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# MECHANICAL PROPERTIES OF FLOATING CONCRETE BY USING EXPANDED POLYSTYRENE BEADS AS REPLACEMENT OF AGGREGATES

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**Abstract -** *Floating concrete is a special concrete which float on the water surface. Expanded Polystyrene (EPS) is a lightweight material that has been used in engineering application since 1950s. EPS is used as lightweight weight aggregate to produce lightweight concrete with unit weight less than 1000 kg/m³ which make it as Floatable concrete. Coarse aggregate is a major contributor for heavy weight of concrete as replacing it with EPS Beads result in the reduction of the density of concrete. EPS has good thermal insulation properties with stiffness and compression comparable to medium aggregates. The main objective of this experimental investigation is to make the Floating concrete in the form of 'Concrete Boat' and checking its Floatability and also should have the required strength.*

***Key Words***: Expanded Polystyrene (EPS), EPS Beads, Floating Concrete

## 1. INTRODUCTION

This Project investigates the properties of the Floating concrete by using a EPS Beads. In this technique the EPS Beads are used for preparation of the Floating concrete and density is reduced to attain the maximum efficiency, whereas the self weight of the structure is minimized thereby reducing the dead load on structure. Expanded Polystyrene (EPS) is one of the most widely used plastics, the scale being several billion kilograms per year. The polystyrene foam is a thermoplastic material obtained by polymerization of styrene. The use of expanded polystyrene in construction has lot of advantages compare with the use of conventional materials which results in sustainable future. The use of EPS Beads also reduces the environmental hazards that causes during its disposal. Most of this kind of waste is late unnoticed and they will lead to global warming.

**Fig -1**: Floating Concrete

The aim of this report is to achieve mix design for floating concrete with density lesser than 1000 kg/m³ and performing experimental approach by making the concrete as a Floating concrete model.

## 2. MATERIALS

### A. Cement

The cement used was Ordinary Portland cement of 53 grade, Ambuja Cement. Conforming to IS 12269.

### B. Fine Aggregate

Fine Aggregate used for the project work was River sand should be taken as per the ASTM standard. It should be clean, strong and hard and free of organic impurity. Specific gravity of fine aggregate was 2.74. It confirming to grading zone II with Particles in between 4.75 mm and 150 µm.

### C. Expanded Polystyrene (EPS)

Expanded Polystyrene (EPS) used in the project was in the form of 'EPS Beads' which is spherical in shape with size varying in between 4 mm to 6 mm in diameter. It is made up of pre-extended Polystyrene globules. It offers a non hydroscopic and does not readily absorb moisture from the atmosphere.

**Table -1:** Properties of Expanded Polystyrene

| Sr.No. | Specification | Values |
|---|---|---|
| 1 | Size | 4 mm to 6 mm |
| 2 | Density | 18 kg/m³ |
| 3 | Melting ranges | 100-180 ºC |
| 4 | Moisture absorption | Low |
| 5 | Thermal Conductivity | Low |

**Fig -2**: EPS Beads

### D. Other Material

i. **Admixture :-** Water Proofing Solution as a Dr Fixit

ii. **Mesh :-** Chicken Mesh made of steel was used for giving the Tensile strength and bonding to the floating concrete specially in the concrete boat

## 3. MIX DESIGN

The Mix Proportion for conventional concrete arrived as per IS 10262-2009. This Mix proportion of conventional concrete was taken as reference to the Floating Concrete by making replacement to aggregate by EPS Beads.

Specific gravity of cement: 3.15

Specific gravity of fine aggregate: 2.74

Bulk density of EPS Beads: 18 kg/m$^3$

For the floating concrete we are replacing 100% coarse aggregate and 25% Fine aggregate by EPS Beads ( To finalize the percentage replacement for Fine aggregate we test density of the various cube by varying percentage replacement )

**Mix Proportion :-**

**Table -2:** Mix Design of Floating concrete

| | |
|---|---|
| w/c | 0.5 |
| Cement | 280kg/m$^3$ |
| Fine Aggregate | 693.22 kg/m$^3$ |
| Water | 140 kg/m$^3$ |
| EPS Beads | 9.216 kg/m$^3$ |
| Water Proofing Solution | 250 ml for 50 kg cement |

## 4. PROCEDURE

### 4.1 Mould Preparation

For the preparation of the mould we firstly fix the shape with suitable size by referring various boat design, then by taking ply wood we marked the dimension and according to this we cut the ply wood. Then by using nails we make the mould frame in required shape.

### 4.2 Reinforcement Placing

The chicken mesh which is used for the reinforcement purpose is placed and fixed over the inner mould in accordance to the shape of Concrete Boat. To maintain the distance between surface of mould and mesh the cover made up by same concrete material were used.

**Fig -3**: Reinforcement Placing

### 4.3 Batching and Mixing

Weight Batching was practiced with. Batching was done as per the mix proportion. The mixing was done manually. First the cement and sand was mixed and then this was mixed by half the water content in addition with Dr Fixit then the EPS Beads were added along with remaining water content to make uniform mix.

