysis of flexural strength test

IV. CONCLUSION

1. The foaming agent used seems to be more effective in producing concrete of lighter weight in structure.
2. The foaming agent also has the ability to enhance the strength of concrete up to 10% of replacement beyond which the concrete strength reduces marginally.
3. The addition foaming agent at 5% proportion enhance the strength at early stage whereas 10% seems to be the right proportion for enhancing the strength for longer period.
4. The preformed foam not only reduces the weight of the concrete but also has the ability enhances the strength of concrete up to 10% replacement.

REFERENCES

1. D.Bouvard, J.M.Chaix, R.Dendievel, A.Fazekas., "Characterization and Simulation of Microstructure and Properties of EPS Cellular Lightweight Concrete" Cement and concrete research, Vol 37, Issue 12, December 2012
2. H.K.Kim, J.H.Jeon, H.K.Lee., "Workability, Mechanical, Acoustic and Thermal properties of lightweight aggregate concrete with a high volume of entrained air" Construction and building materials, Vol 29, april 2012
3. IS: 383-1970, Specification for coarse and fine aggregate, Bureau of Indian Standards, New Delhi, 1970
4. IS: 516-1959, Methods of test for strength of concrete, Bureau of Indian Standards, New Delhi, 1959
5. IS: 1199-1959, Methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi, 1959
6. IS: 2386-1963, Methods of test for aggregates of concrete, part I, III & IV, Bureau of Indian Standards, New Delhi, 1963.
7. Khampee Jitchaiyapum, Theerawat Sinsiri, Chai Jaturapitakkul, Prinya Chindaprasirt., "Cellular lightweight concrete containing high calcium, fly ash and natural zeolite" International journal of minerals, metallurgy and materials, May 2013, Vol 20, issue 5
8. KhampheeJitchaiyaphum, TheerawatSinsiri, PrinyaChindaprasirt., "Cellular lightweight concrete containing pozzolan materials" Procedia Engineering, 2011, Vol 14
9. P. Sundar Kumar, M.J .Ratna Kanth Babu, K. Sundara Kumar and K. Satish Kumar "Experimental Study on Lightweight Aggregate Concrete" International Journal of Civil Engineering Research Volume 1, Number 1 (2010), pp. 65–74
10. A.Suba lakshmi , S.Karthick , Gasper Helden , M.Dinesh Boopathi , V.Balaji Pandian, "Experimental Investigation On Light Weight Concrete Using Pumice Aggregate" International Journal of Innovative and Emerging Research in Engineering Volume 4, Issue 3, 2017
11. Shetty, M. S., Concrete Technology, S.Chand and company, New Delhi, 2005

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