EXPERIMENTAL INVESTIGATION ON CONCRETE USING PERLITE AS PARTIALY REPLACEMENT FOR FINE AGGREGATE AND STEEL SLAG AS FULLY REPLACEMENT FOR COARSE AGGREGATE

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Abstract - *The light weight concrete made by using of fully replaced with steel slags as a coarse aggregate and partially replaced with perlite aggregate as a fine sand . This type of concrete can be reduced the dead load of the structure, size of foundation ,to increase the slab thickness through bearing the heavy load and reduce the cost of construction. A brief review of literature is presented. Light weight concrete contains, perlite aggregate with 4mm size, steel slag, OPC cement and water. These are increase the strength, thermal and acoustic insulation. The perlite content in 0%, 25%, 50% and 75% as a fine sand. These contents are mostly produced from industrial by products. So that it will be economically & environmental friendly.The test are carried out in fresh and hardened concrete.The test include compressive test, split tensile and flexural test.*

Key word:

Perlite aggregate, steel slag, compressive strength, flexural strength and split tensile strength.

1.INTRODUCTION

To compare the behaviour, strength and properties of normal conventional concrete with perlite aggregate as partial replacement of fine aggregate and steel slags as fully replacement of coarse aggregate. The concrete comprises the OPC cement, steel slag, pelite aggregate, and water .steel slag weight can be varied 70 to 150 pounds per cubic feet and perlite aggregate weight can be varied 15 to 30 pounds per cubic feet. Structural light weight aggregate concrete has a lot of environmental advantages and is through to become a decisive material in future. This applications are apply for shell roofs, bridges multi storey buildings, curtain walls, building frame, precast, and pre-stressed elements. It is used to reduce dead weight of structure and reduce the earthquake damages, better tensile stress capacity, better sound and heat insulation characteristics. Perlite is on volcanic rock that has relatively high water content.

The development of new technology in the material science is progressing rapidly. In last three decades, a lot of research was carried out throughout globe to improve the performance of concrete in terms of strength and durability qualities.

Concrete technology has under gone from macro to micro level study in the enhancement of strength and durability properties from 1980 on wards.Perlite has used in light weight plasters,mortars,insulation and ceiling tiles in the construction process.Perlite insulating concrete roof decks have popular for well over 50 years now. Over 50% of perlite world wide is used by the construction industry.from being used as loose fill insulation material.Steel slags manufactured from iron industry. The steel slag 100% of replaced as a coarse aggregate.

2. OBJECTIVE

- To study the compressive strength of concrete specimen by using perlite and partially replaced steel slag as a fine sand.
- To produce light weight concrete within economic construction.
- To compare the compressive strength,split tensile strength and flexural strength for light weight concrete with the conventional concrete.
- To study the strength of concrete and optimum percentage of the partial replacement by replacing fine sand 0%, 25%, 50%, and 75% of perlite and 100% replacement of steel slags as a coarse aggregate.
- To reduce the risk of earthquake damages.
- To reduce the dead load and quantity requirement of natural aggregate.

3.SCOPE OF STUDY

- To Minimize the maximum demand for fine sand.
- To use industrial waste by product of steel slag.
- To protect the natural resources.

- To reduce the environmental problems.

4. METHODOLOGY

- Literature Collection
- Material Collection And properties study
- Mix Design M-25 Grade Of Concrete
- Testing Of Fresh Concrete and hardened concrete
- Casting Of Specimens
- Curing Of Specimens
- Testing The Mechanical Properties Of the Concrete
- Result And Discussions
- Conclusion

4.1 USE OF MATERIAL AND PROPERTIES

a) Cement (OPC 53)
b) Coarse Aggregate
c) Fine Aggregate
d) Perlite aggregate
e) Steel slag
f) Mixing of water

4.1.1 Cement

The cement used for this study is 53 grade OPC. Specific gravity of cement is 3.11 and the finess of cement 4.16%.

Table -4.1 Properties of cement

S.NO	PROPERTY	RESULT
1	Initial setting time	30 minutes
2	Final setting time	600 minutes
3	Consistency	33%
4	Specific gravity	3.11
5	Fineness	4.16%

Fig -1: Cement

4.1.2 Coarse Aggregate

As per IS 383:1970 the 20mm used. The shape of coarse aggregate is angular, water absorption is 0.5%. Specific gravity of nominal size of aggregate is 2.82.

