Experimental Investigation of Partial Replacement of Fine Aggregate using Leca in Concrete

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ABSTRACT: This report presents experimental study on effect of partial replacement of fine aggregate (sand) by Light weight coarse aggregate (LECA) and steel fibre. LECA is also more or less similar to properties of sand. LECA is used in concrete to minimize the demand of coarse aggregate (sand) and also in design of concrete structures, self weight occupies very large portion of total load coming on the structures critically in cases such as weak soils and tall structures. Also impressive benefits in lessening density of concrete ,thus contributing towards economy of work. The light weight concrete gives low density than conventional concrete and has better thermal insulation comparatively. Main intention of carrying out this project is to compare the weight of concrete and strength properties viz. cube compressive strength, split tensile strength cylinders and flexural strength of light weight concrete against conventional concrete by partially replacing natural sand by LECA by 10%,20%,30%,40%. And addition 1%,1.5%, steel reinforcement significantly increases the strength of concrete, and results in concrete with homogenous tensile properties.

I INTRODUCTION

Protecting the depleting natural sand resource and the shore line is a major concern of the day. It is essential today, to reduce excessive consumption of the natural river sand and there by prevent sand mining. It is possible by utilization of industrial by-products as well as other waste materials in the production of normal concrete. These products can be used as partial and/or full replacement of cement or/and aggregates or as admixtures. Also, many times, it was found that concrete made with wastes and industrial by-products possesses superior properties than the conventional concrete in terms of strength, performance and durability. Hence, in this project, steel fibre and leca is explored to find its suitability as a replacement material for cement and fine aggregate in making concrete.

Light-weight concrete can be defined as a type of concrete which includes an expanding agent in that it increases the volume of the mixture while giving additional qualities like lessened the dead weight. It's lighter than the conventional concrete . The required properties of the light-weight concrete will have a bearing on the best type of light Expanded Clay Aggregate to use. The Structural light weight concrete as we call is a concrete whose density varies from 1400 to 2000 kg/m3.The literatures have thrown a light on influence of palm oil clinker, coconut shell, ceramic waste, Light expanded clay aggregate concrete to reduce the density of structural concrete member. It reduces the weight of concrete and cost of concrete by reducing the aggregate cost and produces economic infrastructure system . Light-

weight concrete cubes, cylinders are casted and tested for determining compressive strength, split tensile strength, and obtain the results are compared with the control specimens.

PROBLEM STATEMENT:

A large number of wastes materials generated by industries are disposed in the environment. If the wastes cannot be disposed properly it will lead to social and environmental problems. The use of silica fume and copper slag in the concrete as a replacement for cement and fine aggregate, reduces the costs of disposal, lowers the cost of the concrete and also helps in protecting the environment. Despite the fact that several studies have been reported on the effect of silica fume and copper slag on the properties of Concrete, further investigations are necessary in order to obtain a comprehensive understanding that would provide an engineering base to allow the use of silica fume and copper slag in concrete.

II LITERATURE REVIEW

Concrete now serves as a backbone of the infrastructural development of every country. We have a long way to go to learn and practice the art and science of making quality concrete. The past studies on various type of replacement of cement and fine aggregate used in concrete were studied by conducting literature survey and some of them are listed below.

T. Sonia1, R. Subashini reviewed the paper "Experimental Investigation on Mechanical Properties of Light Weight Concrete Using Leca" which aims to investigate on concrete mix M25 by the effect of partially and fully replacement of the coarse aggregate by Leca with various percentage such as 20%, 40%, 60%, 80% and 100% and fly ash percentage such as 15%, 20%, 25% used as partial replacement for cement in concrete. Analysis of this concrete was done in fresh state as well in hardened state to evaluate physical and mechanical properties of concrete.

Anilkumar1, Anil Kumar R2 studied "Experimental Investigations on Structural Lightweight Concrete Columns obtained by Blending of Light Weight Aggregates". In the present investigation the experimental work is divided in two phases, in the first phase the light weight concrete was obtained by blending of LECA and cinder in place of conventional coarse aggregates at different proportions of 0:100, 10:90, 20:80, 30:70, 40:60, 50:50 and vice versa.

R.N. Raj Prakash*, A.Krishnamoorthi investigated "Experimental Study On Light Weight Concrete Using Leca"**.**This report presents experimental study on effect of partial replacement of coarse aggregate (Jelly) by Light weight coarse aggregate (LECA).

