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Experimental Investigation Of Expanded Polystyrene Beads With Partial Replacement In Concrete

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ABSTRACT

Concrete is the most important ingredient in the construction field. The increases quest for sustainable and ecofriendly materials in the construction industry has led to research on partial replacement of the conventional constituents of concrete by selected waste materials. In our project work is using Expanded Polystyrene (EPS), It is a non-biodegradable waste material which is coming from packaging industry. Concrete has to be designed based on density factor to accomplish reduction of the concrete self-weight with is ranging from 2000kg/m^3 to 990kg/m^3. Substituting partially or completely the coarse part of low weight aggregate (EPS Beads) with normal aggregates produces lightweight concrete that can achieve a reliable decent compressive strength. Substitution of various percentages of eps beads according to desirable design details for different proportion. Various tests was conducted for fresh and harden concrete to know physical and mechanical properties of concrete at age of 7, 14 and 28days. The outcome indicates that increasing the quantity of EPS beads there will be decreasing strength of concrete with reduction in density.

Keywords: Fibers, Synthetic, Banana and Behaviour.

1. INTRODUCTION

With the greater requirement for construction materials. For sustainable improvement there should essential to use alternative materials. Concrete is most flexible material for construction of building. In basic structural applications, the structure self-weight is quite important it shows a maximum portion of the load details. Substituting partially or completely the coarse part of low weight aggregate with normal aggregates produces lightweight concrete that can achieve a Reliable decent compressive strength. With the Industrial advancement and mass construction in different parts of the world, the pollution contamination levels and shortage of construction materials have reached the highest level. In the present day construction, it is utilized as a base or sub level aggregate in floor materials and in addition washrooms in structures and asphalt construction. The lightweight concrete having greater demand in present day development applications, for example, offshore structures, tall buildings and long spans bridges. This intrigue rises from the simplify size of maximum load bearing components, and the better thermal properties of lightweight analyzed than normal concrete. Lightweight concrete can be acquired by inserting air or foam into the cement paste or by completely or partially replacing the coarse aggregate with low-weight and especially minimal cost of the element. Lightweight aggregates are extensively characterized into two types: Natural (e.g., diatomite, pumice and volcanic ash) and Artificial (e.g., perlite, mud, sintered fly fiery debris and expanded shale). Expanded Polystyrene beads are a generally utilized as aggregates and can be effectively joined into concrete or mortar to make light-weight concrete with a extensive variety of densities.

2. METHODOLOGY

Figure 1 shows the methodology of the study.

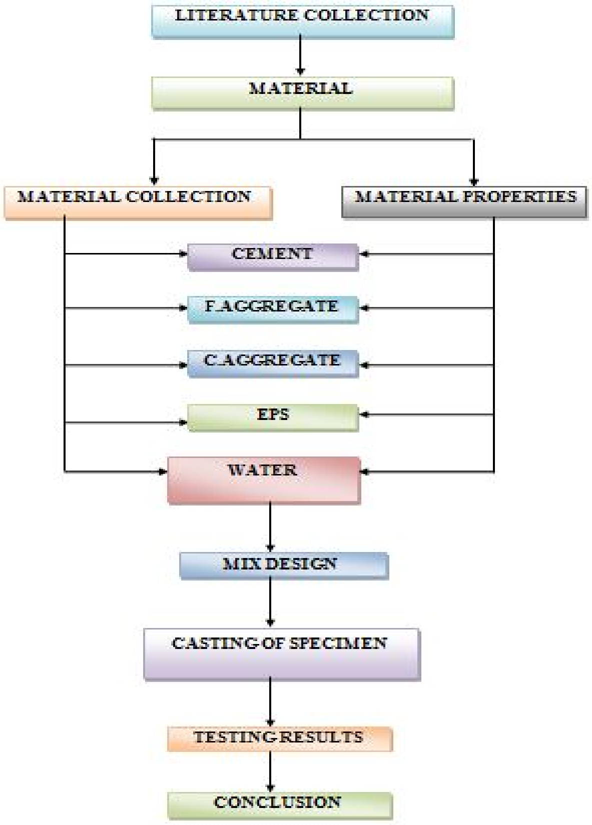

Figure 1 Methodology

3. MATERIAL COLLECTION

3.1 Cement

This type of cement gives enough comprehensive strength after soaking in water for 3 days, 7days and 28 days. This is suitable for all types of modern civil engineering constructions. The Ordinary Portland Cement is popularly known as grey cement, which is produced by grinding clinker with 5 per cent gypsum. It is used in all general concrete construction, mass and reinforced concrete. Table 1 shows the Properties of cement.

