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AN EXPERIMENTAL STUDY ON FLOATING CONCRETE USING SOAP SOLUTION, PLYWOOD DUST & THERMOCOL

Atharva Patil[1], SajidAhmad Mulani[2], Mithun Kokare[3], Rahul Kumbhar[4]

[2-4]UG Students, Dept. of Civil Engineering, PVPIT Budhgaon, Maharashtra, India.

Abstract - Floating concrete is a peculiar type of newfangled concrete which has less density than water(<1000kg/m3), suitable for building floating concrete structures, thereby reducing the saturation of concrete jungles on Land. It has low density and moderate compressive strength as compared to the conventional concrete. Auxiliary efforts are made in order to increase compressive strength of the concrete. Main aim was to make use of as much as organic materials we can make, Wood which is naturally occurring material, we made use of Plywood dust, along with Soap Solution to induce bubble in the concrete mix. Thermocol was also used to fill in the void created to make the concrete light.

Wood Dust (210kg/m3), Thermocol(20kg/m3), Soap solution was mixed 20% to the quantity of water.

Soap induces natural bubbles making the concrete lighter and less dense, without using any chemical toxic admixtures. No other extra additives such as (EPS) Extended Polystyrene, aluminum mesh, aluminum powder, fly ash, silica fumes, Pumice stone, perlite chunks were used. Our main endeavor was to check how much weight the concrete slab can sustain along with its self-weight.

Key Words: Floating concrete, lightweight materials, Wood dust, Soap Solution, Thermocol.

1.INTRODUCTION:

1. GENERAL:
Floating concrete is a composite material composed of cement, water, aggregates Thermocol and Soap solution. The traditional Portland cement concrete (has Density around 2400 kg/m^3); floating concrete contains lightweight aggregates meaning Thermocol chunks of different size (in order to make a bond between cement and Thermocol, round Thermocol have circular hemisphere making it hard for the concrete to make bond) and Soap solution which make the composite concrete paste lighter by inducing small bubbles which are prone in making concrete less dense. The density of the floating concrete ranges from 500 kg/m^3 to 900 kg/m^3.
The Soap solution makes the concrete more workable, solid chunks of Thermocol help in replacing major part of the concrete, Wood dust being naturally available in the market can be used, as wood has a natural ability to float can be induced in floating concrete to make it lighter, Wood fibers can also be used instead of Dust, in order to impart more volume, thereby reducing use of cement in the concrete.
Also, its lightweight property is suitable for use in non-load bearing walls, thermal and sound insulation. Thus, floating concrete is a special type of concrete whose density is about 25% compared to the conventional concrete.

2. By replacing the usual mineral aggregate by light-weight aggregate:
With the use of lightweight aggregates concrete with low density has been achieved. Light weight aggregates such as pumice, perlite, vermiculite, sintered fly ash, bloated clay, expanded slag etc., have been used for achieving lower densities than that of a conventional concrete.

3. By introducing gas or air bubbles in mortar (Aerated concrete):
The "Aerated concrete" was perfected in the mid-1920, by Swedish architect and inventor Dr. Johan Axel Eriksson. Aerated concrete is a lightweight concrete which is made by introducing air or gas into a cement-based mortar. Though it is called aerated concrete, it is really not a concrete in the correct sense of the word since it is only a mixture of water, cement and finely crushed sand without coarse aggregate.

4. By omitting sand fraction from the aggregate (No-fines concrete):
No-fines concrete is a type of concrete from which the fine aggregate fraction has been omitted i.e., the concrete is made up of only coarse aggregate, cement and water. Very often only single sized coarse aggregates, of size passing through 20 mm retained on 10 mm has been used. Such a concrete, in addition to having large voids and hence light in weight, also offers architecturally attractive look.

5. OBJECTIVE:
Our main objective was to find out how much weight can the given slab of concrete sustain along with its self-weight. There are many research papers already available in the market operating on compression tests and tensile tests, but no such paper has mentioned how much weight can the floating structures can carry. Making use of toxic chemicals and admixtures was not our first preference, using materials which cause minimal damage to Aquatic flora and fauna, was out major interest.
Using the floating structures for future concrete establishments on water than land was the main goal.