Table-4.2: Properties of coarse aggregate

S.NO	PROPERTY	RESULT
1	Fineness modulus	3.44
2	Specific gravity	2.82
3	Water absorption	0.5%

Fig -2: Coarse aggregate

4.1.3 Fine Aggregate

As per IS 383:1970 fine aggregate properties were tested. 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 and specific gravity is 2.56 and based on sieve analysis which in zone III.

Table -4.3: Properties of Sand

S.NO	PROPERTY	RESULT
1	Fineness modulus	2.58
2	Specific gravity	2.56
3	Zone	III

Fig-3:River sand

4.1.4 Perlite

Perlite aggregate an amorphous volcanic glass that has relatively high water cement.Aggregate size is 4 mm and the product expands 4 to 20 time its original volume. Perlite expansion is due to the presence of 2 to 6 percent combined water in the crude perlite rock. This product pops in a similar manner to popcorn. It has density less than 2000kg/m3. Perlite aggregate density is 1100 kg/m_2.

Table-4.4: Properties of perlite

S.NO	PROPERTY	RESULT
1	Specific gravity	2.15
2	Physical state	Micronized powder
3	Color	White
4	Water absorption	1.5%

Fig-4: Perlite

4.1.5 Steel slag

It decrease free Cao and MgO contents. Steel slag passing through 12 mm mm sieve and to replace fine aggregate. The impact value is 6.06% and abrasion value is 23.11%.Specific gravity of perlite is 3.31.

Fig-5 Steel slag

Table 4.5: Properties of steel slag

S.NO	PROPERTIES	RESULTS
1	Specific gravity	3.31
2	Finess modulus	3.35
3	Crushing strength	2.95
4	Impact value	6.06

2.1.6 Water

Clean portable 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 mustbe free of all acid, based and other dissolved salts.

4.2 Mix Design

3.1Concrete mix proportion

The mixes were designated in accordance with IS 10262-2009 mix design method. Based on the results, the mix proportions M25 was designed. Concrete mix with w/c ratio of 0.4 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	637	1145	191.58
	1	1.33	2.39	0.4

4.3 CASTING OF SPECIMENS

a) Cubes (150x150x150mm)
b) Cylinders (150mm diameter, 300mm height)
c) Prism (500,100 and 100mm)

4.4 TESTING OF SPECIMENS

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

5.RESULTS

5.1 COMPRESSION STRENTH TEST

Compressive strength =load/area(N/mm2)

Fig-6 specimen subjected to compressive strength

Table 5.1 Test result for compressive strength

S.NO	Description	Compressive strength (Mpa)		
		7days	14days	28days
1	0% for conventional concrete	16.18	24.88	36
2	25% perlite with 100% steel slag	12	21.4	25.76
3	50% perlite with 100% steel slag	15	23.4	28
4	75% perlite with 100% steel slag	8	19	24.88

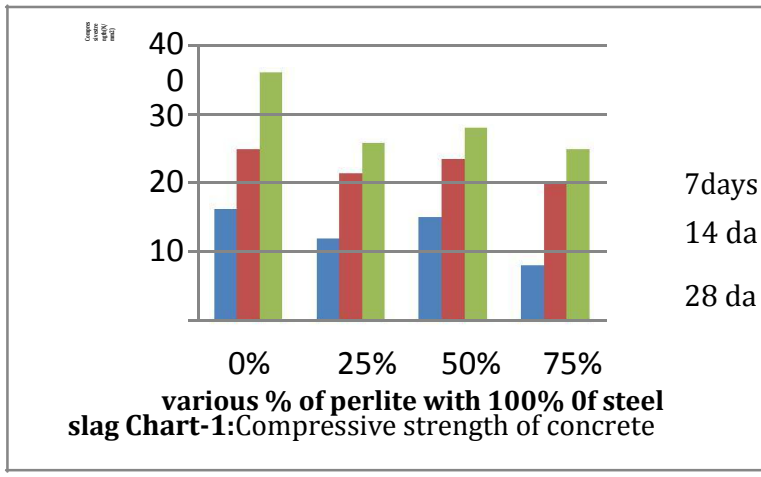


Chart-1: Compressive strength of concrete

5.2 SPILT TENSILE STRENTH TEST

Split tensile strength = 2p/πdl(N/mm2)

p- Load of the specimen(KN)

