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RESEARCH ARTICLE

EXPERIMENTAL STUDY ON LIGHTWEIGHT CONCRETE USING LECA MATERIALS

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Abstract

This study investigates the feasibility of incorporating Lightweight Expanded Clay Aggregate (LECA) materials into concrete to produce lightweight concrete with improved mechanical properties. The experimental approach involves varying proportions of LECA aggregate in concrete mixes and assessing their compressive strength, density, workability, and durability. Additionally, the study examines the effect of LECA aggregate on the thermal and acoustic properties of lightweight concrete. Results from the experiments demonstrate the potential of LECA as a viable lightweight aggregate in concrete production, offering insights into optimizing mix designs for enhanced performance and sustainability in construction applications.

Introduction:-

Light Weight Concrete is produced using light weight aggregates. For the most part light weight concrete is not as strong as concrete made with typical aggregates. It is in this way typically utilized when the lightness of the concrete is useful and when high quality is not needed. Because of high self weight of traditional concrete with ordinary aggregates, a few endeavours have been made in the past to decrease the self weight of concrete called light weight concrete which is lighter than the conventional concrete made with typical weight aggregates.There are numerous favourable circumstances of light weight concrete over the typical concrete, one of them being its low density of concrete aides in decrease of dead load. As officially clarified it is more obliged where lightness is more imperative than the strength, for instance for developing elevated structures. It might likewise be utilized as a part of concrete curve spans, where the dead weight of the concrete makes a noteworthy commitment to the loads thus the strength/weight proportion is imperative instead of without a doubt the concrete strength. Another element for utilizing light weight concrete may be its low warm conductivity, which comes about because of its high void substance. Since the strength is affected fundamentally by the coarse aggregates while the workability depends basically on the fine aggregates, concrete is some of the time made with ordinary weight fine aggregates and light weight coarse aggregates. Usually light weight aggregates must be wetted for 24 hours prior to utilize.

Experimental Program
Materials Used
LECA

The coarse lightweight aggregate used in this study was locally produced from expanded clay type (LECA) from crop store. It is also used as a fertilizer.The maximum nominal size of (LECA) was 10 mm.

PROPERTY	VALUE
Specific gravity	2.10

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Water absorption	10.5%
Impact value	49.86%

Table 1:- Physical properties of LECA.

Cement

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.OPC53gradeconfirming IS 8112: 1989wasuse

TEST PARTICULARS	RESULT OBTAINED
Specific gravity	3.15
Normal consistency	32
Initial setting time (minutes)	130
Final setting time(minutes)	240

Table 2:- Physical properties of cement.

Coarse aggregate

Locally available coarse aggregates having the size of 6 mm were used in the present work. The gradation, specific gravity, water absorption, density were found. Testing on coarse aggregates was done as per IS: 2386 (Part I) – 1963, IS : 2386 (Part III) - 1963 IS : 2386 (Part III) - 1963 and the results obtained were referred with IS 383 : 2016.The test results conducted on coarse aggregate are reported in Tables 3.

PROPERTY	VALUE
specific gravity	2.76
water absorption	0.67%
Bulk density	1642.47kg/m^2

Table 3:- Physical Properties of coarse aggregate.

Fine aggregate

Manufacturing sand was used throughout the investigation as the fine aggregate conforming to grading zone III. The properties of sand by conducting tests according with IS 2386(part -1) -1963. The Specific gravity, fineness modulus and moisture content were determined.

TEST PARTICULARS	RESULT OBTAINED
Specific gravity	2.53

Table 4:- Physical properties of fine aggregate.

Water

Water is an important ingredient of concrete as it actively participates in chemical reaction with cement. This is the least expensive but most important ingredient of concrete. Clean potable water conforming to IS: 456-2000 was used; the water used in the preparation of mortar should not need to be distilled water, but must be free of all acids and other dissolved salts. A lower water-to-cement ratio yields a stronger, more durable concrete,

Mix proportion

The mix design has been made for M20 grade conventional concrete and light weight concrete use of code IS 10262- 1982, IS 456-2000 recommended. The water cement ratio (W/C) was kept constant at approximately 0.45 for all mixes, The percentage like 10%, 25%, and 50%, incorporation was used as partial and full replacement of natural coarse aggregate and the fly ash percentage like 15%, 20%, 25% used as partial replacement for cement concrete. Mix proportion obtained for M25 Grade of conventional concrete and light weight concrete mix ratio was 1:1.5:3