6. IMPLEMENTATION OF FLOATING CONCRETE:
1. Advancement of Borders with floating beams for guiding purposes.
2. Providing decks for ships for loading and unloading.
3. Making use of Largely available water surface for Concrete establishments.
4. Finding an alternative to conventional concrete.
5. Reducing concrete saturation piling up on land.
6. To make water floating surfaces for smooth transportation of vehicles (if possible)
7. To lay pipes in the partially floating concrete instead of underwater gas lines or pipe.
8.Temporary Rescue stations can be formed on it.
9. Slabs with anchors can be formed to sustain the water pumps were essential.
10. Renewable energy pistons can have fixed onto these and can be anchored in the middle of sea to produce green energy instead of erecting whole of the assembly.
11. Floating houses can be made.
12. Linking these floating slabs walk through can be made in the sea.
13. Temporary settlements.

7. PROPERTIES:
1. Light Weight: Density varies from 650 Kg/m3 to 1200 Kg/m3 when contrasted with 1800 Kg/m3 to 2400 Kg/m3 for ordinary block and cement individually. In spite of many small air-filled cells, it is solid and sturdy. Compressive Strength: 2.0 to 7.0N/mm2.
2. Excellent Acoustic Performance: It can be utilized as sturdy sound wall and for acoustic requirements. Can be used for sound proofing in the walls of the theaters or rooms as required.
3. Seismic tremor Resistant: Since lighter than concrete and block, the gentility of the material expands opposition against quake.
4. Protection: Superior warm protection properties contrasted with that of regular block and cement, so lessens the warming and cooling costs.
5. Usefulness: Products produced using lightweight cement is lightweight, making them simple to cast requiring moderate to low talented workers. Can be connected with piping fittings along with some other plumbing fittings to make a long desirable bed according to the requirements.
6. Cost efficient: Because of the porous structures most of the structure is filled with voids and Thermocol, making is cost efficient as that space is used up by the Thermocol waste and air voids, eventually decreasing the requirement for cement, Aggregates, Admixtures for many purposes and further materials if required any.
7. Water Absorption: Closed cell structures and henceforth have lower water retention. Does not pertain water
8. Skim Coating: Rendering like walls is not required for the surface as finished surface coat is obtained, the color can be achieved by mixing colors accordingly.
9. Modulus of Elasticity: The modulus of Elasticity of the solid with lightweight aggregate is lower, 0.5 – 0.75 to that of the ordinary cement.
10. Amazing Fire resistance: Can sustain fires up-to a specified permissible limit.
11. No Need of Curing: Can be casted and placed on site as per requirements, no extra care is to be taken in order to cure the concrete.

1.1 Sub Heading 1

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

1.2 METHODOLOGY AND MATERIALS:

1. GENERAL:

Laboratory investigations carried out on cement, coarse aggregates (Wood Dust, Thermocol chunks) and also on concrete which are used for test specimens have been presented. The properties of Thermocol chunks and Wood Dust as given by the manufacturers. This chapter of thesis contains physical properties of various materials used throughout the experimental work.

2. MATERIALS:

List of the Materials used is as follows:
1. Cement,
2. Fine aggregate (Wood Dust),
3. Coarse aggregate (Thermocol chunks).
4. Water.
5. Soap Solution (25% of water used)

3. CEMENT:

A cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used as a component in the production of mortar in masonry, and of concrete- which is a combination of cement and an aggregate to form a strong building material. Portland cement is the most common type of cement in general use around the world.

SR NO.	PROPERTIES	OBTAINED RESULTS
1	Standard consistency	28%
2	Specific Gravity	3.14%
3	Initial Settling Time	35 min
4	Final Settling Time	154 min
5	Color	Grey
6	Fineness	1.5 %

4. Fine Aggregate:

Fine aggregates play a crucial role in formation concrete. Not only does it help in filling the void present in the concrete but acts as binding agent between coarse aggregates present, which in this case is wood dust and Thermocol. The aggregate whose size is lesser than IS 4.75 mm and retained on IS 150µ is considered as fine aggregate. It must be well graded from the particle point of view in order to guarantee filling of the voids. More fine the Sand is more will be the cohesion between particles, thereby resisting segregation or separation. In Floating concrete, Wood Dust is used as fine aggregates. The size, shape and texture of aggregates control the work ability cement content and drying shrinkage parameters. As Thermocol don't bind well, we used irregular shaped aggregates, to increase the friction between the connecting surfaces in order to have a firm hold on Thermocol surface, Smooth Rounded Balls of Thermocol can be used but the chances of it binding well with the mortar are less, which eventually results in decreased Compressive Strength. Wood Dust is disintegrated into size less than 4.75 mm and is used as fine aggregate.

