EXPERIMENTAL STUDY ON LIGHTWEIGHT CONCRETE USING PERLITE

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Abstract - *For structural application of lightweight concrete, the density is more important than the strength. A low density for the same strength level reduces the self-weight, foundation size and construction costs. In this study, structural lightweight aggregate concrete was designed with natural Perlite aggregate that will provide an advantage of reducing dead weight of structure also compared the strength of normal concrete with Perlite concrete by partially replacing of Perlite with sand as a percentage of 5%, 10%, 15%, 20% and 25% in normal concrete mix. The investigations are to be carried out using several tests which include compressive test, split tensile test and flexural test.*

***Key words**:* Perlite aggregate, Compressive strength, Split tensile strength and Flexural strength.

1. INTRODUCTION

Perlite concrete consists of a mixture of Ordinary Portland Cement, Perlite aggregate, sand and water; its weight can be varied in the range of 20 to 50 pounds per cubic foot, depending on the mix design selected. This is in comparison to sand and gravel concrete which weighs 140 to 150 pounds per cubic foot and the 60 to 120 pounds per cubic foot weight of expanded slag, shale or clay. Because of its exceptionally light weight, Perlite concrete is not considered a true structural concrete. However, it is the strongest concrete in its weight class and has more than adequate strength for floor fills, light structural roof decks placed over form boards, and metal lath or paper backed wire mesh, and makes an economical and versatile insulation fill over metal decking and structural concrete. It can also be sprayed as a fire retardant backup for metal curtain walls.

2. MATERIALS USED

2.1 Cement

The Cement used for this experimental study is 43 grade Ordinary Portland Cement. All properties of cement are tested by referring IS 12269-1987.

2.2 Perlite

Perlite is an amorphous volcanic glass that has relatively high water content. It occurs naturally and has the property of highly expanding when heated sufficiently. It is an industrial mineral and a commercial product useful for its light weight after processing; the product expands four to twenty times its original volume. Perlite expansion is due to the presence of two to six percent combined water in the crude Perlite rock. When the crude oil is quickly heated to above 870^0C (1600^0F), the product pops in a similar manner to popcorn.

2.3 Sand

Good quality natural river sand is used as fine aggregate. The sand is sieved in 2.36mm sieve as the sand passing through this sieve is use as fine aggregate. Zone of the fine aggregate used in this work is zone II.

Fig -1: Perlite

2.4 Coarse Aggregate

Hard granite broken stone was used as coarse aggregate. The coarse aggregate is sieved in 20mm sieve and the aggregate passing through the sieve is used as coarse aggregate.

2.5 Water

Clean potable water conforming to IS 456-2000 was used in preparation of the concrete. The qualities of water samples are uniform. pH of water lies between 6 to 8 and the water is must be free of all acids, based and other dissolved salts.

2.6 Superplasticizer

A superplasticizer of Sulfonated Naphthalene Formaldehyde was used as an admixture during mixing of fresh concrete.

3. PROPERTIES OF MATERIALS

Table -1: Properties of Cement

S.NO.	Property	Result
1	Initial setting time	45 minutes
2	Final setting time	466 minutes
3	Consistency	30%
4	Specific Gravity	3.15
5	Fineness	8.5%

Table -2: Properties of Perlite

S.NO.	Property	Result
1	specific gravity	2.2
2	physical state	micronized powder
3	Colour	White
4	Water absorption	1.5%

Table -3: Properties of Sand

S.NO.	Property	Result
1	Fineness modulus	2.58
2	Specific gravity	2.44
3	Grading zone	II
4	Water absorption	1.0%

Table -4: Properties of Coarse aggregate

S.NO.	Property	Result
1	Fineness modulus	3.44
2	Specific gravity	2.98
3	Water absorption	0.5%

Table -5: Properties of Superplasticizer

S.NO.	Property	Result
1	Appearance	Brown liquid
2	Specific gravity	1.2 to 1.22 @ 20° C
3	% of chloride	< 0.1%
4	Chemical composition	Sulfonated Naphthalene Formaldehyde

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test

The 150 x 150 x 150 mm cubes were tested at the age of 7 and 28 days after curing using Compression Testing machine (CTM). The ultimate load divided by the cross- sectional area of the specimen is equal to the cube compressive strength.

