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LIGHT WEIGHT CONCRETE BY PUMICE & PERLITE AS COARSE & FINE AGGREGATE

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INTRODUCTION

In the recent construction industry, even though we are practicing with different composite materials concrete plays a major role in the construction sector Concrete is a building material, consisting of cement, fine aggregate and coarse aggregate. Among the ingredients of concrete, coarse aggregate imparts greater volumetric stability and durability to concrete. It is cheaper than cement and hence directly helps in achieving economy in concrete. Hence maximum of good aggregate should be used as much as possible. A good aggregate should produce the desired properties in both the fresh and hardened concrete. Based on literature review, pumice stone is selected as replacement material for coarse aggregate Pumice stones are rocks of volcanic origin which occur in many parts of the world. Pumice stone is a natural lightweight aggregate which is light enough and yet strong enough to be used as light-weight concrete. Their lightness is due to the escaping of gas from the molten lava when erupted from deep beneath the earth's crest. Pumice stone is a very popular material as light weight rock, because of its desired properties and it is used as construction material in civil industry for centuries in the world. Replacing pumice aggregate with coarse aggregate decreases the self-weight of the concrete and results in decreasing the self-weight of building. One of the most advantages of pumice aggregate is it has a low density as compared to conventional coarse aggregate. It has low specific gravity and has thermal insulation. Its water absorption is as higher than normal coarse aggregate because it is highly porous material while comparing to coarse aggregate. Hence before using pumice aggregate it is soaked in water for 24hours.Pumice is light coloured or white in colour. It has the fairly even texture of interconnected cells and floats on water. The density of pumice is 0.25gm/cm^3.

METHODOLOGY

i) Material Collection
ii) Material Test
iii) Mix Design
iv) Optimization of Pumice & Perlite
v) Casting and Testing Analysis of specimens
vi) Analysis of test results
vii) Conclusion & Suggestion for future study

TESTING PROGRAM OF LIGHTWEIGHT CONCRETE

In order to study the behavior of lightweight concrete, normal concrete testing was done to determine the material and structural properties of each type of lightweight concrete and how will these properties differ according to a different type of mixture and its composition. Once concrete has hardened it can be subjected to a wide range of tests to prove its ability to perform as planned or to discover its characteristics. For new concrete this usually involves casting specimens from fresh concrete and testing them for various properties as the concrete matures.

MATERIALS USED:

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The materials used in this study for the preparation of specimens,

- Ordinary Portland cement (33 grade)
- Pumice Stone
- Expanded Perlite
- Water
- Foaming Agent

PROPERTIES OF MATERIALS:

The material and their properties are as follows.

- **Cement:**

The cement used in this study was 43 grade Ordinary Portland Cement (OPC) confirming to IS 8112-1989. Cement is a binder material which sets and hardens independently, and can bind other materials together. The standard consistency is 34% whereas, the initial setting time and final setting time is 80 min and 350 min respectively

- **Pumice as Coarse Aggregate:**

Pumice is a light-colored, extremely porous igneous rock that forms during explosive volcanic eruptions. It is used as aggregate in lightweight concrete, as landscaping aggregate, and as an abrasive in a variety of industrial and consumer products. Its Density is 700 to 1200 (Kg/m^3).

- **Perlite as Fine Aggregate:**

Perlite is an amorphous volcanic glass that has a relatively high water content, typically formed by the hydration of obsidian. It occurs naturally and has the unusual property of greatly expanding when heated sufficiently. Its Density is around 1100 (Kg/m^3).

- **Water:**

Water is used for mixing, curing purpose should be clean, portable, fresh and free from any bacteria and desire matter confirming to IS 3025-1964 is used for mixing. Water is a key ingredient in the manufacture of concrete.

TEST ON MATERIALS

4.1 SPECIFIC GRAVITY TEST ON PUMICE STONE

Table 4.1-Specific Gravity Test for Pumice Stone

Sl.No	Observation	Trial 1 (Kg)	Trial 2 (Kg)	Trial 3(Kg)
1	Weight of pycnometer (W1)	0.648	0.650	0.651
2	Weight of pycnometer + Pumice Stone(W2)	0.748	0.750	0.752
3	Weight of pycnometer + Pumice Stone+ water (W3)	1.540	1.545	1.546
4	Weight of pycnometer + water (W4)	1.548	1.550	1.552
5	Specific gravity of Pumice Stone	0.92	0.95	0.94

Specific Gravity of coarse aggregate = 0.92

4.2 IMPACT TEST ON PUMICE STONE

Table 4.2- Impact test on coarse aggregate

Sl. No	Observation	Weight (g)
1	Weight of aggregate taken (W1)g	500
2	Weight of aggregate left over (W2) g	160
3	Weight of aggregate in the cup (W1-W2) g	340
4	Weight of aggregate passing the sieve (W3)g	80

Aggregate impact value = 20%

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4.3 TEST REPORT ON PERLITE :-

