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Experimental Study on Light Weight Concrete by Partial Replacement of Coarse Aggregate by Pumice Stone and Cement by GGBS

K.Koteswar Reddy
Department of Civil Engineering,
Siddartha Educational Academy Group of Institutions-Integrated Campus-9L,
C.Gollapalli, Tirupati Rural, Chittoor Dist,
A.P-517505, India.

Dr. K.Rajasekhar
Department of Civil Engineering,
Siddartha Educational Academy Group of Institutions-Integrated Campus-9L,
C.Gollapalli, Tirupati Rural, Chittoor Dist,
A.P-517505, India.

ABSTRACT

Light weight concrete has become more popular in recent years owing to the tremendous advantages it offers over the conventional concrete. Even Light concrete but at the same time strong enough to be used for the structural purpose. Lightweight concrete has been successfully used since the ancient Roman times and it has gained its popularity due to it slower density and superior thermal insulation properties Compared with Normal weight concrete, Lightweight concrete can significantly reduce the dead load of structural elements, which makes it especially attractive in multi-storey buildings. The most important characteristic of light weight concrete beside its light weight is its low thermal conductivity. This property improves with decreasing density. The adaptation of certain class of light weight concretes gives an outlet for industrial wastes and dismantled wastes which would otherwise create problems for disposal. The conventional mix has been designed for M30 grade concrete. Coarse aggregate replaced with Pumice aggregate in volume.

Percentages of 25% and 35% further Cement replaced with the GGBS in weight percentages of 5%,10%,15%, 20%, 25%, 30% for study in the present investigation. The properties like Compressive strength, Split tensile strength, Flexural strength of above combinations were studied and compared with conventional design mix concrete. It is observed that there is retardation in Compressive strength, Split tensile strength, Flexural strength for the light weight aggregate replaced concrete when compared to the concrete made with normal aggregate. For these light weight aggregate concrete mixes when 'cement' was replaced by 'GGBS' it is noticed that there is a marginal improvement in the properties studied. For 25% and 35% replaced light weight aggregate when cement was replaced by 5%,10%,15%, 20%, 25%, 30%. GGBS maximum gain in compressive strength of 37.25 MPa and 37.25 MPa at 28 days is observed for 20% replacement of GGBS. Similarly the gain in split tensile strength and flexural strength 4.86 MPa and 6.47 MPa is observed at 20% replacement of GGBS respectively.

INTRODUCTION

Light Weight Concrete

Lightweight concrete [1-4] can be defined as a type of concrete which includes an expanding agent in that it expands the volume of the blend while giving extra qualities, for example, nailbility and diminished the dead weight. It is lighter than the customary cement. The principle fortes of lightweight solid are its low thickness and warm conductivity. Its preferences are that there is a lessening of dead load, speedier building rates in development and lower haulage and taking care of expenses.

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Lightweight cement keeps up its expansive voids and not framing laitance layers or concrete movies when put on the divider. Be that as it may, adequate water bond proportion is imperative to create satisfactory attachment in the middle of concrete and water. Deficient water can bring about absence of union between particles, subsequently misfortune in quality of cement. In like manner an excessive amount of water can bring about concrete to keep running off total to frame laitance layers, therefore looses quality [7].

Types of Light Weight Concrete

Lightweight solid can be arranged either by infusing air in its organization or it can be accomplished by precluding the better sizes of the total or notwithstanding supplanting them by an empty, cell or permeable total. Especially, lightweight solid can be classified into three gatherings:

- No-fines concrete
- Lightweight total cement
- Aerated/Foamed cement

No-fines concrete

No-fines solid can be characterized as a lightweight cement made out of bond, water and coarse total. Consistently dispersed voids are framed all through its mass. The fundamental qualities of this kind of lightweight cement is it keeps up its huge voids and not shaping laitance layers or bond film when set on the divider. Figure 1 demonstrates one case of No-fines concrete

No-fines concrete

No-fines concrete normally utilized for both burden bearing and non-load bearing for outer dividers and segments. The quality of no-fines solid increments as the bond substance is expanded. Be that as it may, it is touchy to the water organization. Inadequate water can bring about absence of union between the particles and consequently, resulting misfortune in quality of the cement [5]. In like manner an excessive amount of water can bring about bond film to keep running off the total to frame laitance layers, leaving the majority of the cement lacking in concrete and in this way debilitates the quality.