Table -6: The compressive strength results

S.NO.	Specimen details	Compressive strength (MPa)	
		7 Days	28 Days
1	Conventional mix	15.64	20.52
2	5% Perlite	14.67	19.24
3	10% Perlite	13.17	20.9
4	15% Perlite	13.80	18.8
5	20% Perlite	9.00	12.56
6	25% Perlite	6.11	7.49

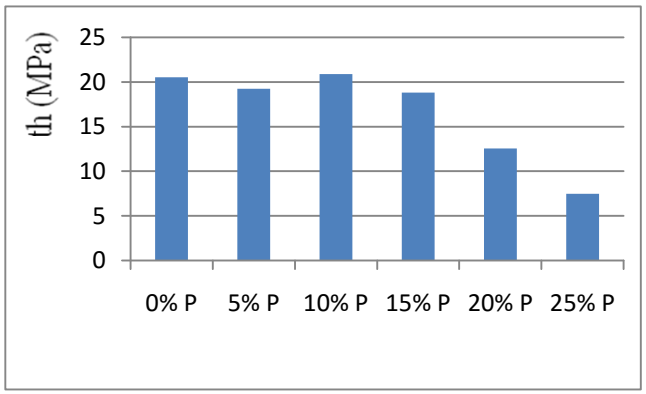

Chart -1: Comparison of Compressive strength of cubes on 28 days.

1.85% increment in the compressive strength is found at 10% replacement of sand by Perlite at 28 days when compared to normal concrete.

4.2 Split Tensile strength test

This test is used to determine the tensile strength of concrete with specimen of size 150 mm Diameter (**D**) and 300 mm Long (**L**) at the age of 7 and 28 days after curing using CTM. The split tensile strength of concrete was found using **(2P/πLD)** where. **P** is the maximum load on the cylinder.

Table -7: The split tensile strength results

S.NO.	Specimen details	Tensile Strength (MPa)	
		7 Days	28 Days
1	Conventional mix	1.22	2.39
2	5% Perlite	1.47	2.41
3	10% Perlite	1.66	2.64
4	15% Perlite	1.62	2.50
5	20% Perlite	1.71	2.55
6	25% Perlite	1.67	2.52

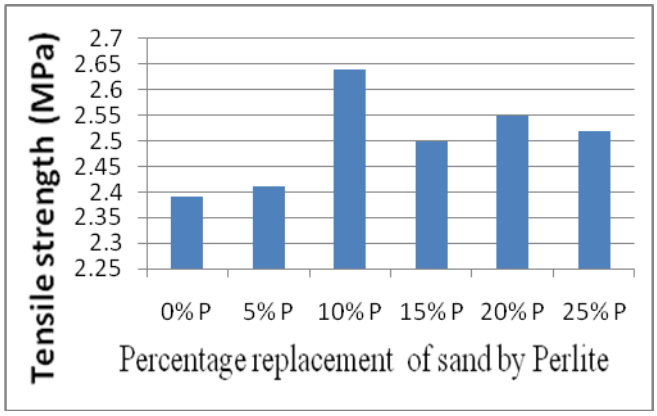

Chart -2: Comparison of Split tensile strength of cylinders on 28 days

10.46% increment in the split tensile strength is found at 10% replacement of sand by Perlite at 28 days when compared to normal concrete.

4.3 Flexural strength test

Flexural strength test was carried out on beam specimens of size 100 x 100 x 500 mm at the age of 28 days after curing using CTM. The flexural strength of concrete was found using **PL/bd²** or **3Pa/bd²** where **P** is the maximum load on the cylinder and '**a**' is the distance of crack from nearest support of a>20 cm and a<20 cm respectively.

Table -8: The flexural strength results

S.NO.	Specimen details	Flexural Strength (MPa)
		28 Days
1	Conventional mix	5.39
2	5% Perlite	5.71
3	10% Perlite	5.94
4	15% Perlite	5.87
5	20% Perlite	5.75
6	25% Perlite	5.52

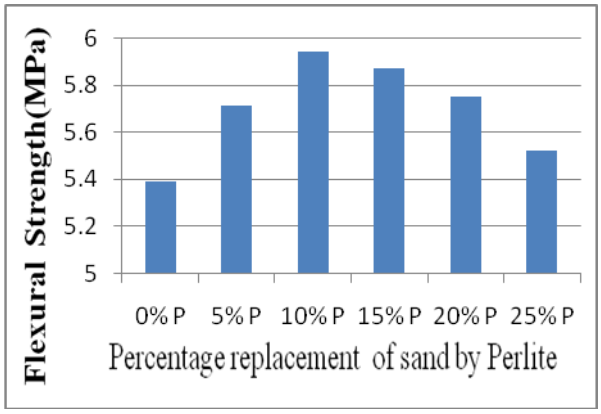

Chart -3: Comparison of Flexural strength of beams on 28 days

10.20% increment in the flexural strength is found at 10% replacement of sand by Perlite at 28 days when compared to normal concrete.

5. CONCLUSION

The following results are obtained.

1. The Compressive Strength was high at 10% Perlite and the percentage increasing was 1.85 % at 28 days.

2. The Split Tensile Strength was high at 10% Perlite and the percentage increasing was 10.46% at 28 days.

3. The Flexural Strength was high at 10% Perlite and the percentage increasing was 10.20% at 28 days

4. The optimum replacement percentage of sand by Perlite is 10%. The compressive, split tensile and flexural strength were reduced if the replacement percentage of Perlite will be increased.

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