A STUDY ON PROPERTIES OF LIGHT WEIGHT CINDER AGGREGATE CONCRETE WITH SILICA FUME AND FLYASH AS ADMIXTURE

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ABSTRACT

In Design of concrete structures, light weight concrete plays a prominent role in reducing the density and to increase the thermal insulation. These may relate of both structural integrity & serviceability. More environmental and economic benefits can be achieved if waste materials can be used to replace the fine light weight aggregate. The new sources of Structural aggregate which is produced from environmental waste is Natural aggregates, synthetic light weight aggregate The use of structural grade light weight concrete reduces the self-weight and helps to construct larger precast units. In this study, an attempt has been made to study the Mechanical Properties of a structural grade light weight concrete M30 using the light weight aggregate pumice stone as a partial replacement to coarse aggregate and mineral admixture materials like Fly Ash and Silica Fume. For this purpose, along with a Control Mix, 12 sets were prepared to study the compressive strength, tensile strength and flexural strength. Each set comprises of 4 cubes, 2 cylinders and 2 prisms. Slump test were carried out for each mix in the fresh state. 28-days Compressive test, Tensile Strength and Flexural Strength tests were performed in the hardened state. The study is also extended for blending of concrete with different types of mineral admixtures. The test results showed an overall strength & weight reduction in various trails. Therefore, the light weight concrete is no way inferior for construction purpose. Most of the normal weight aggregate of normal concretes is natural stone such as lime stone and granite. With the increasing amount of concrete used, natural environment and resources are excessively exploited. Synthetic light weight aggregate produced from environmental waste like fly ash, is a viable new source of structural aggregate material. The use of light weight concrete permits greater design flexibility and substantial cost savings, reduced dead load, improved cyclic loading, structural response, longer spans, better fire ratings, thinner sections, smaller size structural members, less reinforcing steel and lower foundations costs. Light Weight Aggregate is a relatively new material. For the same crushing strength, the density of concrete made with such an aggregate can be as much as 35 percent lower than the normal weight concrete. In addition to the reduced dead weight, the lower modulus of elasticity and adequate ductility of light weight concrete may be advantageous in the seismic design of structures. Other inherent advantages of the material are its greater fire resistance, low thermal conductivity, low coefficient of thermal expansion and lower erection and transport costs for prefabricated members.

Keywords: *Light weight concrete, Natural aggregate, light weight aggregate, coarse aggregate*

1.0 INTRODUCTION

Lightweight concrete can be classified as a form of concrete which contains a spreading agent, raising the volume of a mixture with other properties like decreasing dead weight. Better than usual the Beton is thinner. Low density and thermal conductivity are the main lightweight concrete features. Its advantages are to minimize dead load, faster design times, and lower handling costs. Lightweight concrete preserves its large vacuums and does not contain layers on the wall of laitance or cement foils. However, it is critical that the water cement ratio be sufficient to achieve adequate cohesion between cement and water. Insufficient water may result in a lack of cohesion among particles and consequently a loss of concrete strength. Likewise, excessive water can cause cement to run into layers, thereby decreasing its strength.

Lightweight aggregate concrete

This lightweight concrete is used instead of ordinary concrete with a porous lightweight aggregate with a low specific gravity. The light aggregates may be natural aggregates, such as blowing ovens, vermiculite, clinkers, or any volcanoes or artificial aggregates. The main feature of this lightweight aggregate is its high porosity and low specific gravity. Depending on the use, lightweight aggregated betone can be divided into two types. One is compact lightweight, and the other is lightweight strong cement

Scope of the Work

Many researchers have been working on lightweight concrete in various countries corners. The paper reviewed identified Lightweight concrete application and material properties. Lightweight concrete provides compact construction and considerable cost-saving. The scopes of study are:

- Less in dead load.
- 20% to 40% lighter than the conventional concrete.
- Good fire resistance

Objectives of the Research

Concrete, which has a high compressive strength, increases with age, and the hardening process continues for a long time after the concrete has achieved enough strength. Normally concrete form is rendered in the required proportion by combining the cement , water and fine and coarse aggregates. The prices of building materials are increased due to the growing demand for RCC structure. The waste product in valuable products can be used to maximise the output. By adding silica smoke and ash, cement consumption and concrete properties are reduced. The main objectives are:

- concrete and conventional concrete.
- To study the properties like compressive strength, tensile strength, ease of placing & handling and economy.
- To use the waste material like Silica fume and flyashat construction site.
- To spread more awareness about the use of lightweight concrete.

