LIGHT WEIGHT CONCRETE USING EXPANDED POLYSTYRENE BEADS

[1]D.EASWAR KARTHIK, [2]P.VASUDEVA RAO
[1]Vignan's Lara Institute of Technology & Science , Chebrolu Mandal - Vadlamudi Rd, Vadlamudi, Andhra Pradesh 522213
[2]Quality & Quantity control Incharge, LCC Ready Mix Concrete Pvt Ltd, NH5,Opp Raintree park, guntur,vijayawada, Andhra Pradesh 522508

ABSTRACT: Expanded polystyrene (EPS) geofoam is a lightweight material that has been used in engineering applications since at least the 1950s. Its density is about a hundredth of that of soil. It has good thermal insulation properties with stiffness and compression strength comparable to medium clay. It is utilized in reducing settlement below embankments, sound and vibration damping, reducing lateral pressure on sub-structures, reducing stresses on rigid buried conduits and related applications. Expanded polystyrene waste in a granular form is used as lightweight aggregate to produce lightweight structural concrete with the unit weight varying from 1200 to 2000 kg/m³. The polystyrene aggregate concrete was produced by partially replacing coarse aggregate in the reference (normal weight) concrete mixtures with equal volume of the chemically coated crushed polystyrene granules. This paper reports the results of an experimental investigation into the engineering properties, such as compressive strength, modulus of elasticity, drying shrinkage and creep, of polystyrene aggregate concrete varying in density.

Key Words: Beads with 8mm diameter, Air entraining admixture, super plasticizer, compression test, floating test.

1.INTRODUCTION: Lightweight concretes (LWCs) can be used in various construction fields. It can be used for repairing wooden floors of old buildings, carrying walls of low thermal conduction, bridge decks, floating quay, etc. For the first applications, the lightest possible material is used, i.e., usually it has a specific gravity of 0.5, the strength being of less importance. When the aggregate has a modulus higher than that of the matrix, stress concentrations appear in the vicinity of the aggregates. However, when dealing with very lightweight aggregate, like EPS, having a negligible modulus, the two-phase models are in their limit of applicability. Another way is to refer to models based on porosity, assuming that the concrete is described as a matrix containing voids (EPS spheres). The aim of this report is to achieve a mix design for Lightweight EPS Concrete with density lies between the 800-1800kg/m³ and enough high compressive strength so that it can be used in construction purpose.

2.EXPERIMENTAL PROGRAMMING: Test series consisted of 18 cubes of 3 different mixes at 3 different ratios. The dimensions of cube specimens are 150x150x150 respectively. The main parameter of concrete is replacing 100 percent of coarse aggregate. Tests were conducted after curing the specimens for 7and 28 days. Different proportions are consider for different trials.

3. MATERIALS AND MIX DESIGN PRINCILES

Cement: - Ordinary Portland cement of 53 grade conforming to Indian standard codes is used. Specific Gravity of cement is 3.15.

Fly ash: - Fly ash which is obtained from the thermal plants nearby thermal plant from Vijayawada is used in here. Specific Gravity of Fly ash is 2.3.

GGBS: - Ground Granulated Blast Furnace Slag (GGBS), which is obtained from the Iron industries is grounded to fine powder which is finer than cement. Specific Gravity of GGBS is 2.8.

Fine aggregate: - River sand available locally is used, which is free from silt content and waste materials. Specific Gravity of river sand is 2.65.

Super plasticizer: - It is used for reducing the water-cement ratio of concrete. Specific Gravity of super plasticizer is 1.05.

Beads:-The EPS ball of diameter of 8mm size will be taken. Having specific gravity 001804

Air Entraining Admixtures: The air entraining admixture is used for resulting in less bleed and segregation. Specific gravity of air entraining admixture is 1.04.

