AN EXPERIMENTAL STUDY ON LIGHT WEIGHT CONCRETE BY PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH PUMICE AGGREGATE AND CEMENT WITH FLYASH

[1]DR.B.PRASAD, [2]MEESALA KESHAVARDHAN, [3]GUGULOTH VINOD , [4]JONNALA SAI SUPREETH, [5]CH HRITHIK

[1]PROFESSOR, DEPARTMENT OF CIVIL ENGINEERING, CMR COLLEGE OF ENGINEERING & TECHNOLOGY

[2,3,4,5] B-Tech, DEPARTMENT OF CIVIL ENGINEERING CMR COLLEGE OF ENGINEERING & TECHNOLOGY

Abstract:

Light weight concrete has become more popular in recent years owing to the tremendous advantages it offers over the conventional concrete but at the same time strong enough to be used for the structural purpose. The most important characteristic of light weight concrete is its low thermal conductivity. This property improves with decreasing density. Structural lightweight aggregate concretes are considered as alternatives to concretes made with dense natural aggregate because of the relatively high strength to unit weight ratio that can be achieved. Other reasons for choosing lightweight concrete as a construction material is more attention is being paid to energy conservation and to the usage of waste materials to replace exhaustible natural sources. Increasing utilization of lightweight materials in civil structuring applications is making pumice stone a very popular raw material as a lightweight rock. Due to its having a good ability for making the different products based on its physical, chemical and mechanical properties, the pumice aggregate finds a large usage in civil industry as a construction material. Pumice is a natural sponge-like material of volcanic origin composed from molten lava rapidly cooling and trapping millions of tiny air bubbles. Pumice aggregate are abundant at the outskirts of volcanic mountains, particularly in Mediterranean area, Rocky Mountains in US, and most part of Turkey and Indonesia. Pumice is a natural aggregate of abundant resource around the world and it is environmentally friendly. However, pumice is far from being fully utilized in lightweight concrete at the time being. Concrete structures are generally designed to take advantage of its compressive strength. Key Words: Light Weight Concrete, Pumice, Fly ash.

1.INTRODUCTION:

Light weight concrete has become more popular in recent years owing to the tremendous advantages it offers over the conventional concrete but at the same time strong enough to be used for the structural purpose. The most important characteristic of light weight concrete is its low thermal conductivity. This property improves with decreasing density. Concrete with a density between 1350 and 1900 kg/m3 and a minimum compressive strength of 17MPa is defined as structural lightweight concrete (ACI 213R-87, 1998). Structural lightweight aggregate concretes are considered as alternatives to concretes made with dense natural aggregate because of the relatively high strength to unit weight ratio that can be achieved. Other reasons for choosing lightweight concrete as a construction material is more attention is being paid to energy conservation and to the usage of waste materials to replace exhaustible natural sources. Lightweight aggregate, due to their cellular structure, can absorb more water than normal weight aggregate. In a 24-hour absorption test, they generally absorb 5 to 20% by mass of dry aggregate, depending on the pore structure of the aggregate. Normally, under conditions of outdoor storage in stockpiles, total moisture content does not exceed two-thirds of that value. This means that lightweight aggregate usually absorb water when placed in a concrete mixture, and the resulting rate of absorption is important in proportioning lightweight concrete. Due to this more absorption of water of light weight aggregate, internal curing will be maintained for a long period. Increasing utilization of lightweight materials in civil structuring applications is making pumice stone a very popular raw material as a lightweight rock. Due to its having a good ability for making the different products based on its physical, chemical and mechanical properties, the pumice aggregate finds a large usage in civil industry as a construction material. In the initial stage of a building project, the construction material properties should be well evaluated. Therefore, the need arises to analyze the materials to be used in construction experimentally in detail. Pumice stone has been used for centuries in the world. Pumice aggregate can be found in many places around the world where 2 volcanoes are present. Although it has been used successfully in many countries finding new and improved ways to use pumice is little bit slow. When structural lightweight concrete with pumice is used in construction and maintenance of civil engineering structures, the resultant benefits of reduced overall costs, better heat and sound insulation and better resistance to fire can be realized. Despite its lower compressive strength and lower modulus elasticity, pumice concrete can be potentially used in many kinds of structural elements. For example, the disadvantage of possible excessive deformation in such elements as beams due to its low elasticity modulus can be compensated by keeping the span as small as possible, and. Further, in structural wall systems, the expected stress level usually proves to be very low, and consequently, high material strength is not required. The reduced self-weight of walls also leads to a remarkable reduction in the stress. Under these conditions, the size of the foundation can be reduced, further moving and mounting are made easier when precast elements are used. Pumice is a natural spongelike material of volcanic origin composed from molten lava rapidly cooling and trapping millions of tiny air bubbles. Pumice aggregate are abundant at the outskirts of volcanic mountains, particularly in Mediterranean area, Rocky Mountains in US, and most part of Turkey and Indonesia. The utilization of Light Weight Aggregate Concrete based on natural lightweight aggregate materials such as pumice has been rather limited, partly due to insufficient quantity obtainable in the early years when the material and production know-how is low and partly due to lack of enthusiasm and industrial interests. In recent years, the existing limited research that has been conducted in this area structural concrete with compressive strength up to 25 MPa can be produced with adequate economic benefits using pumice.Pumice is a natural aggregate of abundant resource around the world and it is environmentally friendly. However, pumice is far from being fully utilized in lightweight concrete at the time being. Concrete structures are generally designed to take advantage of its compressive strength. The primary structural property of concrete that a concrete designer is generally concerned is the compressive strength of concrete at a specific age. Pumice is the only rock that floats on water, although it eventually becomes waterlogged and sink. Since pumice is a volcanic rock, and retains its