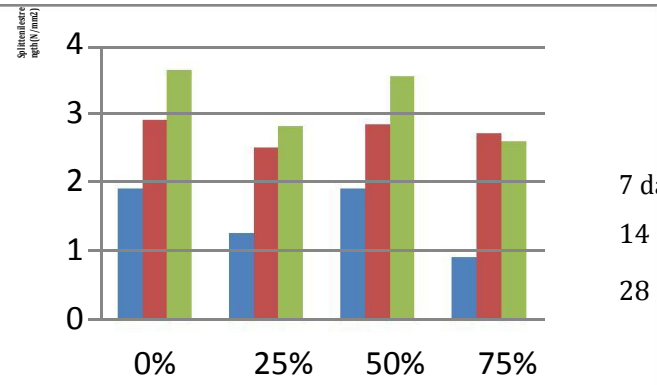
d- Diameter of the specimen(mm)

l- Length of the specimen(mm)

Fig-7 specimen subjected to split tensile strength

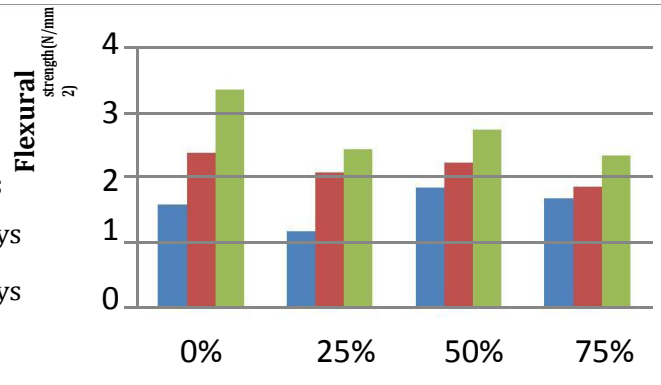
Table -5.2 Test results for split tensile strength

S.NO	Description	Split tensile strength (Mpa)		
		7days	14days	28days
1	0% for conventional concrete	1.9	2.9	3.62
2	25% perlite with 100% steel slag	1.25	2.5	2.8
3	50% perlite with 100% steel slag	1.9	2.83	3.53
4	75% perlite with 100% steel slag	0.9	2.7	2.58



Various % of perlite with 100% of steel slag

Chart-2:Split tensile strength of concrete



Various % of perlite with 100% steelslag

Chart-3: Flexural strength of concrete

5.3 FLEXURAL STRENTH TEST

Flexural strength = $pl/bd^2(N/mm^2)$

p- load of the specimen(N/mm^2)

b- width of the specimen(mm)

d- depth of the specimen(mm)

l- length of the specimen(mm)

Fig-8 specimen subjected to flexural strength

Table-5.3 Test results for flexural strength

S.NO	Description	Flexural strength (Mpa)		
		7days	14days	28days
1	0% for conventional concrete	1.56	2.35	3.3
2	25% perlite with 100% of steel slag	1.15	2.05	2.4
3	50% perlite with 100% of steel slag	1.82	2.2	2.7
4	75% perlite with 100% of steel slag	1.65	1.83	2.3

6. CONCLUSION

1. The compressive strength was high at 50% perlite with fully replaced of steel slag and the percentage increasing was 20% at 28 days.
2. The split tensile strength was high 50% perlite with fully replaced steel slag and the percentage increasing was 25% at 28days.
3. The flexural strength was high 50% perlite with fully replaced of steel slag and the percentage was 35% at 28days. Thus the concrete have to improve the flexural strength.
4. The fully replacement of steel slag and partially replacement of perlite have to improve the workability, flexural strength, fire resistance, give light weight and not affected by weathering.
5. The concrete increase density and mechanical property.
6. The replaced concrete was increasing the dimensional stability and durability.

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