Lightweight total cement

Permeable lightweight total of low particular gravity is utilized as a part of this lightweight cement rather than standard cement. The lightweight total can be characteristic total, for example, pumice, scoria and those of volcanic beginning and the counterfeit total, for example, extended impact heater slag [9], vermiculite and clinker total. The fundamental normal for this fundamentally lightweight total cement is completely compacted like that of the ordinary fortified cement of thick total. It can be utilized with steel support as to have a decent bond between the steel and the cement. The cement ought to give satisfactory insurance against the erosion of the steel. The shape and the surface of the total particles and the coarse way of the fine total have a tendency to deliver cruel cement blends. Just the denser assortments of lightweight total are suitable for utilization in auxiliary cement. Figure 2 demonstrates the component of lightweight total cement.

Lightweight aggregate concrete

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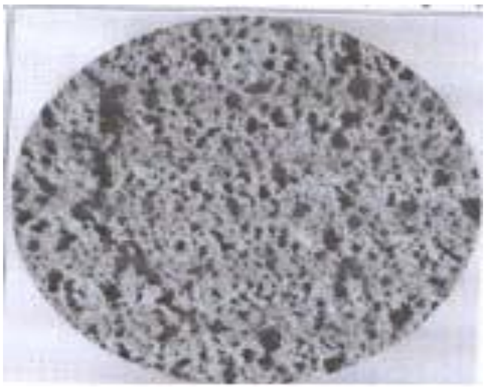
Aerated cement

Circulated air through solid does not contain coarse total, and can be viewed as a circulated air through mortar. Regularly, circulated air through cement is made by bringing air or different gas into a concrete slurry and fine sand. In business hone, the sand is supplanted by pummelled fuel fiery debris or different siliceous material, and lime possibly utilized rather than bond [6].

There are two strategies to set up the circulated air through cement. The primary strategy is to infuse the gas into the blending amid its plastic condition by method for a compound response. The second strategy, air is presented either by whipping so as to blend in stable froth or in air, utilizing an air-entraining operators. The principal strategy is typically utilized as a part of precast solid manufacturing plants where the precast units are along these lines autoclaved to deliver cement with a sensible high quality and low drying shrinkage. The second system is principally utilized for as a part of situ concrete, suitable for protection rooftop screeds or funnel slacking. Demonstrates the circulated air through cement.



Aerated concrete

Application of Lightweight Concrete

Lightweight cement has been utilized subsequent to the eighteen centuries by the Romans.

The application on 'The Pantheon' where it uses pumice total in the development of cast in-situ cement is the confirmation of its use. In USA and England in the late nineteenth century, clinker was utilized as a part of their development for instance the 'English Museum' and other minimal effort lodging. The lightweight cement was likewise utilized as a part of development amid the First World War. The United States utilized principally for shipbuilding and solid pieces. The frothed impact heater slag and pumice total for square making were presented in England and Sweden around 1930s. These days with the progression of innovation, lightweight cement extends its employments. Case in point, as prelate with its extraordinary protecting qualities. It is broadly utilized as free fill protection as a part of brick work development where it upgrades fire evaluations, lessens clamour transmission, does not spoil and termite safe. It is likewise utilized for vessels, rooftop decks and different applications [8].

In addition to reduce weights of light weight aggregates can also provide unique and potentially useful properties to concrete as follows.

- Light weight concrete is thermally efficient
- There is a less risk of condensation with warmer walls.
- It possibility to eliminate the insulation layers in sand which panels.
- Light weight concrete is fire resistant. Because light weight aggregates have already been pre fired.

MATERIALS USED AND THEIR PROPERTIES

Invention of Portland cement by John Aspirin which is fine gray powder. Among the various kinds cement it is the most commonly used as binding material. It is a mixture of chalk or limestone together with clay. In India are manufactured the three grades of OPC, namely 33grade, 43 grade and 53 grade. As per the standard testing procedure compressive strength of cement will be obtained after 28days. Apart from OPC, there are several other types of cement, e.g. sulphates resistant cement, collared cement, oil well cement, expansive cement, etc.