Table 1: Properties of cement

S.NO	Description of test	Test results obtained	Requirements of IS: 8112 1989
1	Initial setting time	65 minutes	Min. 30minutes
2	Final setting time	270 minutes	Max. 600minutes
3	Fineness (specific surface by Blaine's air permeability test)	412.92 m^2/kg	Min. 225 m^2/kg

3.2 Fine Aggregate

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; a soil containing more than 85 percent sand-sized particles by mass. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO2), usually in the form of quartz. Table 2 shows the physical properties of fine aggregates.

Table 2: Physical Properties of fine Aggregate

S.No.	Description of materials	Properties
1	Specific gravity	2.8
2	Fineness modulus	4.44
3	Loose bulk density kg/m³	2500
4	Compacted bulk density kg/m³	2890
5	Water absorption %	0.46

3.3 Course Aggregate

Coarse aggregate is mined from rock quarries or dredged from river beds, therefore the size, shape, hardness, texture and many other properties can vary greatly based on location. Even materials coming from the same quarry or pit and type of stone can vary greatly. Table 3 shows the Physical properties of coarse aggregate.

Table 3: Physical properties of coarse aggregate

S.No.	Description of materials	Properties
1	Specific gravity	2.69
2	Fineness modulus	7.950
3	Loose bulk density kg/m³	1290
4	Compacted bulk density kg/m³	1584
5	Water absorption %	1.343

3.4 Water

Water used for mixing and curing shall be clean and free from injurious amounts of Oils, Acids, Alkalis, Salts, Sugar, Organic materials Potable water is generally considered satisfactory for mixing concrete Mixing and curing with sea water shall not be permitted. The pH value shall not be less than 6.

- Role of Water in Cement Concrete
- Requirements of water used in concrete
- The permissible limits for solids in water
- Solids Permissible Limits (Max)
- Organic 200 mg/lit
- Inorganic 3000 mg/lit
- Sulphates (SO4) 500 mg/lit
- Chlorides (Cl) 500 mg/lit

3.5 Expanded Polystrene Beads

Table 4 shows the properties of Expanded polystyrene beads.

Table 4: Properties of Expanded polystyrene beads

S.No	Property	Average value
1	**Density**	**13kg/m3**
2	**Compressive strength**	**0.09MPa**
3	**flexural strength**	**0.21MPa**

4	**Water absorption**	**4%by volume**

4. MIX DESIGN

Table 5 shows the Mix Design of the study.

Table 5: Mix Design

Cement (kg)	FA (kg)	CA (kg)	Water (liter)
358.69	582.41	1305.48	165

5. TEST PROCEDURE

5.1 Slump Test

Concrete slump test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. Generally concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value. Figure 2 shows the slump cone test.

Figure 2 Slump Cone Test

Table 6 shows the slump test graph.

Table 6: Slump test graph

Degree of workability	**Slump in (mm)**	**concrete is suitable**
Medium	85	Medium workability mixes

5.2 Compressive Strength Test

When a specimen of material is loaded in such a way that it extends it is said to be in tension. On the other hand if the material compresses and shortens it is said to be in compression. On an atomic level, the molecules or atoms are forced apart when in tension whereas in compression they are forced together. Since atoms in solids always try to find an equilibrium position, and distance between other atoms, forces arise throughout the entire material which oppose both tension and compression. Figure 3 shows the compression test.

Figure 3 Compression Test

Table 7 shows the compressive strength test results.

Table 7: Compressive strength test results

Mix Design	% Of Replacement	Avg. Compressive Strength(N/mm^2)		
		7days	14 Days	28days
M_{30}	0	19.50	24.2	29.2
	2	22.4	28.50	30.4

Figure 4 shows the compressive strength of graph result.