Casting of Specimen

Fresh prepared mixes were casted for each group in three standard cube moulds, cylinder mouldsThree groups of mixtures were produced. For each mixture, specimens were prepared in the cubical 150×150×150mm, . The mixing process was as follows: firstly, coarse, fine and lightweight aggregate (Leca) and 1/3 of the water were loaded into the mixer for 1 minute. Then the cement, remaining water, and super plasticizer were added. Finally, the constituents were mixed for 3 minutes.The mixture was rested for 3 minutes then mixed again for a further 2 minutes. After that moulds were filled by concrete in the suitable mix. The top surface of the concrete was leveled

with the help of trowel and was left for 24 hours allowed the concrete to set. The specimen were remolded after 24 hours.

Figure 1:- Materials required.

Figure 2:- Cube Specimens.

S.No	Type of Concrete	Cement(kg)	Coarse aggregate(kg)	Fine Aggregate(kg)	LECA aggregate(kg)	Water cement ratio
1	Conventional concrete	4.90	14.70	7.45	-	0.45
2	Concrete with 10% LECA	4.90	13.23	7.45	1.47	0.45
3	Concrete with 25% LECA	4.90	11.025	7.45	3.675	0.45
4	Concrete with 50% LECA	4.90	7.35	7.45	7.35	0.45

Table 5:- Mix Proportion.

Result and Disscussion:-

The Discussion will be focused on the performance of lightweight expanded clay aggregate. All the Tests Method adopted were describe in the previous one. The results Presented on regarding the Compressive strength, Bulk Density, Moisture content, split tensile strength and Flexural strength. The performance of concrete is influenced by proper and good practice of mixing which can lead to better performance and quality of the concrete. In the present study, M20 grade of concrete cubes of size 150×150×150mm, cylinders were cast for determining the compressive strength,The cast specimens were remoulded at the end of 24 hours ,7 days cured for 28days .Concrete is an artificial stone like material having an excellent resistance to compression

Compressive Strength

Compressive strength is the primary physical property of concrete (others are generally defined from it),and is the one most used in design .It is one of the fundamental properties used for quality control for lightweight concrete . compressive strength may be defined as the measured maximum resistance of a concrete specimen to axial loading.Cubes and cylindrical specimens were tested for compressive strength in the Compression testing machine of capacity 2000KN.The cylindrical specimens also were tested to determine split tensile strength. The prism specimens were tested in Universal testing machine of capacity 2000KN.An average of three specimens was tested for each strength tests.

S.No	Type of Concrete	Compressive strength in n/mm2	Weight of Cube in kg
1	Conventional concrete	11.47	7.9
2	Concrete with 10% LECA	8.02	7.1
3	Concrete with 25% LECA	6.45	6.8
4	Concrete with 50% LECA	5.15	6.67

Table 6:- 7 Days compressive strength of concrete.