2.0 LITERATURE REVIEW

Lightweight concrete is a particular concrete form. One of conventional strong drawbacks is cement's high self-weight. The thickness of ordinary solid is 22.00 to 26.00 KN / M3. This excessive self-weight would make it very un-economical structural material. In the past, Endeavours are made to reduce the cement's self-weight to create the cement 's effectiveness as structural material. The solid lightweight is a material whose thickness changes from 300 to 18,50 KN / M3.

Ganesh Babu. K et al.,[1] The Behaviorlight weight, stretched on a silicon fume-containing polystyrene cement, and it concentrated on lightweight concrete, can be produced by substituted totals with small or full lightweight total that are subject to the necessities of thickness and consistency. The performance of silica fume at different percentages was designed for these blends.

NiyaziUgurKockal et al.,[2] The shown strengthand elastic properties of lightweight structural concrete. The research explores an effect on the strength and elastic properties of concrete mixtures of attributes of four total kinds (two snaped light weight fly cinder aggregates, standard calcareous weight aggregates and cold-bonded lightweight fly ash) Various models were also used to estimate elasticity values for concrete strength and frame. The results of this study demonstrated the achievements of the development by using sintering and cold-bonding fly ash aggregates of high strength air-entrained lightweight aggregated concrete.

3.0 METHODS AND MATERIALS

The technical structures compose primarily of materials known as building materials or constructions. Prior to the final material selection for specific application, the working conditions of structures which are subject to a variety of materials and the different properties of materials such as solidity, shape, permeability, water pressure, temperature tolerance, physical and chemical properties must be carefully researched. A specific and appropriate material should be selected according to the necessary properties to increase the consistency and the quantity of a building structure. The lightweight, reinforced concrete is primarily made up of cement mixtures, light-weight aggregates, natural aggregates, air conditioning agents and admixtures. For the project implementation, the following content is selected:

- Cement
- Cinder Aggregates
- Silica fume
- Fly ash

Properties of Material

The engineers must be aware of the basic characteristics of the material to be used before using building material durability, etc. The various chemical and physical properties of cement, aggregates, fly ash, silica fume and coarse cinders will be discussed in this section

Cement

Cement is by far the largest concrete element since it is the binding medium of distinct ingredients. Cement is an elastic and flexible substance that can bind solid particles in a compact durable mass. Its constituent are calcareous cements with lime as their primary components, its key purpose being to mix fine (sand) and rough (grit) particles. The bulk of cements are made of Ordinary Portland Cement (OPC).

Aggregates:

This is the generic term used for chemically reactive or inert materials, which are primarily natural aggregates, such as crushed stone, gravel and sand in association with construction. The quality of the concrete is dependent on shape, distance, impurity, crush strength and additional grades, and makes up a total of about 75 percent of the concrete.

Fine aggregates:

Small aggregates are classified as those of less than 4.75 mm. The fine aggregates normally use natural sands. River, lake, sea-shore and pits can produce sand. The sand 's particular gravity is 2,65 and the fine sand density is 1,44 kg / litre. Small aggregates are the river sand.