ISSN-2394-5125 VOL 10, ISSUE 04, 2023

useful properties only when it is 3 young and unaltered, pumice deposits are found in areas with young volcanic fields. Worldwide, over 50 countries produce pumice products. The largest producer is Italy, which dominates pozzolana production. Other major pumice producers are Greece, Chile, Spain, Turkey, and the United States. Pumice and pumicite are used to make lightweight construction materials. About three-quarters of pumice and pumicite is consumed annually for this purpose. In the present investigation, the Light weight aggregate has been replaced in the normal coarse aggregate by an amount 25% and 33.33%.

OBJECTIVES:

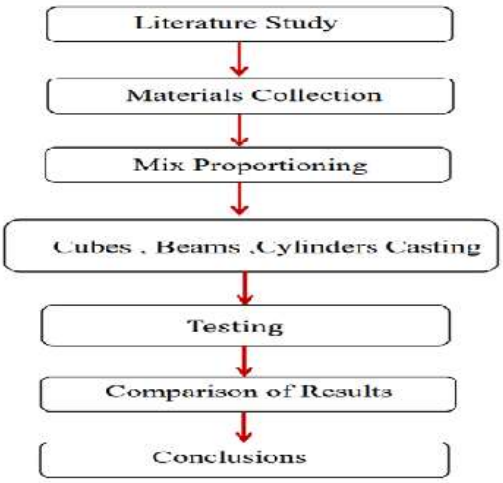
The specific objectives of the present investigations are as listed below.

i.To conduct the feasibility study of producing light weight aggregate pumice concrete with fly ash admixture.

ii. To investigate the mechanical properties of pumice aggregate concrete, such as, compressive strength, tensile strength, flexural strength and modulus of elasticity.

iii. To investigate the flexural behavior of pumice Light Weight Aggregate Concrete beam.

METHODOLOGY:



Materials Required

1) Cement,2) Fine Aggregate, 3) Coarse Aggregate ,4) Water, 5) Fly ash, 6) Pumice Aggregate

Tests On Materials

1) CEMENT:

i) Fineness Test ,ii) Initial Setting time Test, iii) Final Setting time Test ,iv) Normal Consistency Test, v) Soundness Test

2) FINE AGGREGATE:

i) Water Absorption Test ii) Specific Gravity Test iii) Sieve Analysis Test 3) COARSE AGGREGATE: i) Water Absorption Test ii) Specific Gravity Test iii) Sieve Analysis Test

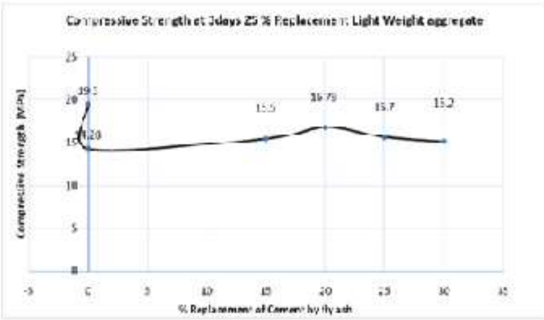
RESULTS:

The results presented in this investigation are mainly over the properties of concrete mixes prepared with the replacement of natural aggregate by light weight aggregate, and replacement of cement by fly ash. The properties like Compressive strength, Split tensile

ISSN-2394-5125 VOL 10, ISSUE 04, 2023

strength, Flexural strength and Young modulus were studied and the same were properties obtained for compared with conventional design mix concrete M25 The cube compressive strength of concrete at 3 days for the different replacements of fly ash with the cement and with 25% light weight aggregate replaced in coarse aggregate are reportedin Table.1

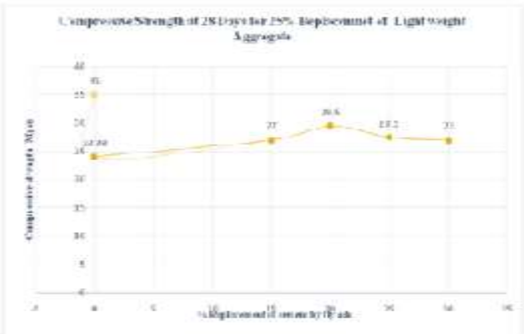
S. No	% Replacement of Cement by Fly Ash	Compressive Strength at 3 days (Mpa)
1	0 (0% Fly Ash, 0% LWA)	19.5
2	0	14.28
3	15	15.5
4	20	16.78
5	25	15.7
6	30	15.2



Graph:-1

The cube compressive strength of concrete at 28 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 2

S. No	% Replacement of cement by fly ash	Compressive strength (Mpa)
1	0 (0% fly ash, 0% LWA)	35
2	0	23.98
3	15	27
4	20	29.5
5	25	27.5
6	30	27



Graph:-2

ISSN-2394-5125 VOL 10, ISSUE 04, 2023

From the table and fig 2, it is observed that there is reduction in Compressive strength from 35.0 to 23.98 MPa between the concrete mix prepared with normal coarse aggregate as well as the concrete mix prepared with 25% light weight aggregate replaced with normal coarse aggregate. For the mixes prepared with 25% light weight aggregate when cement was replaced by fly ash 15%, there is 9.6 % gain in strength observed at 28 days, similarly at 20%, 25% and 30% a gain of strength 15.48%, 10.11 % and 9.04% is observed at the same age. From the above it is noticed that the compressive strength maximum for the mix prepared with 25% light weight aggregate replaced in coarse aggregate and cement replaced by fly ash 20%.

CONCLUSIONS:

Compressive strength The compressive strength at 28 days for the M25 design mix concrete using normal coarse aggregate and cement is obtained as 25Mpa.

The compressive strength at 28 days for 25% light weight aggregate replacement in normal coarse aggregate and 0% replacement of cement by fly ash is observed as 23.98 MPa

Further the compressive at 28 days for 25% light weight aggregate replacement in normal aggregate and 20% replacement of cement by fly ash, it is observed as 29.5 MPa The compressive strength at 28 days for 0% replacement of cement by fly ash and 33.33% light weight aggregate replacement in normal coarse aggregate it is observed as 21.0 MPa

Further the compressive at 28 days for 20% replacement of cement by fly ash and 33.33% light weight aggregate replacement in normal aggregate it is observed as 28.59 MPa

FUTURE SCOPE:

The similarly studies can be carried for different replacement of light weight aggregate.

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

REFERENCES:

1. The Indian Concrete Journal, Vol.65, No.3, May 1995
2. Gambir. M.L, Concrete Manual, Dhanpat Rail & Sons
3. Concrete Technology, M.S. Shetty
4. Concrete Technology. Neiveli
5. IS-456-1978, Code of Practice for plain concrete,bureau of Indian standards

ISSN-2394-5125 VOL 10, ISSUE 04, 2023

6. SP-23- 1982, Hand book on the concrete mixes
7. IS -456-2000 Plain and Reinforced concrete, Bureau of Indian Standards
8. Short and W. Kinniburgh, (1988) light weight concrete, Third edition, Applied Science Publishers
9. A.M Neville (1980), properties concrete, Third edition
10. Brink, R. H . and Halsted, W .J .(1956), Studies related to the testing of fly ash for use in concrete, proc. ASTM, Vol .56