Lose Weight Density: 35 - 45 kg/m³
Tamped Weight Density: 55 - 60 kg/m³
Color: White
Free Quartz: < 0.5 %
Mechanical Resistance: 0.6 - 1.51 kg/cm²/cm
Thermal Conductivity λs = 0.034 - 0.042 W/(m.K)
Softening point: 890 - 1100 °C
Fusion point: 1280 - 1350 °C
Specific heat: 0.20
Specific gravity: 2.2 - 2.4
Fire resistance: Perlite is non-combustible

RESULT AND DISCUSSIONS

TEST RESULT

Pumice as Coarse& Perlite as Fine Aggragate

SI.NO	Pumice %	Perlite %	Average Compressive Strength N/mm^2			Remarks
			7 Days	14 Days	28Days	
1.	10	5	08	11.2	13.6	Not floating
2.	20	10	10	11.8	14.3	Not floating
3.	30	15	11.5	13.7	15.2	Floating
4.	40	20	12.7	14.5	16	Floating

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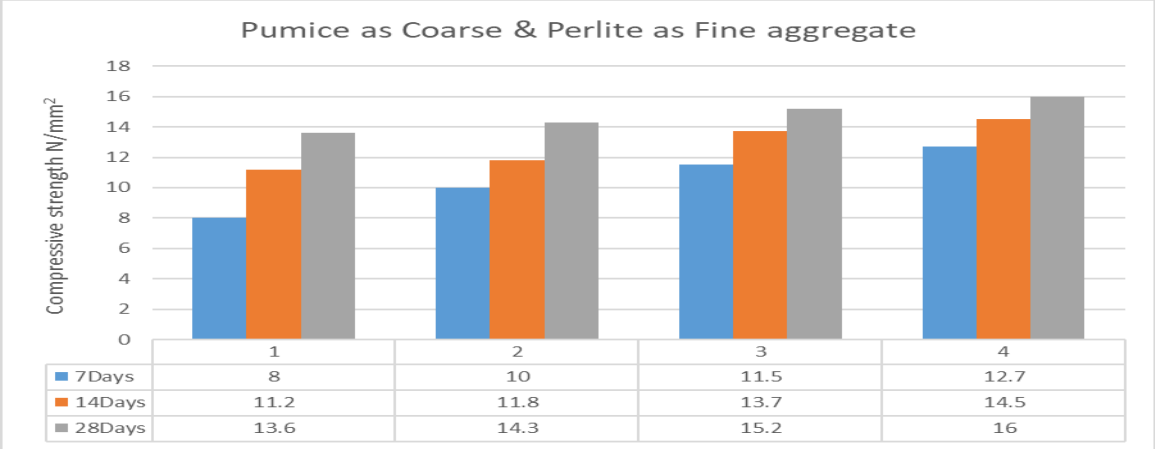
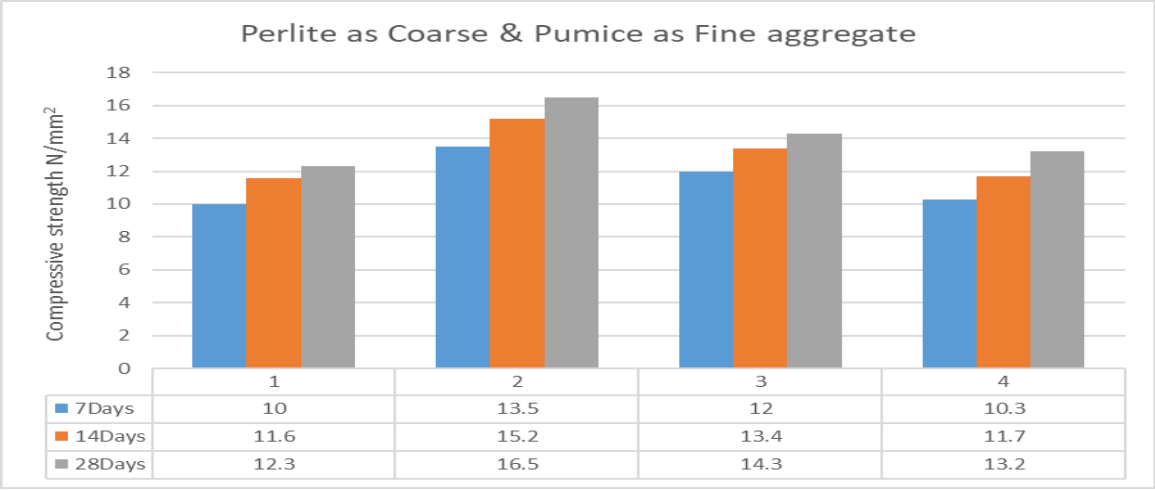


Perlite as Coarse& Pumice as Fine Aggragate

SI.NO	Perlite%	Pumice %	Average Compressive N/mm^2 Strength			Remarks
			7 Days	14 Days	28Days	
1.	10	5	10	11.6	12.3	Not floating
2.	20	10	13.5	15.2	16.5	Floating
3.	30	15	12	13.4	14.3	Floating
4.	40	20	10.3	11.7	13.2	Floating