Ordinary Portland Cement of 53 grade Ultra tech cement brand confirming to IS 12269:1987 standard is used in the present investigation. The cement is tested for its

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various properties as per IS 4031:1988 and found to be conforming to the requirements as per IS 12269:1987. Various tests conducted on cement to determine its properties [3].

- Specific gravity of cement
- Normal consistency of cement
- Initial and final setting times of cement
- Compressive strength of cement

Specific gravity of cement

Specific gravity is determined by measuring the weight of a cement sample and its volume by measuring the liquid displaced by the cement sample. The liquid, which is to be used, should be such that it does not have any chemical reaction with cement otherwise the volume would include that of products the reactions. Also the liquid, which is to be used, should be such that it does not have any physical reaction such as absorption with the cement. If polar liquids are used their density in the regions very close to the cement, particle surface will be more than of the free Liquid away from the surface of particles. Also the cement should not have any agglomerated particles with internal voids otherwise only average apparent density will be measured [9].

Normal consistency of cement

Normal consistency is characterized as that rate water necessity of the concrete glue the thickness of which will be such that the Vicat plunger moves into a guide 5 toward 7mm from the base of the Vicat's mold. At the point when water is added to concrete, the subsequent glue begins stiffening and gaining strength simultaneously losing its consistency [3].

Initial and final setting times of cement

Normal consistency is defined as that percentage water requirement of the cement paste the viscosity of which will be such that the Vicat plunger moves [10] into a point 5 to 7mm from the bottom of the Vicat'smould. When water is added to cement, the resulting paste starts stiffening and gaining strength simultaneously losing its consistency.

Compressive strength of cement

The compressive strength of hardened cement is one of the main important property thanall the other properties. Strength tests are not done on neat cement paste because of the difficulties like too much shrinkage and happening after something cracking of neat cement. Strength of cement is found indirectly on cement sand mortar in specific proportions. The standard sand to be used in the test shall conform to IS: 650:1966

Specific gravity	3.14
Normal consistency	30 %
Initial setting time, min	45
Final setting time , min	700
Compressive strength, N/mm2	52

Pozzolanic Admixtures in Concrete

Pozzolanas [12] are either normally happening or accessible as waste materials. They for the most part contain silica, which gets to be receptive in the vicinity of free lime accessible in concrete when pozzolanic admixtures are blended with bond. The reactivity fluctuates relying on the kind of pozzolana, its compound arrangement and its fineness. In creating nations like India, pozzolanic materials are chiefly accessible as modern waste by-items, Fly cinder, silica smoke, impact heater slag, stone dust etc., are a percentage of the mechanical squanders and MetaCem is a quality controlled responsive pozzolana, produced using cleansed kaolin which have pozzolanic receptive properties. Broad exploration work has been completed on the utilization of pozzolanas in development materials. Out of the above pozzolanic admixtures, Fly fiery remains can be considered as the one, which is inexhaustibly accessible.

Fly fiery remains cement has notable alluring and upgraded properties contrasted with normal plane cement. Silica smoke produced using filtered kaolin is not mechanical waste item can be prescribed to be utilized alongside bond to determine certain improved properties for solid in extraordinary circumstances.

Silica Fume

In the refractory's world thirty-five prior, nobody was working with silica smoke and few realized what it was. Inside of a couple of years, it was being utilized as an admixture to block. At the point when amount of substantial Alumina block, mullite [11] was framed in the framework of the block on terminating, giving the block great volume quality, quality and synthetic resistance. At the point when utilized as a part of fundamental block, expansive qualities came about at least at 2700 F, which spoke the truth the farthest point of what could be tried.

At the time it was just conclusion that silica smoke would be utilized as a part of block not cast capable. Block was utilized for exceptionally imperative applications; nobody would have plausibility of utilizing thrown capable. Today's headstrong cast capable have gone past having "block like properties" too really out bit of work block in numerous applications. Silica smoke has assumed a greater part in this change.

Properties Of Silica Fume Concrete

Small particle size, high surface area and high silicon dioxide content are the properties of silica fume that make it so unique.

However the round or spherical shape of silica fume particles has a great significance in the flow ability of mix for both refractory cast able and Portland cement based concretes. The average particle size of silica fume is about 100 to 150 times smaller than the average particle size of Portland cement and much smaller than any other component in a refractory cast able. They found that in the order to wet this large surface area, much more water needed to get the same slump (flow) as mixes without silica fume.