Hanamanth Shebannavar ,Maneeth P. D,,Brijbhushan S reviewed that "comparative study of leca as acomplete replacement of coarse aggregate by aci method with equivalent likeness of strength of is method ". in design of concrete structures, self weight occupies very large portion of total load coming on the structures critically in cases such as weak soils and tall structures. also impressive benefits in lessening density of concrete ,thus contributing towards economy of work. Main intention of carrying out this project is to compare the densities of concrete and strength properties viz. cube compressive strength, split tensile strength cylinders and flexural strength of light weight concrete against conventional concrete by 100% replacing natural aggregates by ECA. Lightweight aggregate has been effectively utilized for well more than two millennia. use of lightweight total

adds to the maintainable advancement by moderating energy, bringing down transportation prerequisites, boosting outline and construction proficiency and expanding the service life of the item it is utilized as a part of With expanding concern over the intemperate abuse of common aggregates, lightweight aggregate delivered artificially is a feasible new resource of structural aggregate objects. LECA lately, turned into a vital basic material and the interest for it is expanding.

Priyanga.R 1,Rajeshwari L.B2 Vijaya Baskar S conducted "experimental investigation on mechanical properties Of lightweight concrete using leca and steel scraps". The Mechanical Properties Of Lightweight Concrete Using LECA And Steel Scrap. The Replacing Normal Coarse Aggregate By Lightweight Expanded Clay Aggregate(LECA).

III PROPOSED WORK

Objective:

The objectives of this research work are:

- To study the strength properties for concrete in fine aggregate replaced by leca.
- To study compare it with the compressive, split tensile and flexural strength of concrete.

STEEL FIBER

The use of Steel Fiber Reinforced Concrete (SFRC) has received much attention in concrete industry as more research is being performed and more is being understood about its material properties and behavior. Steel fiber reinforced concrete （SFRC） has the ability of excellent tensile strength, flexural strength, shock resistance, fatigue resistance, ductility and crack arrest. Therefore, it has been applied abroad in various professional fields of construction, irrigation works and architecture. When steel fibers are added to high strength concrete, the increase in fiber volumetric ratio results in an increase in the compressive strength of the concrete and a considerable amount of increase in the tensile strength of the fiber reinforced specimens is observed in split cylinder tests.

PROPERTIES OF STEEL FIBER

- Flexural Strength: Flexural bending strength can be increased of up to 3 times more compared to conventional concrete.
- Fatigue Resistance: Almost 1 1/2 times increase in fatigue strength.
- Impact Resistance: Greater resistance to damage in case of a heavy impact.
- Permeability: The material is less porous
- Abrasion Resistance: More effective composition against abrasion and spalling.
- Shrinkage: Shrinkage cracks can be eliminated.
- Corrosion: Corrosion may affect the material but it will be limited in certain areas

ADVANTAGE OF STEEL FIBER

- More ductile concrete with a high load bearing capacity-resulting in thinner slabs with equal or betterperformance than their mesh counter parts
- Efficiency crack control -3,200 Fibers on average per Kg
- Durability –steel Fibers slabs reinforce the structure through of the concrete
- iv. Quick and Easy application – steel Fibers can be added at the concrete plants or at the job site directly.

LECA:

Lightweight expanded clay aggregate (LECA) or **expanded clay** (exclay) is a light weight

Design M20	Water	Cement	Fine aggregate	Coarse aggregate
Weight (kg)	191.58	383.6	564.9	1242.2
Ratio	0.5	1	1.47	3.24

aggregate made by heating clay to around 1,200 °C (2,190 °F) in a rotary kiln. The yielding gases expand the clay by thousands of small bubbles forming during heating producing a honeycomb structure. LECA has an approximately round or potato shape due to circular movement in the kiln, and is available in different sizes and densities. LECA is used to make lightweight concrete products and other uses.

Uses of leca:

Common uses are in concrete blocks, concrete slabs, geotechnical fillings, lightweight concrete, water treatment, hydroponics, aquaponics and hydroculture.

FIG. LECA

I.S. Sieve Size (mm)	Weight retained (g)	Percentage of weight retained %	Cumulative Percentage of weight retained %	Percentage of Fineness %
4.75	10	0.5	0.5	99.5
2.36	60	3	3.5	96.5
1.18	350	17.5	21	79
600 µ	450	22.5	43.5	56.5
300 µ	920	46	89.5	10.5
150 µ	210	10.5	100	1
Total	2000	100	258	

Table: sieve analysis of fine aggregate

Table:Mix Proportion By Weight

IV RESULTS AND DISCUSSION

In order to study the behaviour of the replacement specimen concrete with normal concrete. Testing was done to determine the material and structural properties of each type of replacement specimen and will these properties differ according to a different type of mixture and its composition.