### 4.4 Placing And Compacting

Before the placing the concrete mould was cleaned and oiled to prevent the formation of bond between concrete and mould. The fresh concrete filled into the mould of boat in three layer uniformly with hand compaction, sufficient blows were given after adding each successive layer. In case of concrete with EPS Beads Vibration makes segregation that's why more preference is given to hand compaction method. After the compaction has been completed, the excess concrete was removed from the mould with the help of trowel and the surface was leveled.

**Fig -4**: Showing Placing and Compaction of Concrete

### 4.5 Demoulding And Curing

After Placing Fresh Concrete in Mould, it was allowed to set for 24 hours. Concrete Boat model was demoulded. The Concrete cubes and cylinders were cured by keeping in curing tank.

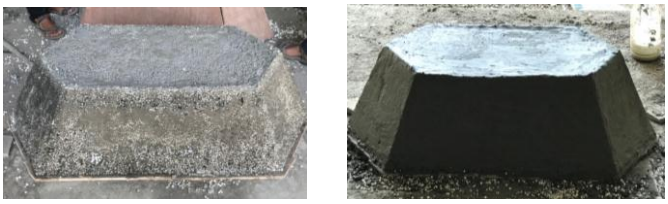
Curing for Boat model was done in two stages at initial stage wet gunny bags are used for curing purpose and after two to three days the inner portion of boat was filled by water for the curing purpose.

**Fig -5**: Demoulding

**Fig -6**: Curing

### 4.6 Finishing

To overcome the rough surface problem of harden concrete by EPS Beads proper finishing was provided by using cement paste. Such finishing improves the appearance and reduces the leakages in the boat.



(Before) (After)

**Fig -7**: Finishing

## 5. TESTING ON CONCRETE AND RESULTS

### 5.1 Density Test

Our investigation aim is to make concrete floatable for that it is necessary to check the density of concrete. For the test three cubes was casted and their weight is calculated, by dividing this weight by volume we get density.

**Table -3:** Density Test Result

| Sr. No. | Weight (kg) | Size of Block | Density (kg/m³) | Average Density |
|---|---|---|---|---|
| 1 | 1856 | 0.15x 0.15x 0.15 m | 562.00 | |
| 2 | 1870 | 0.15x 0.15x 0.15 m | 566.67 | 566.22 |
| 3 | 1881 | 0.15x 0.15x 0.15 m | 570.00 | kg/m³ |

### 5.2 Compressive Strength Test

A compressive strength test was performed and results were obtained as per the given table.

**Table -4:** Compressive Strength Test Result

| Average Compressive Strength (N/mm²) of 3 specimen for 3 Days | Average Compressive Strength (N/mm²) of 3 specimen for 7 Days | Average Compressive Strength (N/mm²) of 3 specimen for 28 Days |
|---|---|---|
| 1.68 | 2.94 | 4.2 |

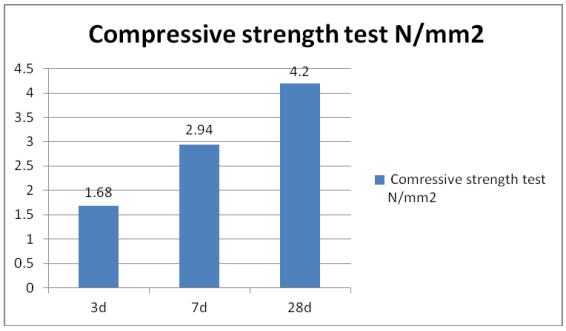



**Chart -1**: Compressive Strength Test Result

**Fig -8**: Compressive Strength Test

### 5.3 Split Tensile Strength Test

A Split Tensile strength test was performed and results were obtained as per the given table.

**Table -5:** Split Tensile Strength Test Result

| Average Split Tensile Strength (N/mm²) of 3 specimen for 3 Days | Average Split Tensile Strength (N/mm²) of 3 specimen for 7 Days | Average Split Tensile Strength (N/mm²) of 3 specimen for 28 Days |
|---|---|---|
| 0.52 | 0.91 | 1.3 |

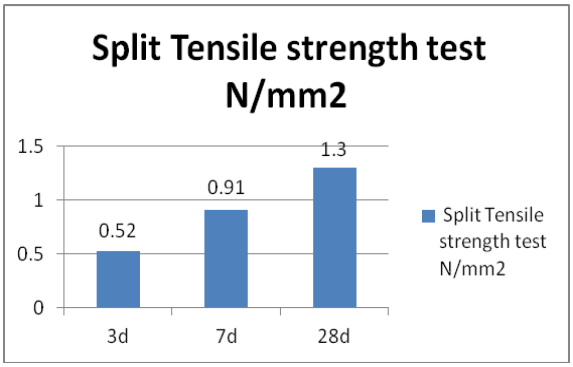



**Chart -2**: Split Tensile Strength Test Result