Physical properties and Chemical composition of Silica fume

Physical properties

Small piece diameter is about 0.1 micron to 0.2 micron
Surface area about 30,000 m2/kg
Density varies from 150 to 700 kg/m3
When its density is about 550 kg/m3 it is suitable for concrete additive.

Chemical composition

Contains more than 90% silicon dioxide and other produce arts like carbon, sulphur and oxides of aluminium, iron, calcium, magnesium, sodium and potassium.

Sample of Silica fume.

A sample of Silica fume

Physical and Chemical Properties of Silica Fume

Physical properties	Results
Physical State	Micronized Powder
Odour	Odourless
Appearance	White Colour Powder
Colour	White
Pack Density	0.76 gm/cc
PH of 5% Solution	6.90
Specific Gravity	2.63
Moisture	0.058%
Oil Absorption	55 ml / 100 Gms

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CHEMICAL PROPERTIES

Silica (SiO_2)	99.886%
Alumina (Al_2O_3)	0.043%
Ferric Oxide (Fe_2O_3)	0.040%
Titanium Oxide (TiO_2)	0.001%
Calcium Oxide (Cao)	0.001%
Magnesium Oxide (Mgo)	0.000%
Potassium Oxide (K_2O)	0.001%
Sodium Oxide (Na_2O)	0.003%
Loss On Ignition	0.015%

FLY ASH

Fly ash [13], is also known as fuel-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and process of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic ingredients in many coal-bearing rock strata.

Advantages of Fly ash

Cement production requires huge amounts of energy. Partial replacement of cement with fly ash is economical. In the case of mass concreting and large scale works, it is proved to be most economical. It is practically revealed that up to 40 to 50% cement replaced and the designed strengths are achieved.

It reduces water requirement and improves paste flow behaviour

- Improves workability
- Increases cohesion, pump ability, finish ability and flow properties
- Reduces heat of hydration, Segregation and bleeding
- Cracking
- Enhances durability
- High resistance against chemical attack by sulphates, soil and sea water
- Improves serviceability of concrete
- Less shrinkage and creep
- Improves resistance against freezing and thawing.

Areas of usage of fly ash

It is a waste product of thermal power plants. It is suitable to use in concrete because of its inherent properties. It is having pozzolonic and cementations properties. Fly ash is widely used to provide

- Mass concrete
- Structural Concrete
- High strength concrete

Chemical composition and classification

Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify rapidly while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 µm to 300 µm. The major consequence of the rapid cooling is that only few minerals will have time to crystallize and that mainly amorphous, quenched glass remains.

Two classes of fly ash are defined by ASTM C618: Class F fly ash and Class C fly ash [14]. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash. The chemical properties of the fly ash are largely influenced by the chemical content of the coal burned.

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Component	Bituminous	Sub bituminous	Lignite
SiO2 (%)	20-60	40-60	15-45
Al2O3 (%)	5-35	20-30	20-25
Fe2O3 (%)	1040	4-10	4-15
CaO (%)	1-12	5-30	15-40
LOI (%)	0-15	0-3	0-5

Coarse Aggregate

Conventional Natural Aggregate (Granite) and Light Weight Aggregate (Cinder) [9] are used in the concrete mixes. Machine Crushed granite aggregate conforming to IS 383:1970 consisting 20 mm maximum size of aggregates has been obtained from the local quarry. The Cinder is hand broken to 20 mm size. Both granite and cinder have been tested for Physical and Mechanical Properties such as Specific gravity, Bulk Density, Sieve Analysis.

