Study of Behavior of Light Weight Concrete using Rice Husk Ash, Steel Fiber and Red Soil

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Abstract –*Light weight concrete has been successfully used and it has gained popularity due to its lower density than conventional concrete. Light weight concrete is created by uniform distribution of air bubbles throughout the mass of concrete. Generally light weight concrete has lower compressive strength. In this study the compressive strength of light weight concrete M20 grade tested by using laterite soil, rice husk ash, steel fiber and its combination by the replacement of sand. The final result revealed that the replacement of sand by laterite soil not very much increases the compressive strength. By comparing light weight concrete cube the average percentage weight reduction in cube mixed with red soil is also decreases by 16.83%.*

Key Words: Compressive strength, weight reduction, laterite soil, fly ash, steel fiber etc.

1. INTRODUCTION

Concrete widely used as construction material composed of cement as well as other cementations materials such as fly ash and slag cement, water and chemical admixtures. Cellular Light weight concrete is a versatile material which consists primarily of a cement based mortar mixed with at least 20% of volume air. The air bubble developed in concrete through chemical admixture and mechanical foaming. This type of concrete also called as aerated and cellular concrete. Light weight concrete possesses high flow ability, low self-weight, minimal consumption of aggregate, controlled low strength and excellent thermal insulation properties. The term light weight concrete according to ACI is also known as Light density concrete. It is defined as the concrete which is made with light weight coarse aggregate and normal weight fine aggregate with possibly some light weight fine aggregate. This concrete is of density less than 1950 kg/m3. Light weight Concrete can be placed easily, by pumping if necessary, and does not require compaction, vibrating or levelling.

1.1 Literature review

N. Narayanan, K. Ramamurthy, The main objective of this paper is to classify the inspections on the quality of aerated concrete in accordance of physical (microstructure, density), chemical, mechanical (compressive and tensile strengths, modulus of elasticity, drying shrinkage) and functional (thermal insulation, moisture transport, durability, fire resistance and acoustic insulation) characteristic.

Raj Vardhan Singh Chandel, Rashmi Sakale In this research work light weight cellular concrete blocks are casted with 65% of Fly ash and 35% of cement with foam content 1.5% of total weight and to increase its strength sand and quarry dust is added in its composition which replace fly ash up to 30% at an interval of 5%. Compressive Strength of the CLWC is increased when quarry dust is partially replaced by fly ash content in it. It is also observed that increasing content of quarry dust in the composition, increases the compressive strength of CLWC, replacement of fly ash by quarry dust upto 30% possess increment of 33.33% in compressive strength.

Pantawee et al (2008) have investigated the use of natural pozzolanic diatomaceous and perlite to replace sand and cement at various percentages by mass of binder. They formed that the mortar containing diatomaceous replacing Portland cement effectively increased the compressive strength better than replacing sand. They also found the optimum content of perlite that contributed to the highest compressive strength.

Yun Bai, Ratiyah Ibrahim, and P.A. Muhammed Basheer (2004) studied that fly ash, furnace bottom ash and lytag were used to take over ordinary Portland cement, natural sand and coarse aggregate, respectively, and thereby to manufacture light weight concrete. The density, compressive strength, pull – off surface tensile strength, air permeability, sorptivity and porosity of the concretes were investigated. With part of OPC replaced with FA, the strength decreased but the permeability of resulting concrete improved.

2. Material used

The basic materials used for the formation of light weight concrete are cement, fine aggregate, coarse aggregate, foaming agents. In this study we also use fly ash steel fiber and red soil as a partial replacement of fine aggregate. The properties of material used in experimental program are as follow:

2.1 Cement: Ordinary Portland cement of grade 43 conforming to IS: 8112-1989 was used. Cement was tested according to IS: 4031-1988. The cement was of uniform color i.e. grey with light greenish shade. The properties of cement with its experimental value are given in table 1

Table -1: Properties of cement

S.No.	Physical Property	Experimental Value
1	Consistency of cement	29%

2	Specific gravity	3.15
3	Initial setting time	30 min.
4	Final setting time	600 min.

2.2 Aggregates: For fine aggregates river sand has been sieved from IS 1.18mm sieve. It did not contain any impurities such as vegetable matters, organic matter, lumps, etc. The physical properties of fine aggregates are given below in table 2.

