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AN EXPERIMENTAL STUDY OF FLOATING CONCRETE

[1] Vinayak T. Hulwane, [2] Vivek S. Patil, [3] Vedant M. Patil, [4] Jyotiraditya P. Shekhar, [5] Atharv P. Thorat,

[6] Harshwardhan H. Kavthekar

[(1)]Professor, Department of Civil Engineering.

[(2,3,4,5,6)]Diploma Student, Department of Civil Engineering.

Rajarambapu Institute of Technology Rajaramnagar, India.

Abstract: Floating concrete is a distinct type of concrete with a density below 1000 kg/m³, making it suitable for various applications due to its low density and moderate compressive strength. Currently, extensive research is underway to enhance the quality and compressive strength of floating concrete. It is characterized by a density lower than that of water, allowing it to float on water. Various methods, such as incorporating lightweight aggregates or air-entraining admixtures, enable the creation of lightweight concrete capable of floating. Coconut coir has been identified as a beneficial addition to concrete, improving crack resistance, durability, flexural strength, cohesion, and reducing water absorption. Traditional aggregates are replaced with lightweight alternatives, reducing the overall weight of the concrete while maintaining its structural integrity. The objective of projects focusing on floating concrete is to enhance permeability while reducing weight. Expanded Polystyrene (EPS) beads, a lightweight material commonly used in construction since the 1950s, are utilized in this work to decrease the weight of floating concrete.

Index Terms - Density, EPS beads, Lightweight Aggregate, Coconut coir

I. INTRODUCTION

Floating concrete is a unique or special type of concrete that floats on water. The concrete which has density is less than 1000 kg/m3 is known as floating concrete. For the design of floating concrete, we need a lightweight material, which makes the concrete lighter as compared to conventional concrete. For this purpose, we use cement, fly ash, EPS beads, coconut coir, etc. With a proper combination of cement, fly ash, EPS beads, lightweight aggregates, and coconut coir, floating concrete offers enhanced buoyancy, durability, and environmental sustainability. The manufacturing process of floating concrete involves carefully blending these materials in specific proportions to achieve good characteristics, considering factors like strength, durability, and float during the curing stages is important.

By use of these materials, we can make the floating concrete. Floating concrete is important for innovative construction. It allows making the infrastructures into the aquatic environment. These types of concrete shall be used for the construction of floating docks, pontoons, floating homes, bridges, etc. The floating concrete opens up new opportunities for the development of infrastructures in coastal areas, riverbanks, etc. The floating is more resilient to natural disasters such as floods, storms, and earthquakes. As the cost of floating concrete is less it should be used by the common persons. Floating concrete is massively useful for massive construction. In the 20th century, engineers started to make floating concrete by adding the lightweight aggregate and air entrainment admixtures. After the World War 2, the floating concrete is popularly used for

offshore oil and gas exploration. In recent decades, it has been used for floating solar farms, floating homes, etc

II. OBJECTIVES

- To increase waterproofing property of floating concrete.
- To check the compressive strength of floating concrete by adding artificial sand.
- To compare cost of floating concrete with conventional concrete.

III. MATERIAL COLLECTION

A.CEMENT-

It is a binding material used in construction to bind the other materials together. It is generally made from limestone, clay, shale, and other raw materials heated at high temperatures in a rotary kiln. There are different types of cement, such as Portland cement, which is the most popular type used in construction. The chemical reaction in between cement and water, we known as hydration process, it creates a strong, cohesive paste that binds all material together and forms a strong solid.

B.FLY ASH-

The use of fly ash in concrete to making enhances workability and makes it easy to place and finish. Fly ash helps to reduce the heat generated during the hydration process of concrete, which is especially advantageous where the mass concreting work is done, such as dams and foundations.

C.EPS beads-

EPS beads can be mixed with cement, sand, and water to make lightweight concrete. By use of this, the density and dead load of structures is reduced. It helps to improve thermal insulation and is easy to handle during construction work. **C.1. Role EPS beads in floating concrete-**

Expanded Polystyrene (EPS) beads are commonly used in floating concrete. It helps to reduce its density and makes it capable of floating on water. When EPS beads are mixed with concrete, they disperse throughout the mixture and create air voids so that a decrease in the overall density of the concrete is possible. EPS beads are also helpful to reduce the insulation property of the concrete. It provides thermal resistance. It also helps to increase the waterproofing property in floating concrete. It reduces the cost of floating concrete.