Specific Gravity of Aggregate

Specific gravity of light weight cinder aggregate is 2.33
Specific gravity of Granite aggregate is 2.75

Water absorption of aggregate

Water absorption of light weight cinder aggregate is 16%
Water absorption of Granite aggregate is 0.5%

Bulk Density

For determination of bulk density the aggregates are filled in the container and then they are compacted in a standard way. The weight of the aggregate gives the bulk density calculated in kg/liter or kg/m^3. Knowing the specific gravity of the aggregate in saturated and surface-dry condition, the void ratio can also be calculated.

$$\text{Percentage voids} = \frac{(G_s - y) \times 100}{G_s}$$

Where Gs = specific gravity of the aggregate and y = Bulk density in kg/liter

Aggregate crushing test

Crushing strength of road stones may be decide either on aggregates or on cylindrical specimen cut out of rocks. These two tests are not very different in not only the come near but also in the show of the results. Aggregates used in road construction, should be strong as much as is necessary to resist crushing under traffic wheel loads. If the aggregates are weak, the change of pavement structure is likely to be adversely influence. The strength of coarse aggregates is value by aggregates crushing test.

$$\text{Aggregate crushing value} = \frac{100\ X W3}{W1}$$

$$= \frac{100\ X 0.97}{2}$$

$$= 48.5\%$$

Aggregate impact test

Impact test is used to evaluate the toughness of stone or the resistance of aggregate to fracture under repeated impacts.

After subjecting the sample to 15 blows by hammer of weight 13.5 to 14 kg, it is sieved on 2.36mm sieve. The aggregate impact value is show as the percentage of the fine formed in terms of total weight of the sample.

$$\text{Aggregate impact value} = \frac{B}{A} \times 100$$

Where B = weight of fraction passing 2.36mm IS sieve
A = weight of oven dried sample

$$= \frac{150}{300} \times 100$$

$$= 50\%$$

METHODOLOGY AND DESIGN MIX PROPORTIONING

The mix design has been conducted for M20 concrete making use of ISI method of mix design using normal constituents of concrete. In the course of investigation normal granite aggregate has been replaced by light weight aggregate namely (cinder) in percentages of 0%, 25%, 40%, 60%, 75% and 100%. In the present investigation the OPC cement has been replaced by admixture (silica fume) in three percentages i.e. 5, 10, 15 and admixture (fly ash) in three percentages i.e. 10, 20, 30

Stage 1: Procurement of materials and its testing.
Stage 2: Moulding of specimens and curing.

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Stage 3: Testing of specimens.

Steps of Experimentation

Procurement of materials and its testing

Materials used in the concrete are fine aggregate, coarse aggregate(granite), light weight aggregate (cinder), cement, water, Silica fume, Fly ash have been procured from various places. Fine aggregate has been procured from Penna River chenur. Coarse aggregate (20mm) has been procured from Kadapa. Local drinking water is used for mixing and curing. Cinder (20mm) has been procured from yerraguntla. The Silica fume is obtained from Astraa chemicals Ltd Chennai.

Mixing of concrete

Initially the ingredients cement and Silica fume, were mixed, to which the fine aggregate and coarse aggregate, light weight aggregate (cinder) were added and thoroughly mixed. Water was measured exactly. Then it was added to the dry mix and it was thoroughly mixed until a uniform mix will come and then ready for casting. Prior to casting of specimens, workability was measured by slump test and compaction factor.

Moulding of specimens

After the Completion of workability tests, the concrete placed in the standard metallic moulds in three layers and it was compacted by tamping rod. The concrete in the moulds was vibrated for 2 min using the vibrating machine and the surface of the specimens was finished smoothly.

Casting of cubes with vibrator

Details of specimen cast

Compressive strength of concrete

For each variable three cube specimens were cast. In all 30 cubes of size 150 mm x 150 mm x 150 mm were cast.

Split tensile strength of concrete

For each variable two cylinder specimens were cast. In all 30 cylinders of size 150 mm diameter and 300 mm height, were cast.

Curing procedure

After the casting of cubes and cylinders, the moulds were kept for air curing for one day and the specimens were removed from the moulds after 24 hours of casting. Marking was done on the specimens to identify the specimens. All the specimens were cured in curing tanks for the desired age i.e. 28 days. The identification of the specimens is as follows.

Curing of specimens

Testing Procedure

Test for measuring workability

For checking the consistency of workability standard tests like slump and compaction factor were conducted and with the addition of super plasticizer workability is maintained more or less constant.

Testing of cube for compressive strength

Compression test was done conforming to IS 516:1959. All the concrete specimens were tested in a 200 tones capacity of compression testing machine. Concrete cubes of sizes 150mm x 150mm x 150 mm were tested for

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crushing strength, crushing strength of concrete was determined by applying load at the rate of 140 kg/sq.cm/minute till the specimens failed.