Fly ash:

It is also called pulverized ash, an ash precipitated by the exhaust gases of carbon-fired power stations electro-statistically or mechanically, and is the most common artificial pozzolan. Fly-ash particles are spherical and exceptionally fine: the majority of particles are smaller than 1-micron metre in diameter and 100-micron sizes, and fly-ash typically has a wide area range in length from 250 to 600 m2 / kg. Class C fly ash is high-lime ash from lignite coal with limes up to 24 percent. The average compression capacity of Fly Ash in 1 to 365 days is 7,1 MPa to 47,5 MPa. Fly Ash is a by-product of many thermal power plants which produce almost 70% fly ash on coal burning. Physical and chemical properties Table 8 shows the chemical properties

Silica Fume:

It is a relatively recent arrival of additional materials cementing. It was released as a pozzolana initially. It is also referred for micro silica or condensed silica fume and is a by-product of the processing of high-purity quartz silicone and ferrosilicon alloys and coal in the electric oven of submerged arcs. Silicon-94-98 is usually made of the following: Ferrosilicon-90%. The specific gravity of silica is normally 2.20, but when the Silica content is lower it is much higher. The particle diameter of the fume varies primarily from 0.03 to 0.3 micron. The volume is very low: 200 to 300 kg / m3. Silica fume can be obtained in densified form from 500 to 700 kg / m3 of bulk pellets. By applying silica particles, the general physical properties of concrete are:

The permemeness is decreased.

- The hydration heat is reduced or delayed.
- More erosion resistance due to water effects and decreased thawing and freezing.
- Sulphate tolerance.
- Enhance concrete power.

MIX DESIGN OF CONCRETE

This strength depends primarily on the water cement ratio and the properties of the concrete compressing strength depend almost independently on the other parameters, in addition to that of water cement ratios, on the aggregate properties. In order to achieve good strength, the lower W / C ratio that influences the working ability of the mixture must be used. In the current state of art, concrete with a required compressive force of 28days of at least 15Mpa, 20Mpa, will 25Mpo be produced using standard mixing methods by the necessary component share.

4.0 RESULTS AND DISCUSSION

The compressive strength results are shown in Table 1 that substitute 100 % natural aggregates with 0% cinder, and with different percentages cement replacements with silica fume. The compressive intensity ranges graphically from a cement substitution percentage to silica fume. It can be observed that a decrease in strength is achieved by increasing compressive strength by five per cent for the replacement of silicone fumes and 10 per cent and 15 per cent for the replacement of cement hardened concrete. Its compressive strength is the key factor supporting the use of concrete in buildings. The resilience of the hard concrete, defined by its ability to withstand forces, is among the important characteristics. The intensity of the concrete compressor is considered the most critical one and also is considered to be an indicator of the overall concrete quality

COMPRESSIVE STRENGTH TEST

The concrete should be prepared to the necessary degree and the specimen filled with proper Compactation in the ideal mould type 15 cm x 15 cm x 15 cm block, then put in the water for treatment after 24 hours.

Table 4.1 Compressive strength of concrete with replacement of cinder aggregate and silica fume

MIX DESIGNATION	COMPRESSIVE STRENGTH IN N/mm2	COMPRESSIVE STRENGTH IN N/mm2	COMPRESSIVE STRENGTH IN N/mm2
	7 Days	28 Days	90 Days
CA 0% +SF 5%	26.85	28.5	32.2
CA 0% +SF 10%	28.26	30.25	44.28
CA 0% +SF 15%	27.98	29.22	43.26
CA 25% +SF5%	26.23	28.26	42.40
CA 25% +SF 10%	25.96	27.32	41.32
CA 25% +SF 15%	24.23	26.89	40.80
CA 50% +SF 5%	23.28	25.00	39.03
CA 50% +SF10%	22.85	24.89	38.25
CA 50% +SF 15%	21.00	22.65	37.33
CA 75% +SF 5%	19.26	20.89	36.50
CA 75% +SF 10%	18.23	20.82	35.42
CA 75% +SF 15%	16.32	20.63	34.46
CA 100% +SF 5%	15.32	19.69	33.30
CA 100% +SF 10%	14.89	18.68	30.60
CA 100% +SF 15%	13.86	18.23	28.48

SPLIT TENSILE STRENGTH TEST

Prepare the concrete as necessary and compose the specimen with the correct compaction, fill the concreted mould in the appropriate 10 cm x 30 cm mould and position the specimen into water for curing after 24 hours.

