AN EXPERIMENTAL INVESTIGATION OF LIGHT WEIGHT CONCRETE BY USING NATURAL LIGHT WEIGHT AGGREGATES AND POLYSTYRENE BEADS

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Abstract
In this paper presents the light weight concrete mixture is made with a natural light weight pumice coarse aggregate, steel slag, and polystyrene beads. Sometimes a portion of (or) entire aggregates may be light weight instead of normal aggregate. Structural light weight concrete as in place density unit weight on the order of 300kg/m^3 – 1840 kg/m^3. Normal weight concrete a density in the range of 2240 kg/m^3- 2400 kg/m^3. For structural applications the strength should be greater than 17 N/mm^2. In this project the light weight concrete is made by using fine aggregate as 50% of crushed pumice stone and 50% of crushed steel slag, and coarse aggregate as natural light weight aggregate (Pumice stone and polystyrene beads) with full percentage of replacement. Pumice as replaced for both fine aggregates and coarse aggregates. In fine aggregates pumice stone as 50%, 100% and coarse aggregates as 100%, 50%. Here we added the super plasticizer to reduce the water content and the grade of concrete is M25.
Keywords: Natural light weight Concrete, Super plasticizer, Steel slag, Crushed pumice powder, Polystyrene Beads, Compressive Strength, Split tensile strength, Flexural strength.

1.INTRODUCTION

Lightweight concrete is defined according to NP EN 206-1 [1] as a concrete that has a density, after oven drying, that isn't larger than 2000 kg/m3, total or partially produced with porous structure aggregate. The main difference between lightweight concrete and normal concrete is the lower density mass, besides its distinguishable thermal and durability characteristics. In addition, the standard NP EN 13055-1 defines lightweight aggregate as having a particle density not exceeding 2000 kg/m3 or a loose bulk density not exceeding 1200 kg/m3. Concrete is the most versatile man-made construction material in the world and being extensively used in all types of construction activities. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, the mix proportions, the method of compaction and other controls during placing, compaction and curing. The advances in concrete technology have paved the way to make the best use of locally available materials by proper mix proportioning and workmanship so as to produce a strong, durable and uniform concrete. One of the major thrust areas of research in concrete has been in the use of supplementary cementing materials or mineral admixtures or replacement of ingredients. The uses of industrial wastes which are pozzolanic in character and develop cementations properties are used to replace cement and aggregates partially improve strength, durability and help to protect the environment. The environmental impacts of extracting river sand and crushed stone aggregate become a source of increasing concern in most parts of the country. Thus the production of light weight concrete with alternate aggregates is highly recommended by researchers..

1.1 OBJECTIVE

1 To develop light weight concrete.

2 To determine whether pumice stone light weight concrete can be used as a structural concrete.
3 To improve thermal properties.
4 To reduce the dead load in foundation and reinforcement.
5 To reduce form work and propping.

1.2 METHODOLOGY

- Literature Collection And Study
- Material Collection And Study☐ Test On Material Study & Properties
- Mix proportion of LWC
- Casting Of Specimens
- Curing Of Specimens☐ Testing Of specimens
- Result And Discussions
- Conclusion

2.MATERIAL PROPERTIES

2.1MATERIAL USED

a) Cement (OPC 53)
b) Crushed pumice powder
c) Pumice stone
d) Polystyrene beads
e) Steel slag
f) M-Sand

2.1.1 Cement

OPC53 Grade conforming IS12269:1987, Minimum cement content: 320 kg/m3 (IS456:2000)

S .No	Test for cement	Apparatus	Value obtained
1.	Standard consistency test	Vicat apparatus	5.7mm
2.	Initial setting time test	Vicat apparatus	30min
3.	Final setting test	Vicat apparatus	550mim
4.	Specific gravity test	Conical flask	3.12
5.	Sieve analysis test	Sieve setup	4%

2.1.2 Pumice Aggregates

S .No	Characteristics	Experimentalvalueofpumice aggregates
1.	Specific gravity of CA	0.78
2.	Specific gravity of FA	2.54
3.	Sieve analysis for FA	2.7
4.	Impact test for CA	44%

2.1.3 M-Sand

S.NO	Test for M sand	Apparatus	Value obtained
1	Fineness modulus	Sieve	2.75
2	Specific gravity	Pycnometer	2.7
3	Water absorption	Pan, water	1.6%

3 MIX PROPORTION

3.1 concrete mix proportion

The mixes were designated in accordance with IS 102622009 mix design method. Based on the results, the mix proportions M25 was designed. Concrete mix with w/c ratio of 0.45 was prepared. The details of mix proportions for $1m^3$ of concrete are given in Table below

Mix proportions for M25 Grade of Concrete (Kg/m^3)

Grade	Cement	FA	CA	Water
Mix 25	479	636	1139	191.58
	1	1.33	2.38	0.45

4. CASTING OF SPECIMENS

Cubes (150x150x150mm)
Cylinders (150mm diameter, 300mm height)
Prism (700,100 and 100mm)