The maximum load applied to the specimens was recorded dividing the failure load by the area of specimens ultimate compressive strength was calculated. The results are tabulated and graphs are plotted which are presented in the next chapter.

Compressive Strength = load/area in N/mm^2

Testing of cylinders for split tensile strength

This test was conducted in a 200 tones capacity of compression testing machine by placing the cylindrical specimen of the concrete horizontal, so that its axis is horizontal between the FIGUREs of the testing of specimens.

Narrow strips of the packing material i.e., ply wood was placed between the FIGUREs and the cylinder, to receive the compressive stress. The load was applied uniformly at a constant rate.

Load at which the specimens failed was recorded and the splitting tensile stress was obtained using the formula based on IS 5816:1970

$F_1 = 2P/\pi DL$

where p = Compressive load on cylinder

L = Length of cylinder

D = Diameter of the cylinder

Testing of cube FIGURE

Testing of cylinder by split tensile

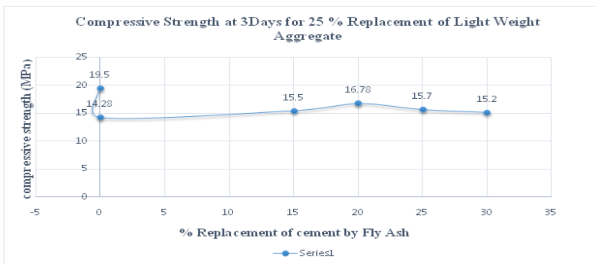
RESULTS AND DISCUSSIONS

The outcomes displayed in this examination are for the most part finished the properties of cement blends arranged with the substitution of characteristic total by light weight total, and substitution of concrete by fly cinder. The properties like Compressive quality, Split elasticity, Flexural quality and Young's modulus were examined and contrasted and traditional outline blend concrete.

The solid shape compressive quality of cement at 3 days for the diverse sup plantings of fly cinder with the concrete and with 25% light weight total supplanted in coarse total are accounted for in Table.

Table.5.1

S.NO	% Replacement of Cement by Fly Ash	Compressive Strength at 3 days(Map)
1	0(0% Fly Ash , 0% LWA)	19.5
2	0	14.28
3	15	15.5
4	20	16.78
5	25	15.7
6	30	15.2



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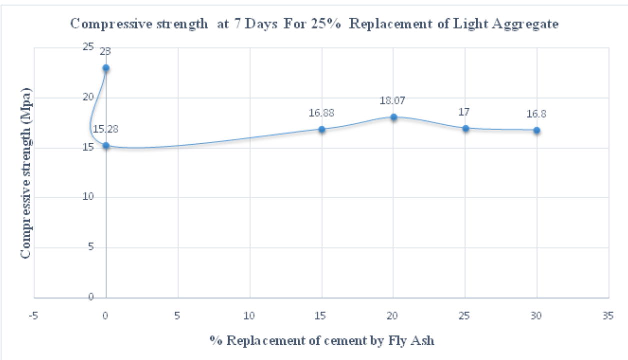
From the table and fig, it is watched that there is lessening in Compressive quality from 19.5 to 14.28 Map between the solid blend arranged with ordinary coarse total and additionally the solid blend arranged with 25% light weight total supplanted with typical coarse total. For the blends arranged with 25% light weight total when concrete was supplanted by fly cinder 15%, there is 7.87 % pick up in quality saw at 3 days, also at 20%, 25% and 30% a pick up of quality 14.8%, 9.09 % and 6.05% is seen at a similar age. From the above it is seen that most extreme quality for the blend arranged with 25% light weight total supplanted in coarse total and bond supplanted by fly fiery debris 20%.

The cube compressive strength of concrete at 7 days for the different replacements of fly ash with the cement and with 25% light weight aggregate replaced in coarse aggregate are reported in Table.