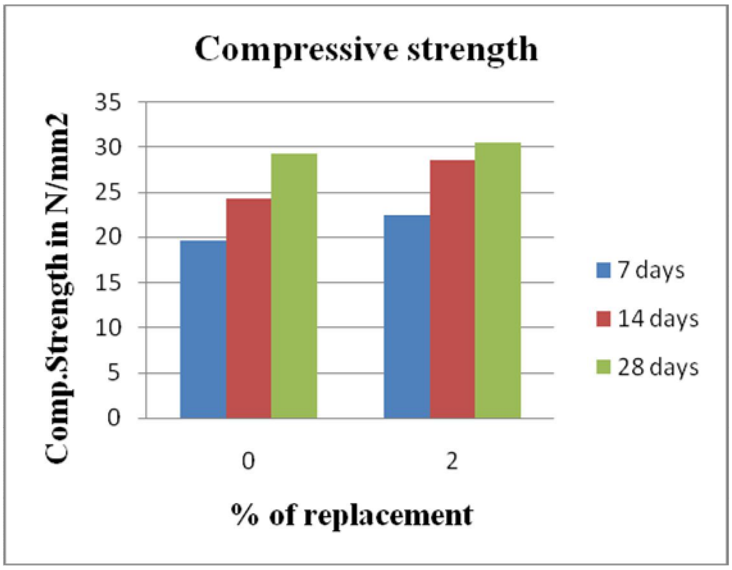

Figure 4 Compressive strength of graph result

5.3 Flexural Strength Test

During the testing, the beam specimens of size 750 mmx150mmx150mm were used. Specimens were dried in open air after 7 days of curing and subjected to flexural strength test under flexural testing assembly. Apply the load at a rate that constantly increases the maximum stress until rupture occurs. Figure 5 shows the Flexural strength test.

Figure 5 Flexural Strength Test

Table 8 shows the Flexural strength test results.

Table 8: Flexural strength test results.

Mix Design	% Of Replacement	Average flexural Strength (N/mm^2)		
		7 Days	14 Days	28 Days
M_{30}	0	3.3	4.10	5.62
	2	4.03	5.13	5.75

Figure 6 shows the Flexural strength of graph results.

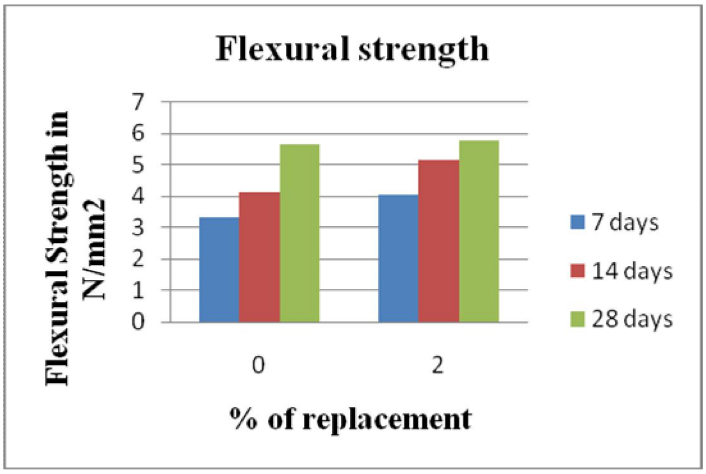

Figure 6 Flexural strength of graph result

6.4 Water Absorption Test

One of the most important properties of a good quality concrete is low permeability, especially one resistant to freezing and thawing. A concrete with low permeability resists ingress of water and is not as susceptible to freezing and thawing. Water enters pores in the cement paste and even in the aggregate. The permeability of concrete is a measure of the rate at which a liquid pass through it. The permeability of concrete depends upon its pore network, which arises from the excess water used during mixing and during initial hardening process. Table 9 shows the water absorption test.

Table 9: Water absorption test

Trail mix	Dry weight (W1) in Kg	Wet weight (W2) in Kg	% of water absorption
CC	8.05	8.24	2.36
M_1	7.10	7.25	2.11
M_2	7.05	7.32	3.82
M_3	7.18	7.38	2.78

7. CONCLUSIONS

The dead weight of structure is decreasing by replacing the polystyrene we can achieve light weight concrete. It is noticed that density will be decreases with compromising strength factor. As the percentage of replacing of polystyrene increasing strength also considerably increasing compare to normal concrete. Workability of the concrete is lesser than the normal mix. In addition of partial replacement by EPS beads can be produced with a less water/cement ratio than required workability. The compressive strength of the expanded polystyrene beads concrete increases with decrease in the replacements levels of the expanded polystyrene beads Polystyrene can replace up to 2%. However it is seen that as the percentage replacement which shows that EPS based concrete has better water absorption as compared to the conventional concrete.

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