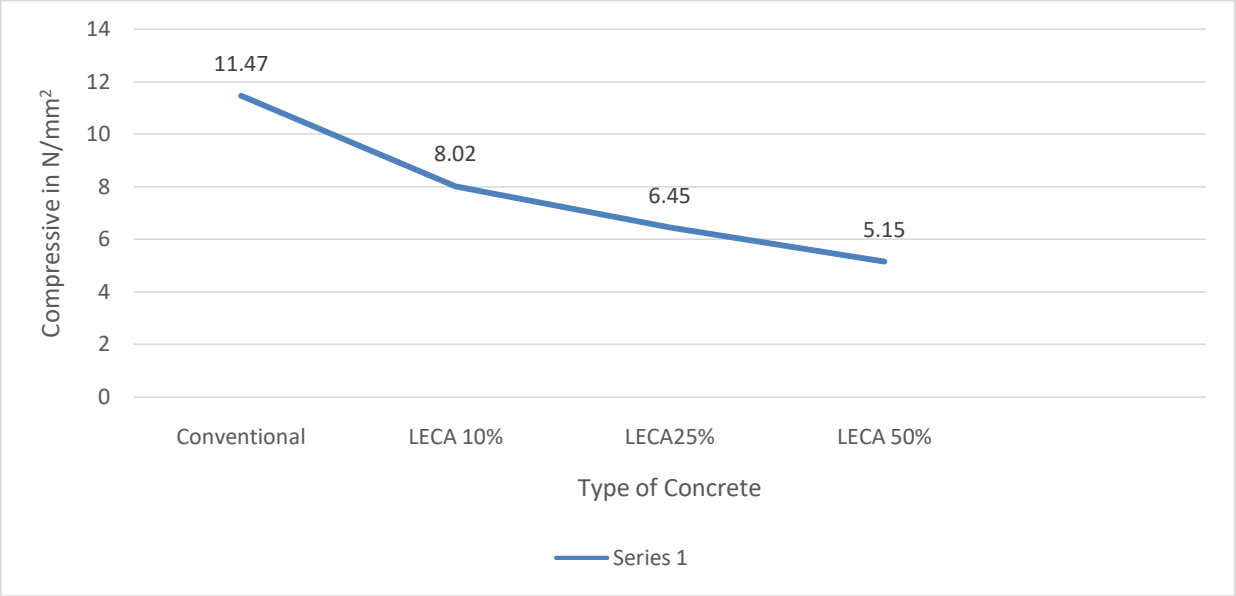

Figure 3:- Graph Details of 7 days Compressive Strength.

Table 7:- 28 Days compressive strength of concrete.

S.No	**Type of Concrete**	**Compressive strength in n/mm2**	**Weight of Cube in kg**
1	Conventional concrete	21.57	8.2
2	Concrete with 10% LECA	19.55	6.73
3	Concrete with 25% LECA	17.32	6.65
4	Concrete with 50% LECA	16.88	6.32

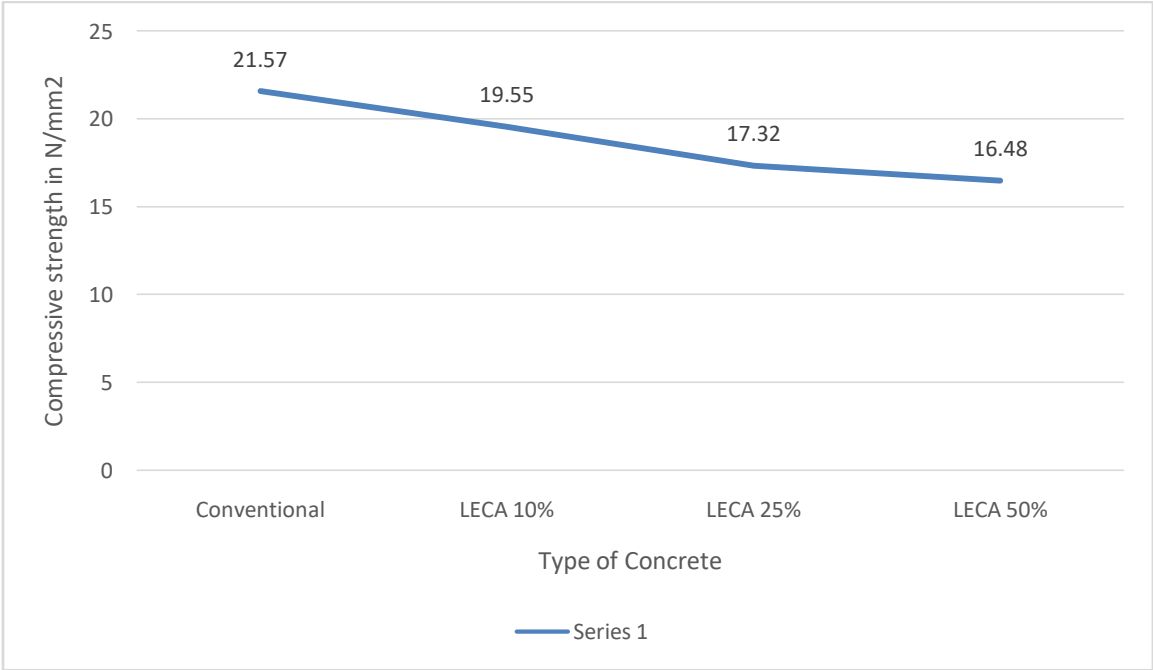

Figure 4:- Graph Details of 28 days compressive strength of concrete.

Figure 5:- Compressive Testing.

Conclusion:-

Based on the experimental investigations concerning the compressive strength and split tensile strength of concrete, the observations and the following conclusions are drawn from the present study.

- Compression strength value is compared to normal concrete and replacement of Coarse aggregate by LECA from different percentages
- Maximum value of strength is obtained in 10% replacement of LECA with coarse aggregate
- Concrete with 25% replacement of LECA the compressive strength is comparable with normal concrete.
- This type of concrete can be utilized in wall panels of non load bearing type for use in precast buildings.

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