D.Artificial sand-

It is a particles passed by 4.755 mm IS standard sieve and retains on the pan. It is helps to increase the strength of concrete.

E.Lightweight aggregate-

We use the AAC block aggregate as Lightweight aggregates. It is helpful to reduce the overall weight and density of concrete. The lightweight aggregates increase the strength of concrete.

E.1. Role of the light-weight aggregate in floating concrete-

Lightweight aggregates are light in weight as compared to regular aggregates. We use the AAC (Autoclaved Aerated Concrete) block aggregate in floating concrete. AAC blocks are light in weight. They have excellent thermal insulation properties. They are made by a mixture of sand, cement, lime, and water, with aluminum powder added to create air bubbles or air voids during the curing process. The use of AAC block aggregate helps us to reduce the overall weight and the density of the floating concrete making it more suitable for its floating applications. It increases the strength of floating concrete.

F.Coconut coir –

Coconut coir is helpful to reduce the cracks and increase the strength of concrete.

F.1. Role of the Coconut coir in floating concrete-

Coconut coir is used in floating concrete as crack resistant. By use of this material, the chances of honeycombing are reduced. It helps to increase the bonding in concrete. Its primary role is to provide

reinforcement and enhance the structural properties of the concrete. Coconut coir has natural moistureresistant properties. This can help to enhance the durability of floating concrete structures. By reducing water absorption and preventing the effects of moisture. Coconut coir also helps to increase the strength of concrete.

IV. TESTING

A.IMPERMEABILITY TEST-

PROCEDURE-

1. Take concrete cube sample of size 150mm x 150mm x 150mm.
2. Place the cube samples which are completed the curing period and dried.
3. Sample top surface should be roughened by wire brush.
4. Now tight the all bolts with the help of suitable equipment.
5. Open the bottom valve to release water if any.
6. Unscrew the top water column cap, fill the water upto top of column.
7. Now close the bottom valve.
8. Now open the water column bottom bar.
9. Now start the air compressor and open the pressure gauge valve. Adjust the pressure with the help of knob.
10. 1st day pressure 1 kg/cm2. 2nd day pressure 3 kg/cm2. 3rd day pressure 5 kg/cm2.
11. After 3 days remove the cube samples from the apparatus.
12. Clean the top surface of cube samples.
13. Now place the samples at compressive test apparatus, place the 10 or 12 mm dia bar at top of the sample and apply the force.
14. After the cubes are converted into parts, observe the depth of water penetrated in cube samples.
15. Calculate the depth of water penetrated in each sample.

B.Compressive strength- Procedure-

1. Prepare a sample of concrete mix and cast cubes of 15 cm x 15 cm x 15 cm.
2. The concrete is filled into molds in 3 layers, each layer gives 25 times blows with the help of tamping rod. After top layer take the surface smooth finish with the help of float.
3. Place the cube samples as it is for 24 hours. Remove the cubes from the mold and take it for curing. As the curing period.
4. After the complete curing period the samples remove from water. Take test after samples dried.
5. Remove all the loose material from samples.
6. Place the cube samples in apparatus. Apply the load slowly.
7. Note the maximum load carried by each sample.
8. Calculate the average compressive strength of concrete.

V. PREPARATION AND TESTING

A.Conventional concrete- m20 grade

For our experiment, we are going to make the 3 blocks of (15 X 15 X 15) cm by normal concrete with grade M20.

Table 1 Quantities required for 3 blocks of conventional concrete

Sr.No	Material	Quantity	Unit
1	Cement	4	Kg
2	Sand	6	Kg
3	Aggregate	12	Kg
4	Water	2	Liter

Figure 1 conventional concrete blocks

Table 2 Death of water penetrated in conventional concrete

Sr.No	Sample	Depth of penetration
1	Conventional Concrete	65 mm

Table 3 Compressive strength of conventional concrete

Sample	Compressive strength (N/mm2)	Average (N/mm2)
1	21.8	22.235
2	22.67	

Table 4 Density of conventional concrete

Sample	Weight (gm)	Density (kg / m3)
1	8750	2592.59
2	8733	2587.55
3	8237	2440.59

Observation - As per the M20 grade we achieved good strength after the curing period.