Physical tests	Values
Specific gravity	2.63
Fineness modulus	2.404
Water absorption	1.7

Table -2: Properties of aggregate

The material which is retained on 4.75 mm sieve is known as coarse aggregate. Coarse aggregate passing 10 mm IS sieve and retained on 4.75 mm sieve was used in this experimental work.

2.3 Foaming Agent: Foaming agent are categorized in two forms protein and synthetic. Protein based is generally used for the low density and for higher density synthetic foaming agents were used. Foam in the concrete mix can create through forcing the chemical, air and water. In this experimental work protein based foaming agent is used. In this research work only 50% foaming agent is used.

2.4 Rice husk ash: Rice husk ash having high percentage of silica, fine silica will provide a very compact concrete. Combustion of rice husk provides rice husk ash. This rice husk ash contains nearly 85-90 % silica. The rice husk ash also is a very good thermal insulation material. The fineness of the rice husk ash also makes it a very good applicant for sealing fine cracks in civil structures, where it can seep deeper than the conventional cement sand mixture.

2.5 Steel Fiber: Steel Fiber are generally distributed throughout a given cross section area. Steel fiber improves resistance to impact or progressive loading, and to resist material fragmentation. Steel Fibers are ordinarily added to concrete in low volume dosages (usually less than 1%), and have been shown to be useful in shortening plastic shrinkage cracking.

3. Experimental program: In this study 10cmx10cmx10cm cube mould is used and the ratio of concrete 1:1.5:3 i.e. M20 is used. The concrete cubes are tested on 7, 14 & 28 days by compression testing machine to get their compressive strength. The highest compressive strength about 22.5 N/mm^2 get when rice husk ash, iron chips and laterite soil respectively are mixed. We use foaming agent to reduce the weight by foaming foam (voids) in concrete with air entering agent. Foam in the concrete mix can create through forcing the chemical, air and water. In this experimental work protein based foaming agent is used.

Fig -1: Casting of Cube

Fig -2: Mould opening

Fig -3: Addition of foaming agent in Mix

4. Result and Discussion

4.1 Average strength of Different cubes

Three cube of each category were cast and average strength was calculated. CC refers to conventional concrete. Except CC all sample were light weight concrete sample. In SP-1 sample greater than 10mm coarse aggregate are used. In SP-2 less than 10 mm coarse aggregate used. In SP-3 sample rice husk ash and coarse aggregate less than 10mm are used. In SP-4 sample steel fiber added to see the variation. In SP-5 sample rich husk ash as well as steel fiber is added. In SP-6 sample fine aggregate replaced with lacustrine soil. In SP-7 sample fine aggregate replaced with red soil.

Table -3: Average compressive strength of different samples

S. No.	Cube	7 DAYS		14 DAYS		28 DAYS	
		Wt. (gm)	C.S (N/mm²)	Wt. (gm)	C.S (N/mm²)	Wt. (gm)	C.S (N/mm²)
1.	CC	2156	10	2214	16.50	2212	23.16
2.	SP-1	1891	7.73	1923	8.06	1924	18.14
3.	SP-2	1712	3.88	1722	4.84	1754	9.55
4.	SP-3	1410	1.57	1409	2.41	1417	2.81
5.	SP-4	2119	6.03	2064	8.82	2066	11.82
6.	SP-5	1086	1.40	1199	2.10	1079	1.59
7.	SP-6	1753	0.88	1761	1.45	1759	2.55
8.	SP-7	1779	3.50	1846	10.42	1849	22.00