Once concrete has hardened it can be subjected to a wide range of tests to prove its ability to perform as planned or to discover its characteristics. For new concrete this usually involves casting specimens from fresh concrete and testing them for various properties as the concrete matures.

compressive strength:

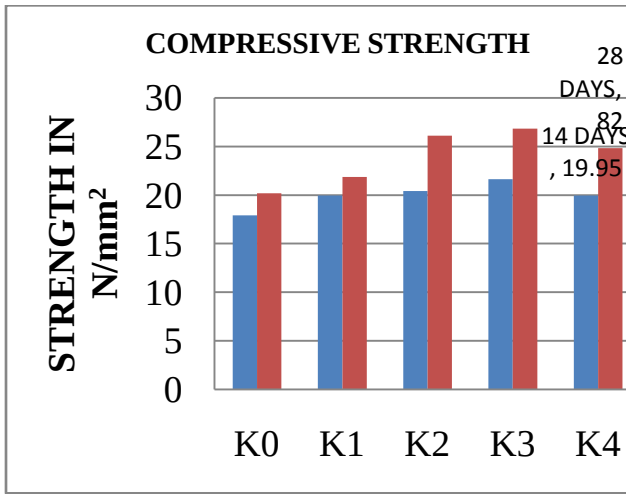
for 7 days is shown below

SPECIMEN	COMPRESSIVE STRENGTH			AVERAGE
	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3	IN N/mm²
K_0	18.33	18.50	17.23	18.02
K_1	19.80	20.54	19.50	19.95
K_2	20.01	20.23	21	20.41
K_3	21.5	21.68	21.7	21.62
K_4	19.8	20.54	19.5	19.95

Table Compressive strength for 7 days.

SPECIMEN	COMPRESSIVE STRENGTH			AVERAGE
	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3	IN N/mm²
K_0	20.70	20.30	19.60	20.2
K_1	21.78	22.30	21.53	21.87
K_2	26.69	25.30	26.33	26.1
K_3	26.72	26.8	27	26.84
K_4	25.5	24.61	24.35	24.82

Table: Compressive strength for 28 days



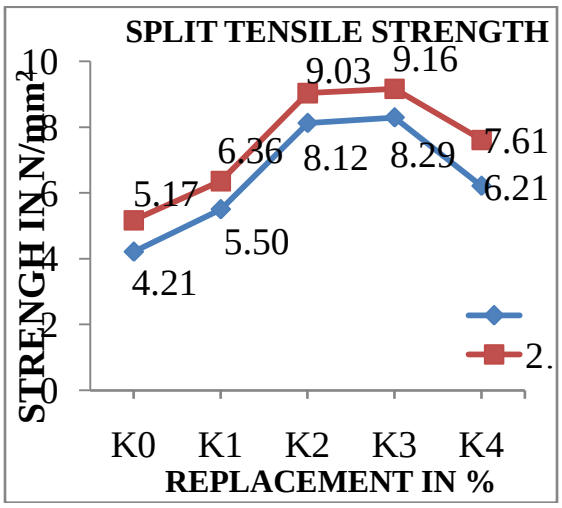


Figure: graph of Split Tensile strength for 7 and 28 days

The graph shows the variation of compressive strength of concrete cubes and tensile strength of concrete cubes and cylinders for 7 and 28 curing days from the date of cast of specimen. From this the compressive strength and tensile strength increased gradually up to replacement of fine aggregate by 30 % leca.

splitting tensile strength

For 7 days is shown in the table:

SPECIMEN	TENSILE STRENGTH			AVERAGE
	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3	IN N/mm²
K_0	4.14	4.28	4.23	4.21
K_1	5.55	5.98	4.98	5.5
K_2	8.30	8.69	7.38	8.12
K_3	8.40	8.86	7.61	8.29
K_4	6.53	6.69	5.42	6.21

For 28days

SPECIMEN	TENSILE STRENGTH			AVERAGE
	SPECIMEN 1	SPECIMEN 2	SPECIMEN 3	IN N/mm²
K_0	5.20	5.36	4.95	5.17
K_1	6.40	6.19	6.50	6.36
K_2	8.36	9.16	9.57	9.03
K_3	9.41	8.86	9.21	9.16
K_4	7.92	9.65	7.28	7.61

V CONCLUSION

We have concluded that workability increases when replacing cement by addition steel fibre . Self weight of the concrete increases while sand is replaced by leca due to the density of leca. Compressive strength increased by 30% and Tensile strength increased by 30 % by replacing the cement by fine aggregate by 40 % leca when comparing to control specimen. The development in construction technology and architecture has tempted the people to purchase multiple choice materials. Project work gives freedom and opportunity to students to select their own field. This makes, students like us more hopeful it also grows up the operation and understanding between students, which is essential for teamwork.

It also grows up many ideas on selection of project, and also this chance to brush up our activities etc. which are not in syllabus for this semester. On the whole, our project work gives us more hope to march towards a better tomorrow. The project work develops co-operation, co-ordination and awareness of our own individual skills.

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