B.Floating concrete-

B.1.Trial sample no 1-

We study the different research papers to find out the proportion to make the floating concrete. In that we sort the paper whose shall give us the best results. We select the good proportion for start to make the floating concrete, and first of all we make the trial sample of floating concrete. For this purpose we required the following materials for 1 block of (15X15X15)cm.

Table 5 Quantities required for 1 trial block of floating concrete

Sr.No	Material	Quantity	Unit
1	Cement	1.7	Kg
2	Fly ash	750	Gm
3	EPS	50	Gm
4	Water	750	Ml

Figure 2 Floating concrete block sample 1

Table 6 Density of Trial sample no 1

Sr.No	Sample	Weight (gm)	Density (kg / m3)
1	Trial block	2255	668.148

Table 7 Compressive strength of Trial sample no 1

Sr.No	Sample	Compressive strength (N/mm2)
1	Trial block	0

Observation

By this proportion the cube is float on water. It float easily but it has zero strength.

Conclusion:

To get strength we have to add materials which increase the strength of Floating concrete. For next trail we decided to make three samples of floating concrete by using coconut coir, binding wire, light wt. agg.

B.2.Trial sample no 2-

By changing adding the material we make the new proportions for the floating concrete. To achieve the strength we was changed our proportion.

Table 8 Quantities required for trial sample no 2 of floating concrete

Sample Io 1		Sample No 2		Sample No 3	
Material	Quantity	Material	Quantity	Material	Quantity
Cement	1.7 Kg	Cement	1.7 Kg	Cement	1.7 Kg
EPS	50 Gm	EPS	50 Gm	EPS	50 Gm
Fly ash	750 Gm	Fly ash	750 Gm	Fly ash	750 Gm
Water	800 Ml	Water	800 Ml	Water	800 Ml
Light weight aggregate	500 Gm	Binding wire	250 Gm	Coconut coir	200 Gm

Figure 3 Floating concrete block sample 2

Table 9 Density of Trial sample no 2

Sr.No	Sample	Weight (gm)	Density (kg / m3)
1	Coconut coir	3270	968.88
2	Light weight aggregate	3575	1059.25
3	Binding wire	3275	970.37

Table 10 Compressive strength of Trial sample no 2

Sr.No	Sample	Compressive strength (N/mm2)
1	Coconut coir	2.8
2	Light weight aggregate	3.05
3	Binding wire	1.2

Observation:

Cube of Coconut coir: It float but honeycombing is occurred.
Light wt. agg: It not float due to increase in density.
Binding wire: It has huge honeycombing than other materials.

Conclusion:

By using this material we get the strength but honeycombing is occurred.

Max strength obtained by coconut coir and light wt. agg. So we decided to use coconut coir and light wt. agg.

Also use coconut coir and binding wire by cutting in short length fiber form.

B.3.Trial sample no 3-

Table 11 Quantities required for trial sample no 3 of floating concrete

Sample No 1		Sample No 2		Sample No 3	
Material	Quantity	Material	Quantity	Material	Quantity
Cement	1.7 Kg	Cement	1.7 Kg	Cement	1.7 Kg
EPS	50 Gm	EPS	50 Gm	EPS	50 Gm
Fly ash	500 Gm	Fly ash	500 Gm	Fly ash	500 Gm
Water	800 Ml	Water	800 Ml	Water	800 Ml
Light weight aggregate	500 Gm	Binding wire	250 Gm	Coconut coir	50 Gm

Table 12 Density of Trial sample no 3

Sr.No	Sample	Weight (gm)	Density (kg / m3)
1	Coconut coir	3090	915.55
2	Light weight aggregate	3115	922.96
3	Binding wire	3165	937.77

Table 13 Compressive strength of Trial sample no 3

Sr.No	Sample	Compressive strength (N/mm2)
1	Coconut coir	6.10
2	Light weight aggregate	5.23
3	Binding wire	4.36

Observation:

Strength of coconut coir and light wt. agg. is max improved. Also it float.

Conclusion:

By using coconut coir and light wt. agg. strength of block increased. Also by cutting in short length fiber reduce honeycombing.

We decided to make block by using light wt. agg. and coconut coir at a same time.