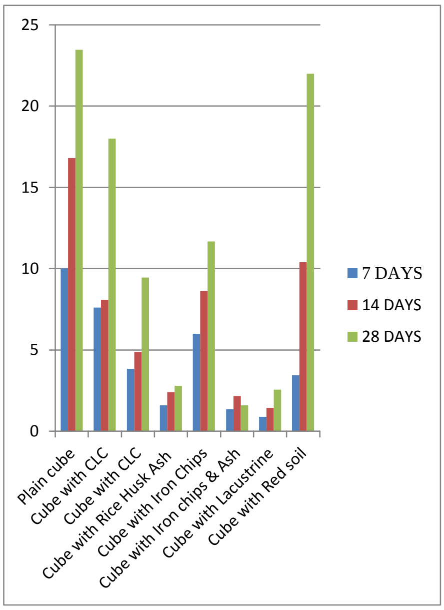

Chart -1: Compressive Strength of different cube samples

4.2 Comparison between Avg. % Weight reduction & Avg. % strength reduction with Conventional Concrete

On the basis of finding it has been observed that sample having red soil in replacement with fine aggregate provide strength up to M20 grade concrete as well as having minimum weight.

Table -3: Comparison between Avg. % Weight reduction & Avg. % strength reduction with Conventional Concrete

S. No.	Cube	Avg. % weight reduction	Avg.% strength reduction
1.	SP-1	12.81	31.79
2.	SP-2	20.97	63.5
3.	SP-3	35.63	85.81
4.	SP-4	40.46	45.02
5.	SP-5	50.40	88.75
6.	SP-6	19.87	90.42
7.	SP-7	16.83	36.24

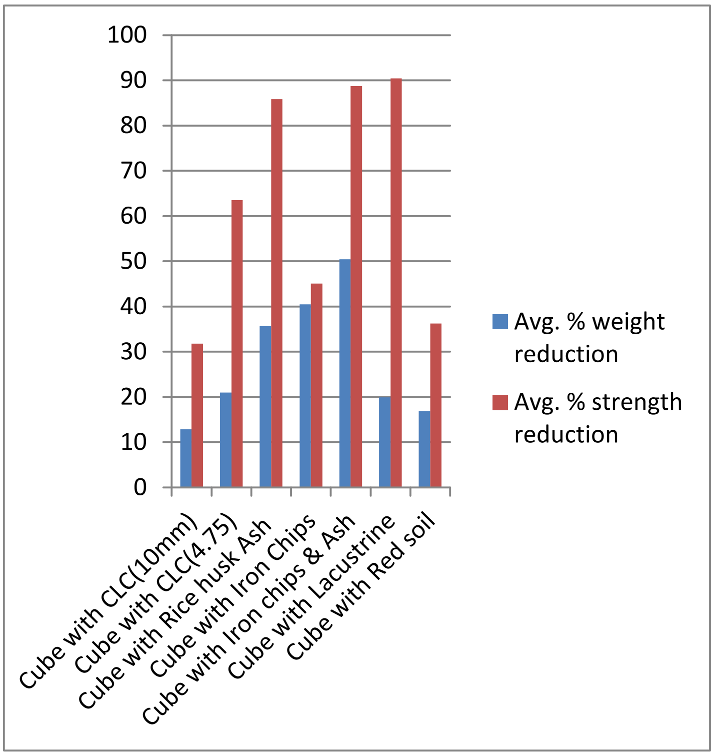

Chart -1: Avg. % Weight reduction & Avg. % strength reduction

5. CONCLUSIONS

On the basis of result obtained from the experiment, we saw many changes in the reduction of weight and strength of concrete with the change in constituent of materials. The changes of reduction in weight and strength are obtained on 7 days, 14 days &28 days. The reduction of weight and strength are compared with plain cement concrete cube.

1. When we use the red soil as the fine aggregate then we found that average reduction in weight is around 17% as compared to conventional concrete.

2. Strength at 7&14 days was less compared to conventional concrete but after 14 days up to 28 days light weight concrete with red soil (Partial replacement with fine aggregate) has obtained its complete strength M20.

3. Light weight concrete can be used for decorative purpose but with the addition of red soil we can also use as load bearing structure at some extent.

4. When we use lacustrine soil as replacement with fine aggregate it is found that weight of the sample increases but its strength drastically reduced.

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