

Experimental Study on Light Weight Concrete by Using LECA and Fly Ash

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Abstract: *This report presents experimental study on effect of partial replacement of coarse aggregate by Light weight coarse aggregate (LECA). LECA is also more or less similar to properties of coarse aggregate. LECA is used in concrete to minimize the demand of coarse aggregate 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. And compare the weight of concrete and strength properties viz. cube compressive strength of light weight concrete against conventional concrete by partially replacing natural aggregates as LECA by 5%,10%,15% and 20%. As the percentage of LECA in concrete increases both slump values and compaction factor values are decreases at fresh concrete. As well as in hardened concrete density of concrete and compressive strength of concrete also decreases. One such waste material is fly ash, which is produced in large quantities from thermal power plants as a by-product. A substantial amount of fly ash is left unused posing environmental and storage problems. The production of sintered lightweight aggregate with fly ash is an effective method to dispose of fly ash in large quantities. The partially replaced coarse aggregate by using LECA and Fly ash in various trial percentage and the conventional water cement ratio and standard proportion to be use for experiment.*

Keywords: *LECA, Fly Ash, Compressive strength.*

1. INTRODUCTION

Concrete is the most important building material used in the construction industry globally. One of the disadvantages of conventional concrete is the high self weight of concrete. Density of the normal concrete is in the order of 2200 to 2600 kg/m³. This heavy self weight results in larger dimensions of load bearing elements and foundations making it to some extent an uneconomical material. Attempts have been made in the past to reduce the self weight of concrete thereby increasing efficiency of concrete as a structural material. This resulted in evolution of light weight concrete with densities of the order of 300 to 1850 kg/m³. Light weight concrete has become more popular in recent years owing to the tremendous advantage it offers over conventional concrete. Some of the advantages of having light weight concrete are that it helps in reduction of dead load, increases the progress of building and lowers handling costs. Another most important characteristic of light weight concrete is the relatively low thermal conductivity and high sound insulation.

Fly ash is a waste material which generates twin problems of discarding as well as environmental degradation, due to its nature of causing air and water pollution on a large

scale. Nearly 145 coal-based thermal power stations in India are producing over 184 million tons fly ash per year out of which only 56% was utilized effectively and the remaining is still a concern to the community. Therefore, the manufacture of sintered fly ash lightweight aggregate is an appropriate step to utilize a large quantity of fly ash in concrete. However, a non-existence of worthwhile technology to produce sintered fly-ash lightweight aggregates and the absence of a market has deterred Indian entrepreneurs from producing sintered fly-ash aggregate. Recently a couple of industry players in India have focused their attention on the development of sintered fly ash light weight aggregates commercially on a large scale from the fly ash obtained from their captive power plants. As such, there is no Indian standard available for the lightweight aggregates. More recently, pilot studies by the authors have established that this material displays substantial potential for use in structural concrete.

2. MATERIAL AND ITS PROPERTIES

a. LECA:

Bloated clay by its commercial name LECA (Lightweight Expanded Clay Aggregate) is an aggregate made by expanding clay at average temperature of 1200 C° in rotary kiln. LECA is usually produced from 0.1 mm up to 25 mm and supplied in various range sizes, which some of the common grades are (0-4) mm, (4-10) mm, (10-25) mm and 0-25 mm which has 510, 330, 250 and 280 kg/m³ average density. Some of the important advantages of LECA aggregate are: lightness, thermal insulation by low conductivity coefficient, soundproofing by high acoustic resistance, moisture impermeable.

TABLE 1: Physical properties of LECA

PROPERTY	VALUE
Specific gravity	0.56
Water absorption	19.04



b. Cement:

In this project work, 53 grade of Ordinary Portland Cement is used. As per the Indian Standard the different tests are done for the accuracy such as Fineness Test, Soundness Test, Consistency Test & Initial and Final Setting time. Cement is defined as the material with adhesive and cohesive properties which make it capable of bonding the constituents of concrete compact mass. Cement is obtained by grinding the raw materials (calcareous materials like limestone, chalk, marine shell and argillaceous materials containing silica, alumina and iron oxide). The mixture is then burnt in a large at a temperature of 1300°C to 1500°C.

TABLE 2: Physical properties of Cement

Fineness	3.8%
Soundness	1.1mm
consistency	28%
Initial setting time:	86min
Final setting time:	390min

c. Coarse aggregate:

Coarse aggregate is used for making concrete. They may be in the form of irregular broken stone or naturally occurring gravel. Material which are large to be retained on 4.75mm sieve size are called coarse aggregates.

Table: 3 Properties of Coarse Aggregate

Sr.No.	Test	Result	SPECIFIED BY IS CODE:383 2016
1	Fineness Modulus	7.082	5.5 to 8
2	Flakiness Index	6.84%	15%
3	Elongation Index	10.04 %	40%
4	Abrasion value	14.78%	50%
5	Impact Value	5.54%	45%

d. Fine aggregate :

Sand is an extremely needful material for the construction but this important material must be purchased with all care and vigilance. Sand which is used in the construction purpose must be clean, free from waste stones and impurities. An examination should be made on the fineness of the available sands and depending on its fineness, it should then be planned to be used for the different purpose of the construction.

e. Fly Ash

Flyash is the by-product from the coal combustion which is composed of fine particles of burned fuel also known as pulverized fuel ash. The properties and chemical composition of flyash depends on the source and composition of coal during burning.

3. MIX DESIGN OF M20 CONCRETE

- Cement = 358.18 kg/m³
- Fine Aggregate =680.8 kg/m³
- Coarse Aggregate =1149 kg/m³
- Water = 197 kg/m³
- M20 mix ratio – **1: 1.9 : 3.2 : 0.55**

4. RESULT

Sr. No.	LECA (%)	Fly Ash (%)	7 th days Compressive strength (N/mm ²)	28 th days Compressive strength (N/mm ²)

1	0	0	13	22
2	5	0	12.88	21.33
3	5	10	13	21.77
4	5	20	12.4	20.88
5	10	0	12.22	20.66
6	10	10	12	20.22
7	10	20	11.55	19.33



5. CONCLUSIONS

- LECA can be used as a light weight aggregate in replacement of Conventional concrete.
- By using 5% and 10% of LECA with Fly ash as a partial replacement to coarse aggregate compressive strength is promising.
- The mechanical properties of light weight concrete is gradually decreasing as we increase the percentage of replacement of coarse aggregate because the light weight aggregate have low specific gravity than conventional aggregates.
- Increasing the percentage of light weight aggregate decreases the overall mass of the structure.
- The structural lightweight concrete is a sustainable material as the aggregate used is economical when compared to coarse aggregate and it is extensively used in agriculture usage.

Scope of the Future Work

- In the present study M20 grade concrete was considered. The present work can be extended to higher grades.
- In the present study we have replaced 5% and 10% of LECA with 0%,10% and 20% of fly Ash percent of normal coarse aggregate and Cement.
- Light Weight concrete by using LECA and Fly ash decreases a dead load of structure.
- The use of light weight aggregate is not highlighted in the construction industry; hence the use of LECA can be a solution.
- The low-density concrete would be used only for filling the areas in the construction industry, but a more in detail study and tests performed can lead to a new Invention to the present trend.
- The use of different light weight aggregates in the production of light weight concrete can be an effective measure to the construction industry and to Concrete Technology.

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