Table.5.2

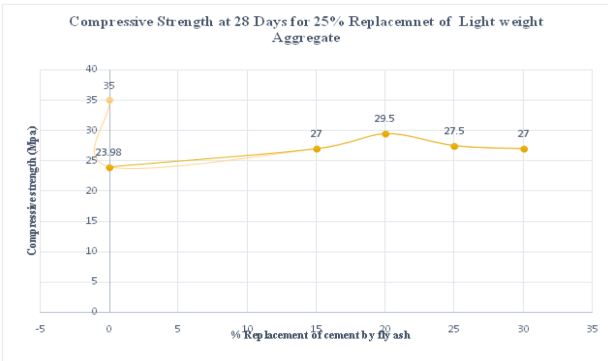
S.NO	% Replacement of Cement by Fly Ash	Compressive Strength (MPa)
1	0 (0% fly ash , 0% LWA)	23
2	0	15.28
3	15	16.88
4	20	18.07
5	25	17
6	30	16.8



From the table and fig, it is watched that there is decrease in Compressive quality from 19.5 to 14.28 Map between the solid blend arranged with typical coarse total and in addition the solid blend arranged with 25% light weight total supplanted with ordinary coarse total. For the blends arranged with 25% light weight total when concrete was supplanted by fly cinder 15%, there is 7.87 % pick up in quality saw at 3 days, correspondingly at 20%, 25% and 30% a pick up of quality 14.8%, 9.09 % and 6.05% is seen at a similar age. From the above it is seen that most extreme quality for the blend arranged with 25% light weight total supplanted in coarse total and bond supplanted by fly powder 20%.

Table—8

S.NO	% Replacement of cement by fly ash	Compressive strength (Map)
1	0 (0% fly ash , o% LWA)	35
2	0	29.8
3	15	27
4	20	29.5
5	25	27.5
6	30	27



From the table and fig, it is watched that there is diminishment in Compressive quality from 35.0 to 23.98 Map between the solid blend arranged with ordinary coarse total and the solid blend arranged with 25% light weight total supplanted with typical coarse total. For the blends arranged with 25% light weight total when bond was supplanted by fly cinder 15%, there is 9.6 % pick up in quality saw at 28 days, comparably at 20%, 25% and 30% a pick up of quality 15.48%, 10.11 % and 9.04% is seen at a similar age. From the above it is seen that most extreme quality for the blend arranged with 25% light weight total supplanted in coarse total and bond supplanted by fly fiery remains 20%.

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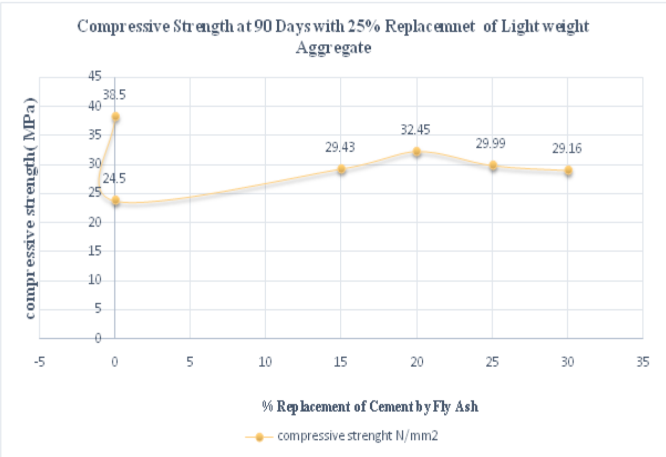
The cube compressive strength of concrete at 90 days for the different replacements of fly ash with the cement and with 25% light weight aggregate replaced in coarse aggregate are reported in Table.

Table—9

S.NO	% Replacement of cement by fly ash	Compressive Strength (Map)
1	0 (0% fly ash 0% lwa)	38.5
2	0	24.5
3	15	29.43
4	20	32.45
5	25	29.99
6	30	29.16