3.1.TEST TO BE CONUCTED ON CEMENT:

They are several test can be done on cement like fineness, compression test, initial setting and final setting time of cement, standard consistency of cement ,specific gravity of cement ,soundness test, this test can give the quality of cement

Test	Is code book	Result
Standard consistency	Is-4031-part-4	5mm at 30% of water content
Initial & final setting time of cement	Is-4031-part-5	110min&24hr
Specific gravity of cement	Is-4031-part-11	1.458
Fineness of cement	Is-4031-part-1	3%
Compression test	Is-4031-part-6	53for 28 days
Soundness test	Is-4031-part-2	10mm

3.2 TEST TO BE CONUCTED ON FLY ASH: Some test can be conducted on fly ash the required given below

Test	Is -3812	Results
Fineness test	320(using 45microns sieve)	350
Compression test	34	35
Lime reactivity	4.5	4.7
Compression test	Not less than 80% of pc mortar	50%
Soundness test	0.8	0.9
Specific gravity	2-2.3	2.2

3.3TEST TO BE CONDUCTED ON GROUND GRANULATED BLAST FURNACE (GGBS): The test can be done on ggbs is given below

Test	**Bs-6699**	**Test results**
Fineness	275(min)	384
Initial setting time	Not less than OPC	195
Moisture content	1(max)	0.03
Glass content	67(min)	95.35
7-days	12(min)	24.74
28-days	32.5(min)	53
Specific gravity		2.85

3.4 TEST TPO BE CONDUCTED ON FINE AGGREGATE: Test to be performed on fine aggregate are presented below

Si:No	**Test**	**Code book**	**Required results**
1	Sieve analysis	Is-383	Zone II
2	Bulk density	Is-2386-part-3	1588kg/m^3
3	Specific gravity	Is-2386-part-3	2.66
4	Moisture content test	ASTM c70-13	5%
5	Silt content test	Is-383	3%
6	Fine modulus	Is-383	Coarse sand

3.5 TEST TO BE CONDUCTED ON CRUSHED SAND: Test to be performed on crushed sand are presented below

SI:No	**Test**	**Code book**	**Required results**
1	Bulk density of crushed sand	Is-2386-part-3	1580.6kg/m^3
2	Silt test of crushed sand	Is-383	2%
3	Moisture content test	ASTM-c70-13	3%
4	Specific gravity test	Is-2386-part-3s	2.65
5	Fine modulus test	Is 383	Medium crusher sand

4. MIX PROORTIONS ARE CAN BE EXLAINED BELOW:

Cement	Fly ash	GGBS	Plasticizer	A.E.A	Beads	water	sand	w/c	Density(kg/m^3)
200	150	100	2.25	3.6	6.0	180	557.15	0.4	1199.7
370	150	-	3.12	4.16	7.0	182	685	0.35	1401.28
250	150	-	2.0	3.0	6.0	168	421	0.42	1000

5.MIXING: The steel moulds of 150x150x150 mm were oiled properly before filling mortar. The mortar was filled into the moulds in three layers with hand compaction after adding each successive layer. After filling the molds completely with the mortar, a needle vibrate was used to remove air voids from the mortar. It is to be kept in mind that needle vibrator is used just for few seconds to avoid segregation and floating of EPS balls to surface. After the compaction has been completed, the excess mortar was removed from the moulds with the help of trowel and the surface was leveled. After a setting time of 24 h, concrete samples were remolded and were taken for curing.

6. CURING: Accelerated Curing was done by covering blocks with mould and keeping them in warm water at 60º Celsius in a water boiler. The temperature was maintained for 24 hours and the moulds were taken out of boiler. Cubes were remolded and were kept untouched for 2 hours. Then again the cubes were kept for curing in water under room temperature.

7. COMPRESSION TEST RESULTS:

Compression test for 7-days results are expressed below

Si:No	Days of curing	Density of cube(kg/m^3)	Compression strength (N/mm^2)
1	7-days	1199.7	2
2	7-days	1401.28	4
3	7-days	1000	3

Compression test for 28-days results are expressed below

Si:No	Days of curing	Density of cube(kg/m^3)	Compression strength (N/mm^2)
1	28-days	1199.7	6
2	28-days	1401.28	8
3	28-days	1000	7

8. CONCLUSION:

1. All the EPS concrete without any special bonding agent show good workability and could easily be compacted and finished.
2. The replacement by using EPS has shown a positive application as an alternate material in building nonstructural members, and it also serves as a solution for EPS disposal.
3. Obtained results suggest that expanded polystyrene concrete has scope for nonstructural applications, like wall panels, partition walls, etc.

9.REFERENCES:

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