EXPERIMENTAL INVESTIGATION ON MECHANICAL PROPERTIES OF LIGHTWEIGHT CONCRETE USING LECA AND STEEL SCRAPS

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Abstract

The Mechanical Properties Of Lightweight Concrete Using LECA And Steel Scrap. The Replacing Normal Coarse Aggregate By Lightweight Expanded Clay Aggregate(LECA).The Influence Of Different Proportions Of Replacement Is Analyzed. The Awareness Of Lightweight Concrete Is Steadily Increasing Because Of Scarcity Of Raw Materials Of Conventional Concrete Like Environmental Hazards And Economic Considerations .Lightweight Concrete Maintains Its Large Voids And Not Forming Laitance Layer Or Cement Films When Placed On Wall. The Uses Of Structural Grade Aggregate Lightweight Concrete Reduce Considerably The Self Load Of A Structure And Permit Large Precast Units To Be Handled.

keywords: Lightweight aggregate, expanded clay, compressive strength, flexural strength, water absorption, bulk density

1. INTRODUCTION

Lightweight concrete has extreme importance to the construction industry. Most of current concrete research focuses on high performance concrete, by which is meant cost-effective material that satisfies demanding performance requirements, including durability. Lightweight 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 such as lessened the dead weight. It is lighter than the conventional concrete. The use of lightweight concrete has been widely spread across countries such as USA, United Kingdom and Sweden. The other main specialties of lightweight concrete are its low density and thermal conductivity. So its advantages are that there is a reduction of dead load, faster building rates in construction and lower transport and handling costs. Lightweight concrete maintains its large voids and not forming laitance layers or cement films when placed on the wall. Sufficient water cement ratio is vital to produce adequate cohesion between cement and water.It reduces a dead load of building.

2. LIGHT WEIGHT CONCRETE

Lightweight aggregates can fill many roles that will make human activity more environmentally responsible. The green house gas emission associated with both the processing of the raw material and from the fuel burned to produce the expansion of the raw material pales in comparison to the environmental rewards derived from its use. The raw material being mostly composed of silica releases low amounts of green house gases upon heating unlike the ingredients used to make cement. The emissions from manufacturing cement are about one tonne of CO2 per tonne of cement and for expanding shale, clay and slate is never above about 0.3 tonne of CO per tonne of aggregates produced. With the rotary kiln used to make both cement and lightweight aggregates, the fuel consumption is cement and 3.0 gigajoules per tonne for expanding shale, clay or slate (Malhotra2004, Haseltine,1972).It was shown some three decades ago that the extra expenditure of energy to make lightweight aggregates as compared to normal weight aggregate was more than compensated by affect by savings associated with in the reduction in the amount of materials needed.

Applications of Light weight concrete

- LWC is used in high rise building.
- Reduces dead load of concrete structure.
- Structural design reduces the size of column and footing.
- More efficient strength to weight ratio in structural elements.
- Appliance to balconies, floors, walls etc.,

Specification

Many structural lightweight aggregate suppliers have suggested specifications and mix proportioning information pertaining to their materials, and some offer field control and technical service to ensure that the specified quality of concrete will be used. Usual specifications for structural lightweight call for a minimum compressive strength, maximum slump, maximum weight, and both maximum and minimum values for air content. However, the contractor will also be concerned with properties of the freshly mixed concrete, such as bleeding, workability, and finish ability.

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 . it is found by a measuring the highest compression stress that a test cylinder or cube will support.

There are three of the test that can be use to determine compressive strength, cube, cylinder, or prism test . The 'concrete cube test' is the most familiar test and is used as the standard method of measuring compressive strength for quality control purpose (Neville,1994).

Density

The density of both fresh and hardened concrete is of interest to the parties involved for numerous reasons including its effect on durability, strength and resistance to permeability. Hardened concrete density is determined either by simple dimensional checks, followed by weighing and calculation or by weight of lightweight concrete sample, the simple method is preferred as listed.

Water Absorption

These properties are particularly important in concrete, as well as being important for durability.(J.H.Bungey,1996).It can be predict concrete durability to resist corrosion. Absorption capacity is a measure of the porosity of an aggregates. The determination of free moisture by oven-drying method. The absorption capacity is determined by finding the weight of surface-dry sample after it has been soaked for 24hrs and again finding the weight after the sample has been dried in an oven; the difference in weight, expressed as a percentage of the dry sample, is the absorption capacity. Absorption capacity can be determine using BS absorption test.