Table: 4.2 Split tensile test results of concrete cylinders for 7, 28, 90 days

S NO	MIX DESIGNATION	SPLIT TENSILE STRENGTH IN N/mm2	SPLIT TENSILE STRENGTH IN N/mm2	SPLIT TENSILE STRENGTH IN N/mm2
		7 Days	28 Days	90 Days
1	CA 0% +SF 5%	2.98	3.85	5.02
2	CA 0% +SF 10%	2.76	3.95	5.10
3	CA 0% +SF 15%	2.73	3.58	4.83
4	CA 25% +SF5%	2.64	3.42	4.76
5	CA 25% +SF 10%	2.55	3.39	4.52
6	CA 25% +SF 15%	2.49	3.32	4.38
7	CA 50% +SF 5%	2.46	3.25	3.96
8	CA 50% +SF10%	2.35	3.05	3.83
9	CA 50% +SF 15%	2.33	3.00	3.76
10	CA 75% +SF 5%	2.21	2.86	3.68
11	CA 75% +SF 10%	2.18	2.75	3.52
12	CA 75% +SF 15%	2.08	2.56	3.48
13	CA 100% +SF 5%	2.02	2.45	3.33
14	CA 100% +SF 10%	1.89	2.36	3.12
15	CA 100% +SF 15%	1.87	2.23	3.10

FLEXURAL STRENGTH TEST

The concrete shall be made to the necessary proportions and the specimen shall be filled with proper compaction in 10x10x50 cm of the appropriate mould size, then put in water to be cured after 24 hours. Remove the specimens from water after specified curing time and wipe out excess from the surface

Table: 4.2 Flexural tensile test results of concrete cylinders for 7, 28, 90 days

S NO	MIX DESIGNATION	FLEXURAL STRENGTH IN N/mm2	FLEXURAL STRENGTH IN N/mm2	FLEXURAL STRENGTH IN N/mm2
		7 Days	28 Days	90 Days
1	CA 0% +SF 5%	2.8	3.8	5.65
2	CA 0% +SF 10%	2.9	3.95	5.75
3	CA 0% +SF 15%	2.55	3.56	5.08
4	CA 25% +SF5%	2.5	3.48	4.98
5	CA 25% +SF 10%	2.48	3.23	4.88
6	CA 25% +SF 15%	2.43	3.16	4.75
7	CA 50% +SF 5%	2.42	3.10	4.30
8	CA 50% +SF10%	2.35	2.98	3.98
9	CA 50% +SF 15%	2.33	2.85	3.89
10	CA 75% +SF 5%	2.28	2.78	3.56
11	CA 75% +SF 10%	2.20	2.65	3.65
12	CA 75% +SF 15%	2.19	2.58	2.98
13	CA 100% +SF 5%	2.17	2.45	2.75
14	CA 100% +SF 10%	2.13	2.38	2.72
15	CA 100% +SF 15%	2.10	2.25	2.71

CONCLUSION:

It has been concluded from the industry that 5% silica fume gives best results, compared to 10% 15% silica and 20% fly ash, give better results, compared with 10 % and 30%

The study concludes that to a certain degree (50%) light weight cinder and granite aggregates (40%) with admixture as silica and fly ash have given a sufficient strength compared with the various strengths investigated. The consistency of porous cinder aggregates is poor compared to standard aggregates and it is concluded. The findings show that compression strength decreases with an increase in the percentage of cinder. The divided tensile strength of 5% silica fumes concrete is higher than 10 % and 15% silicic fumes concrete are higher at twenty-eight days with an equivalent tensile force of 5% Silica fume 10% and 15% Silica Fumes concrete at twenty-eight days 10 percent fly ash concrete compressive strength is more than 20 percent and 28 days 30 percent fly ash concrete 10% fly ash concrete tensile strength is greater than 20% and 28 days is 30% fly ash concrete

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