B.4.Trial sample no 4-

Now we are prepare the new proportion based on the previous proportion. We cast the samples use of new proportion for (15X15X15)cm block.

For 1 block of standard size,

Table 14 Quantities required for trial sample no 4 of floating concrete

Sr.No	Material	Quantity	Unit
1	Cement	1.7	Kg
2	Fly ash	250	Gm
3	EPS	50	Gm
4	Artificial sand	250	Gm
5	Coconut coir	50	Gm
6	Water	750	Ml

Table 15 Density of Trial sample no 4

Sample	Weight (gm)	Density (kg / m3)	Average (kg / m3)
1	2865	848.88	
2	3000	888.88	
3	2890	856.29	864.68

Table 16 Impermeability Test on floating concrete

Sr. No	Sample	Depth of penetration
1	Floating Concrete	54 mm

Table 17 Compressive strength of Trial sample no 4

Sample	Compressive strength (N/mm2)	Average (N/mm2)
1	11.33	11.115
2	10.9	

Observation:

Strength of block increased. Also it float.

Conclusion:

By using coconut coir and light wt. agg. strength of block increased. Impermeability of concrete is also reduced than conventional concrete. Two objectives of works are achieved upto this point.

Figure 4 Impermeability Test on floating concrete

C. Cost comparison- C.1.Cost of floating concrete-

Table 18 Cost of Trial sample no 4

Material name	Cost Rs	Total cost Rs
Cement	38.8	46.97
Fly ash	1.42	
EPS	1	
Fine aggregate	3.75	
Coconut coir	1	
Light Weight Agg.	1	

Add 2% labour charges – 0.939 Rs
Add 10% contractor profit – 4.69 Rs
Grand total cost 52.59 Rs
Cost of 1 block – 17.53 Rs
Cost of 1 m3 floating concrete – 5188 Rs

C.2.Cost of conventional concrete-

Table 19 Cost of conventional concrete block

Material name	Cost Rs	Total cost Rs
Cement	30	49
Sand	10	
Aggregate	7	

Add 2% labour charges – 0.98 Rs

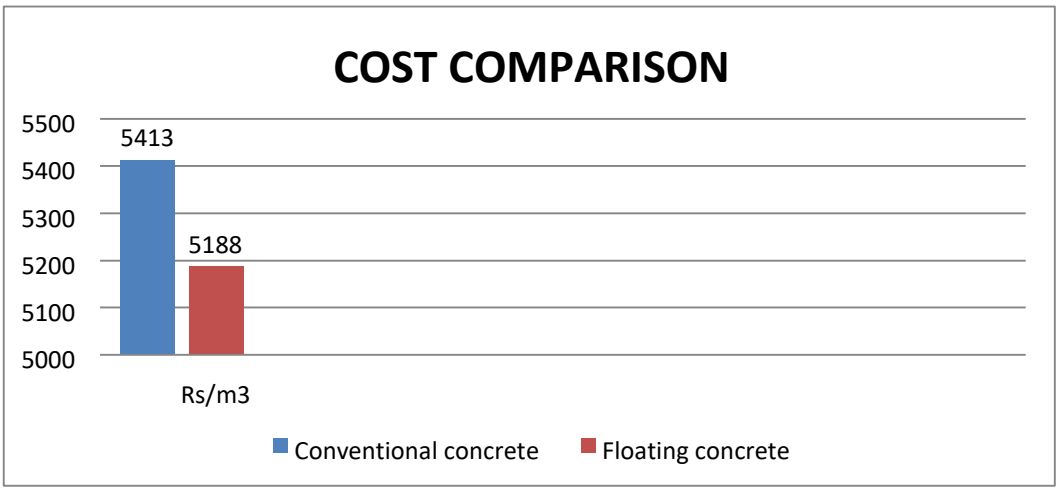
Add 10% contractor profit – 4.9 Rs

Grand total cost 54.88 Rs

Cost of 1 block – 18.29 Rs

Cost of 1 m3 floating concrete – 5413 Rs

Graph 1 Cost comparison



VI. CONCLUSION

From this project we can conclude that….

1. Coconut coir increase strength of floating concrete.
2. EPS beads reduce density of block.
3. Waterproofing properties increased by using coconut coir.
4. Artificial sand increase strength of floating concrete. 5. As coconut coir and EPS reduces the cost of concrete.

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