Table1 Physical Properties Of Expanded Clay Aggregate

Water of plasticity %	53.4
Dry MOR (Kg/cm^2)	15.6
Shrinkage %	2.67
Loss on ignition %	11.18
Fired MOR (kg/cm^2)	150.8
Forming Pressure (kg/cm^2)	200
Temperature	116/1094
Cycle min	28

Table2 Chemical Properties Of Expanded Clay Aggregate

Sio2	48
Al2o3	16.24
Fe2o3	16.8
Cao	0.42
Mgo	0.56
K2o	0.7
Na2o	1.1
Moisture	12.73

LECA and steel scraps

LECA is Lightweight Expanded Clay Aggregate.It is important compenent for lightweight concrete.It gives low density to concrete and give thermal insulation property to concrete

Fig.1 Lightweight Expanded Clay Aggregate (LECA)

Steel Scraps

By using of steel scraps in light weight concrete mixers it gives flexural strength to concrete and attains its strength in concrete

Fig.2 Steel Scraps

3.MATERIAL PROPERTIES

General

Material testing is essential for the mix design of concrete. It gives the optimum amount Of material required for a given strength and workability of concrete. Hence the properties of the following materials were found.

Cement:

Cement is the binding material used to bind the aggregate. Its properties like fineness etc. affect the strength and workability of concrete. Hence the following tests were conducted on cement

- Specific gravity test
- Fineness test

Fine Aggregate

It acts as a filter material, which fills the voids left by the coarse aggregate. Its properties like grading, affect the workability and strength of the concrete. Hence the following tests were conducted on fine aggregates.

- Specific gravity test
- Sieve analysis

Coarse Aggregate

It is the important component of the concrete. Its properties like shape, texture, size etc. affect the strength as well as workability. Hence the following tests were conducted on coarse aggregates.

- Specific gravity test
- Sieve analysis

Test For Cement, Fine Aggregate And Coarse Aggregate

Table3.Test For Cement, Fine Aggregate And coarse Aggregate

PROPERTIES	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
SPECIFIC GRAVITY (G)	3.14	2.65	2.43
FINENESS MODULUS	_	2.86	5.03

Table 4. Test For LECA

SI.NO	TYPE OF TEST	TEST RESULT
1	SPECIFIC GRAVITY	2.10
2	WATER ABSORPTION	10.5
3	BULK DENSITY	0.318
4	IMPACT TEST	65.7

4.RESULT AND DISCUSSION

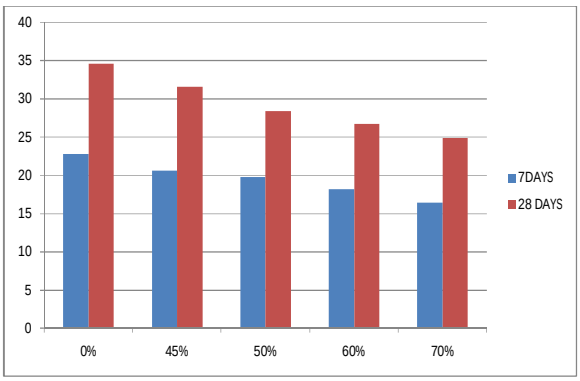
The Discussion will be focused on the performance of lightweight expanded clay aggregate. All the Tests Method adopted were describe in the previous one. The results Presented on regarding the Compressive strength, Bulk Density, Moisture content, split tensile strength and Flexural strength. The performance 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, M30 grade of concrete cubes of size 150×150×150mm, cylinders of size 150×300mm and size of prism 500×100×100mm were cast for determining the compressive strength, split tensile strength and flexural 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. It resembles the principal asset of

natural stone and is usually cast in place in a plastic condition.

Table 5.Compressive Strength and Flexural Strength For 7days and 28 days

Mixtures	Cube weight (kg)	Compressive Strength (N/mm^2) 7Days	Compressive Strength (N/mm^2) 28 Days
Conventional concrete	8.7	22.8	34.6
45% of LECA	6.7	20.6	31.6
50% of LECA	6.2	19.8	28.4
60% of LECA	5.8	18.2	26.7
70% of LECA	5.5	16.5	24.9

COMPRESSION TEST FOR LIGHT WEIGHT CONCRETE



REPLACEMENT OF LECA FOR COARSE AGGREGATE IN %

Fig 3.Graph Result for compressive strength Test

Fig 4 Cube and Cylinder Specimen

Fig .5 Compression Test For Cube

Fig 6 Testing Of Cube

5.CONCLUSION

In this study, the Mechanical properties of lightweight concrete using LECA (Lightweight Expanded Clay Aggregate) and Steel scraps are used. The Replacement of Coarse aggregate by 45%,50%,60%,70% LECA were investigated. It concluded that, The mechanical properties of lightweight concrete gives lightweight strength to structure and also gives stability to building. In the 50% Replacement of LECA found to have high Compressive Strength (28.6 N/mm2)than the normal weight concrete at age of 28 days .Using of Steel scraps in concrete gives flexural strength to concrete and it attains property. Replacing of conventional aggregate by LWA(Light Weight Aggregate)has shown better result. Therefore it reduces a high dead load of the building. The Compressive Strength for 45%,50%,60% are seems to be good but 70% is lower when compared to others. By this Investigation it can be used as construction material

.6.References

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