5. TESTING OF SPECIMENS

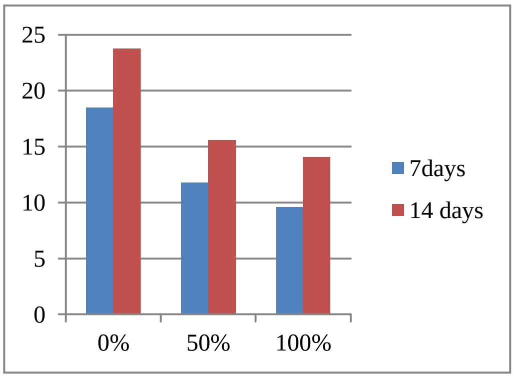
a) Compressive strength test
b) Split tensile strength test
c) Flexural strength test

6.RESULTS

6.1 COMPRESSIVE STRENGTH ANALYSIS

The compressive strength tested on cube for different percentage of pumice, steel slag and polystyrene beads a for M_{25} concrete for 3days and 7days having better result achieved. The below tables shows the compressive strength of cubes at different percentage of LWC.

% OF PUMICE STONE,POLYSTYRENE BEADS,STEEL SLAG ADDED	SPECIMEN	COMPRESSIVE STRENGTH F_{ct} = P/A (N/mm^2)
0%	Specimen	23
50%	Specimen	15.6
100%	Specimen	14.05

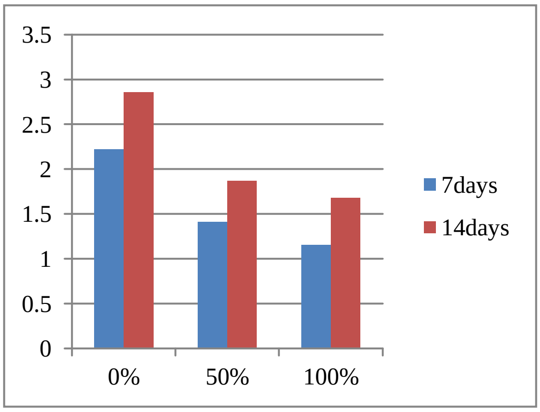


Compressive strength

6.2 SPLIT TENSILE STRENGTH ANALYSIS

The split tensile strength tested on cylinders for different percentage of pumice, steel slag and polystyrene beads for M_{25}concrete for 7days and 14days having better result achieved. The below tables shows the split tensile strength of cylinders at different percentage of LWC.

% OF PUMICE STONE, POLYSTYRENE BEADS,STEEL SLAG ADDED	SPECIMEN	SPLIT TENSILE STRENGTH F_{ct}= P/A (N/mm^2)
0%	Specimen	2.86
50%	Specimen	1.87
100%	Specimen	1.68



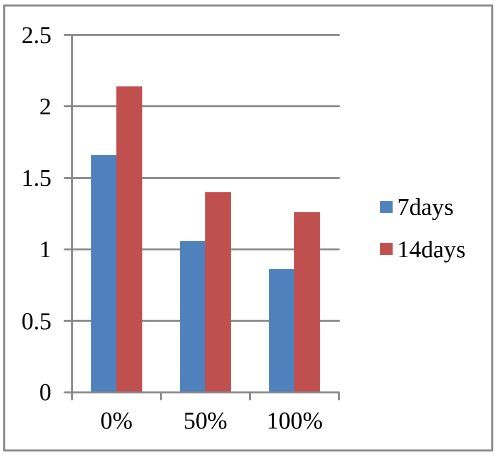
Split tensile strength

6.3FLEXURAL STRENGTH ANALYSIS

All load and dissociation data required for additional calculations will be obtained from digital data under test. The first peak load (P_{max}) is obtained from the slope of the bending curve to the point at zero.

The test sample is stored for 7 days and 28 days. They are tested immediately after being removed from water in 7 days and 28 days. Checked with Universal testing machine.

The flexibility strength of the vertex is shown in below table



Flexural strength

% OF PUMICE STONE,POLYSTYRENE BEADS,STEEL SLAG ADDED	SPECIMEN	FLEXURAL STRENGTH $F_{ct} = P/A$ (N/mm^2)
0%	Specimen	2.14
50%	Specimen	1.40
100%	Specimen	1.26

CONCLUSION

Based on the above test result the following conclusive are arrived.

- Pumice concrete can be used in lintels, sunshades, Partition walls
- Pumice concrete can be used in earthquake resistant structures.
- The compressive strength of light weight concrete is lesser than the ordinary conventional concrete.
- Therefore the light weight concrete can be used in places where the external force acting on the structure is minimum.
- The light weight concrete has low thermal conductivity and has an ability to absorb sound. So, it can be used for acoustic structures.
- The workability of light weight concrete is not good when it is compared to the ordinary conventional concrete.

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