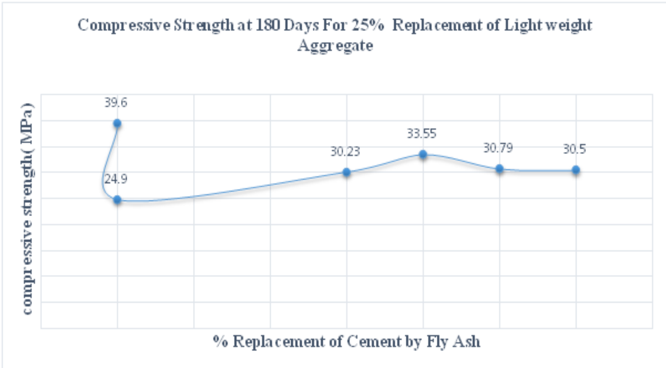


From the table and fig, it is watched that there is lessening in Compressive quality from 38.5 to 24.5 Map between the solid blend arranged with ordinary coarse total and in addition the solid blend arranged with 25% light weight total supplanted with typical coarse total. For the blends arranged with 25% light weight total when concrete was supplanted by fly cinder 15%, there is 16.75 % pick up in quality saw at 90 days, comparatively at 20%, 25% and 30% a pick up of quality 24.49%, 18.57 % and15.94% is seen at a similar age. From the above it is seen that most extreme quality for the blend arranged with 25% light weight total supplanted in coarse total and concrete supplanted by fly fiery debris 20%.

The solid shape compressive quality of cement at 180 days for the diverse supplantings of fly powder with the concrete and with 25% light weight total supplanted in coarse total are accounted for in Table.

Table ---10

S.NO	% Replacement of cement by fly ash	Compressive strength (Map)
1	0 (0% Fly ash 0% Lwa)	39.6
2	0	24.9
3	15	30.23
4	20	33.55
5	25	30.79
6	30	30.5



From the table and fig, it is watched that there is decrease in Compressive quality from 39.5 to 24.9 Map between the solid blend arranged with ordinary coarse total and in addition the solid blend arranged with 25% light weight total supplanted with typical coarse total. For the blends arranged with 25% light weight total when bond was supplanted by fly fiery remains 15%, there is 17.63 % pick up in quality saw at 180 days, likewise at 20%, 25% and 30% a pick up of quality 25.78%, 19.18 % and18.36% is seen at a similar age. From the above it is seen that greatest quality for the blend arranged with 25% light weight total supplanted in coarse total and bond supplanted by fly fiery debris 20%.

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CONCLUSIONS

- When compared to normal concrete the density of concrete is very much reduced so that the dead weight is also reduced
- Density is almost reduced to 695kg/m3 compared to normal concrete.
- The density of concrete is found to decreases with the increase in percentage replacement of natural aggregate by pumice aggregate.
- The workability of concrete is very better same as the normal concrete.
- The compressive strength of concrete is found to decreases with the increase in percentage replacement of natural aggregate by pumice content.
- 25% LWA replacement gives higher values for compressive, split and flexural strength.
- The results obtained with 25% light weight aggregate replacement in normal aggregate were studied with GGBS replacement in cement by 0%,10% 15% 20%, 25% and 30%. At 20% replacement of cement by GGBS the maximum compressive strength is observed for 25% and 35% LWA replacement in coarse aggregate.
- The split tensile strength at 28 days for 20% replacement of cement by GGBS 30% light weight aggregate replacement in normal aggregate it is observed as 4.86MPa and 4.76 Mpa.
- The Flexural strength at 28 days for 20% replacement of cement by GGBS and 35% light weight aggregate replacement in normal aggregate is observed as 6.47MPa and 5.82 Mpa.
- By using 20% of light weight aggregate as a partial replacement to natural coarse aggregates the compressive strength is promising..
- The compressive strength of concrete is found to decreases with the increase in percentage replacement of natural aggregate by pumice content.
- With the addition of mineral admixtures the compressive, split tensile and flexural strength of concrete is increased.
- Light weight aggregate is no way inferior to to natural coarse aggregate it can be used in construction purpose.
- This type of concrete is used in wall panels of non load bearing walls type for use in precast buildings.

Scope for Future Study

1. The similarly studies could be carried for different replacements of light weight aggregate.
2. The similarly studied can be carried for different design mixes.
3. An investigation can be made on pre-wetting of the light weight natural pumice aggregate for different mixes.
4. Studies on fibrous (metallic, nonmetallic and natural) light weight aggregate (Pumice) concretes can be evaluated.
5. The studies on SSC with light weight aggregate (pumice) can be evaluated)
6. Behavior of the pumice aggregate concrete mixes with different mineral admixtures can be made.
7. Durability studies can be conceded out by exposing to chloride sulphate and acidic environments.
8. Elevated temperature studies, freezing, thawing and chloride permeability tests on this particular type of concrete can be studied.

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