Pumice as Coarse & Fine Aggragate

SI.NO	Pumice %	Average Compressive N/mm^{2}Strength			Remarks
		7 Days	14 Days	28Days	
1.	10	14	15.6	17.3	Not floating
2.	20	16.3	18.2	21.2	Not floating
3.	30	17.8	20.6	22.3	Not Floating
4.	40	12.5	14.3	15.8	Floating

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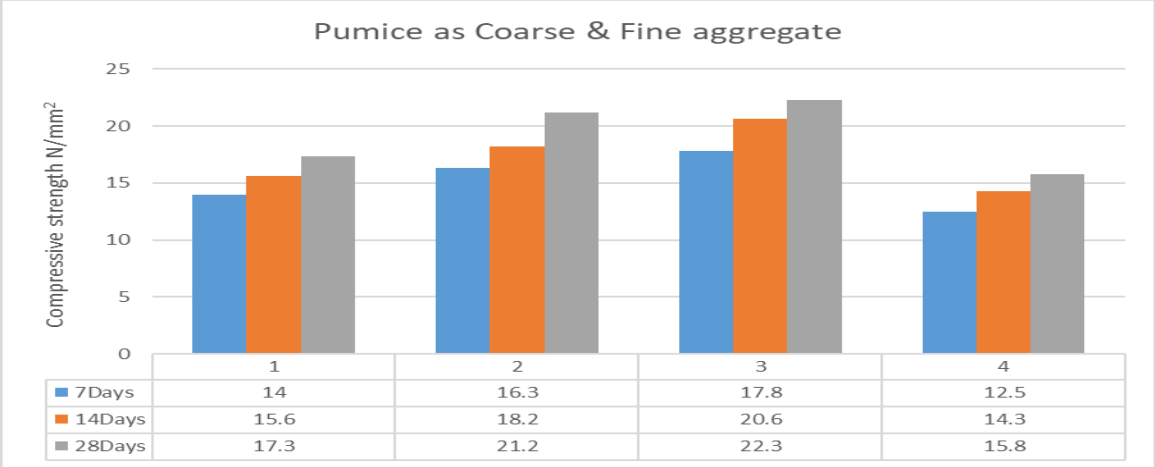
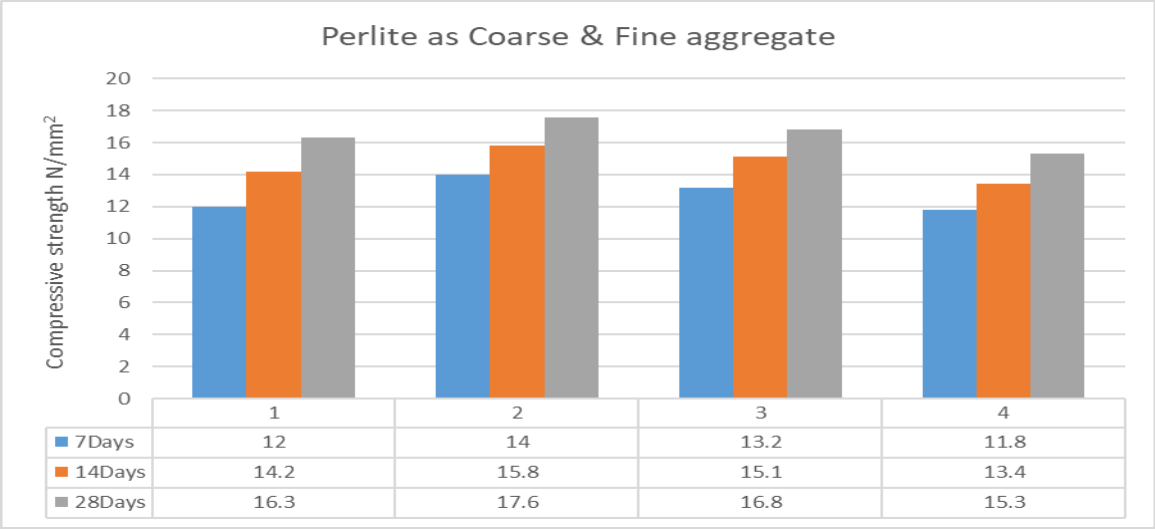


Perlite as Coarse & Fine Aggregate

SI.NO	Pumice %	Average Compressive N/mm^{2}Strength			Remarks
		7 Days	14 Days	28Days	
1.	10	12	14.2	16.3	Not floating
2.	15	14	15.8	17.6	Not floating
3.	20	13.2	15.1	16.8	Floating
4.	25	11.8	13.4	15.3	Floating



CONCLUSION & DISCUSSION

- Pumice is a light weight aggregate obtained from volcanic rock which is foamy in appearance is used for the production of light weight concrete.
- It increases the volume of the mixture while giving additional qualities such as nailbility and lessened the dead weight. It is lighter than the conventional concrete.
- The minimum 20% of Perlite and 10% of Pumice in concrete will start floating in water .
- According to some estimates, many metropolises, specifically in theUnited States, will suffer from frequent flooding and over 400 million people will be directly affected by rising water levels by the end of the century. If no action is taken, the damage to cities from flooding could amount to $1tn a year by 2050, according to a World Bank report. With that knowledge, many world organizations warn about the urgency to protect cities and communities from these risks.

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