5. Coarse Aggregate:

The coarse aggregate contributes to the bulking of concrete mixture and gives the dimensional stability to concrete. Size of aggregates greater than 4.75 mm is considered as coarse aggregate. Generally, aggregates of size between 4.75 mm to 10 mm are used in concrete. The size, shape and texture of aggregates control the workability; cement content and drying shrinkage parameters. In this experimental study Wood Dust and thermocol chunks have been used to reduce the density of concrete.

A) SAW DUST:

Sawdust (or wood shavings) is a by-product or waste product of woodworking operations such as sawing, sanding, milling, planning, and routing. It is composed of small chippings of wood. These operations can be performed by woodworking machinery, portable power tools or by use of hand tools. Wood dust is also the by-product of certain animals, birds and insects which live in wood, such as the Woodpecker and carpenter ant.

--Physical Properties—

Physical Properties	Values
Moisture content	10.8
Apparent specific gravity	0.14
Porosity (%)	84
Water retention (%)	50
Water drainage (m/s^{-1})	282.0

--Chemical Properties—

Chemical Properties	Values
Extractive	3.3
Lignin	29.3
Hello cellulose	83.8
Carbon (C) (%)	61.58
Hydrogen (H) (%)	5.32
Oxygen (O) (%)	33.04
Nitrogen (N)	0

B) THERMOCOL:

- Thermocol is type of plastic and acts as very good thermal insulator.
- It can also be moulded to any desired shape in Plastic moulding machine.
- Thermocol tiles are used in false ceiling and as face tiles.
- Thermocol is very light and is not adequately strong. It gets abraded with slight friction. Hence for thermally insulate partitions, it is only a filling material and not a surface material.
- Thermocol has good sound insulation properties from sound transfer point of view and from acoustic effects.

--PROPERTIES OF THERMOCOL—

PROPERTIES	VALUES
Density	15-30kg/m^3
Compressive strength	0.8-1.6
Tensile strength	3-6 kg/cm
Melting range	100-200C
Thermal conductivity	Low
Sound absorption	High
Moisture Absorption	Low

1.3 BATCH COMBINATIONS:

-- Batches with combinations in ratios are as follows—

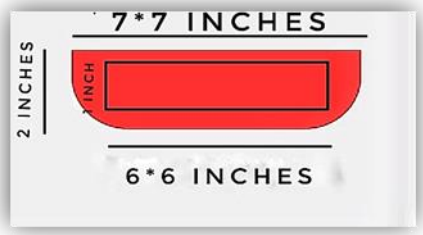
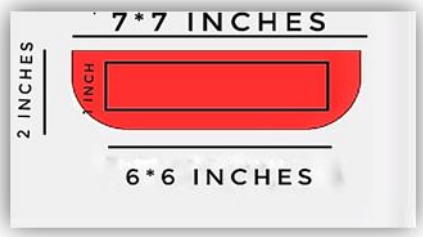
↓ IN RATIO BY VOLUME ↓

BATCH NO.	CEMENT	SAND	WOOD DUST	STEEL SLAG
1.	1	0.5	1	-
2.	1	1	-	-
3.	1	1	-	0.1

↓ ADDITIVES IN % ↓

THERMOCOL (% OF CONC.)	WATER (W/C RATIO)	SOAP (% OF WATER)
57.14	0.3	50
60	0.29	40
50	0.32	-

1.4 BATCH COMPARISON:

PROPERTIES	BATCH 1	BATCH 2
C:S: ratio	1:0.5	1:1
C: WD ratio	1:1	-----
Soap solution	50% w.r.t Water	55% w.r.t water
W/C ratio	0.3	0.3
Thermocol by Vol	-----	50 % w.r.t total volume
Thermocol size	-----	4 to 12 mm
WD size	4 to 10 mm	-----
Shape	Squicircle	Squicircle
Self-Weight	1.2 kg	1 kg
Load Sustaining Capacity	0.5 kg	0.56 kg
Total Load	1.7 kg	1.56 kg
Floats (Yes / No)	Yes	Yes
Dimensions		

Where

i. C= Cement,
ii. S= Sand,
iii. WD= Wood Dust,

BATCH 3:

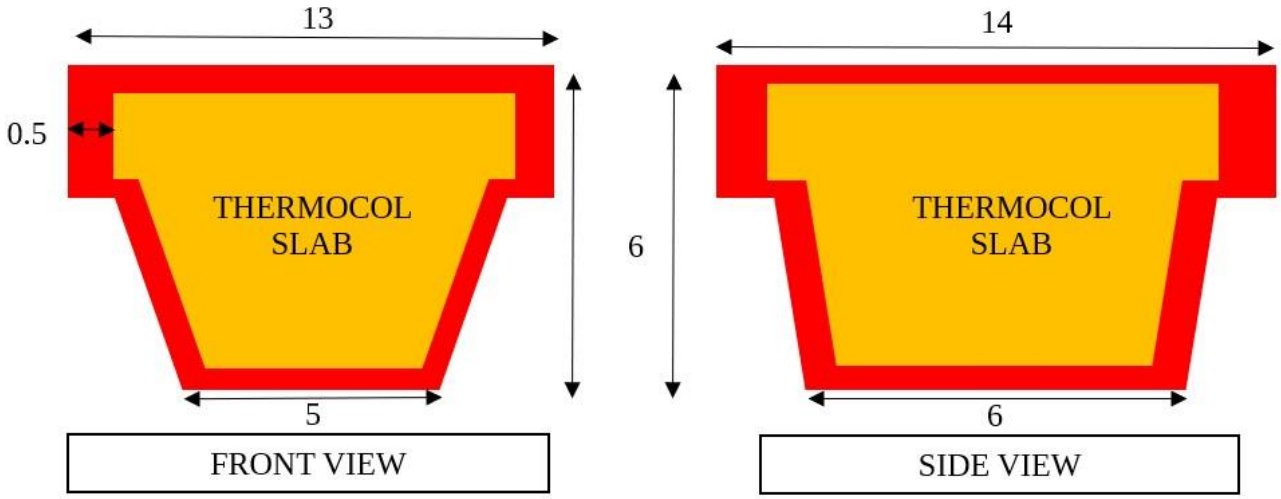
PROLOGUE
The main aim of this batch was to achieve maximum compressive strength in comparison to the other two batches, so in order to achieve that, we used STEEL MESH. The mortar was composed of Thermocol shredding of size 2mm to 4.25mm, one thing that makes this batch distinct is that we made the use of the Steel slag, the volumetric Ratio of the Cement Sand and Steel Slag are in the ratio (1:1:0.1).

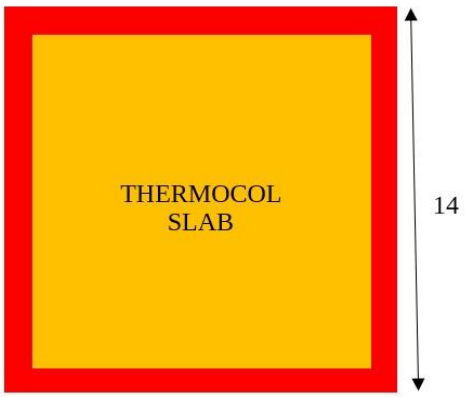
SHAPE:
This batch varied in shape from the other two, the shape can be summarized as a replica Ships, but with a minute difference, it had a flat face at the bottom. In this we considerably increased the dimensions of the Floating concrete. Top surface was of 14*13 inches with a thickness of 2Inches.
Bottom surface decreased considerably and varied uniformly with dimension of 6*5 Inches and thickness of 2 Inches, the overall thickness of the block was 6 Inches, And the middle Portion has a V shaped Thermocol Slab, to decrease the density. Cover of 0.5 Inches was left at the sides of Thermocol.
(Refer fig)

RESULTS:
What we concluded that, although the slab had more than moderate compressive as compared to other batches, it was barely able to sustain its self in water, as a result it did float but partially, making is not a preferable batch as far as Floating concrete concept is concerned.

CONCLUSION:
Not able to meet the required standards set for the floating concrete.

2. SIZE & SHAPE OF STRUCTURE:



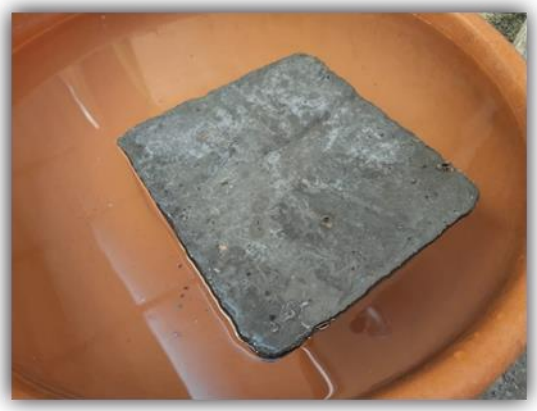


TOP VIEW

PHOTO GALLERY:

--Placing of Thermocol inside the mould--

--Casting of thermocol--



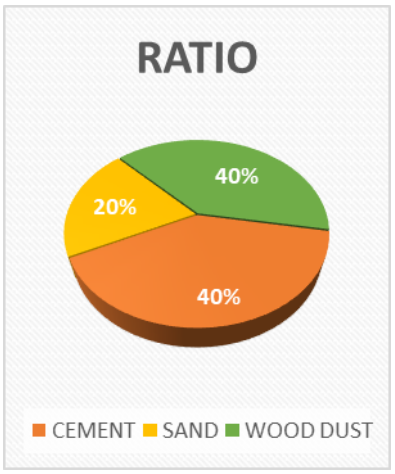
--Floating concrete--

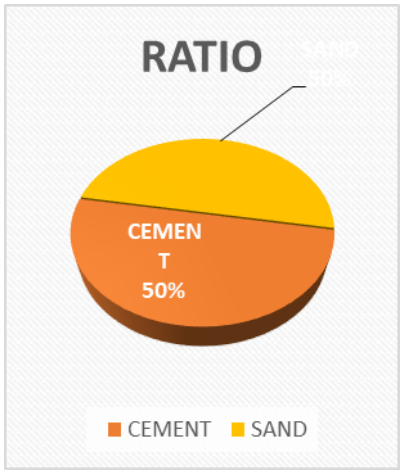
--Side view--

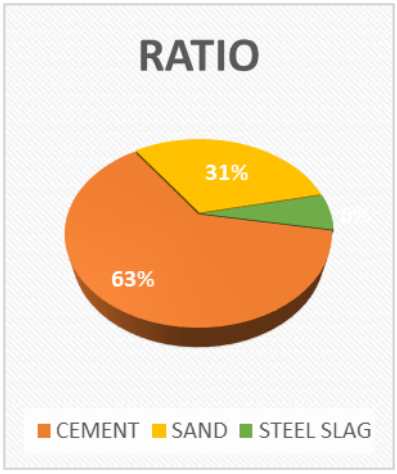
--Photos to interpret the Basic shape of the concrete—

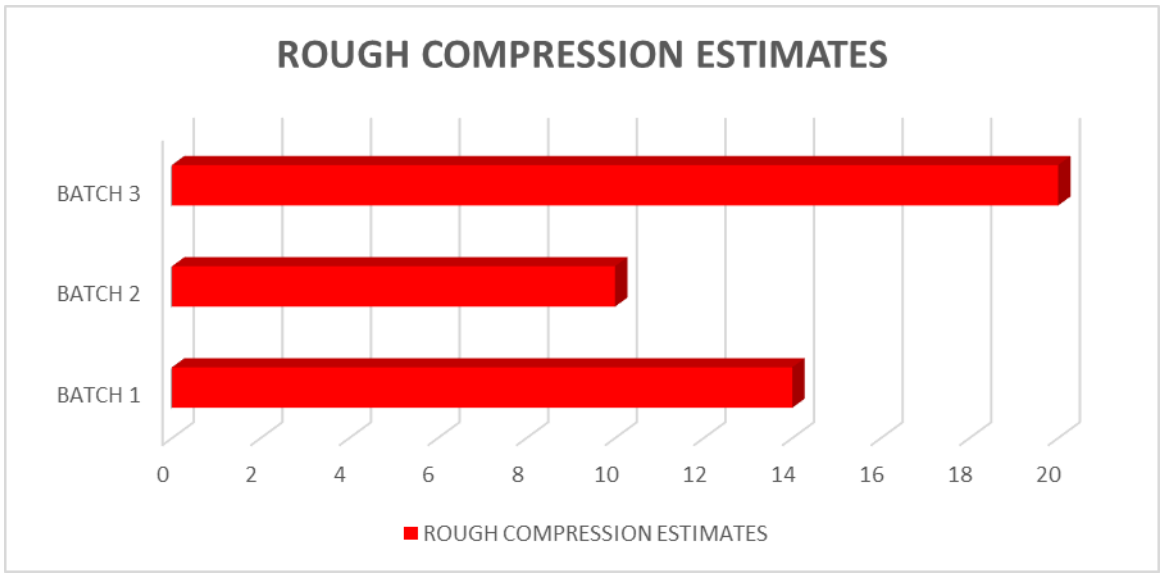
--LINK FOR THE VIDEOS OF THE FLOATING CONCRETE IS PROVIDED HERE—

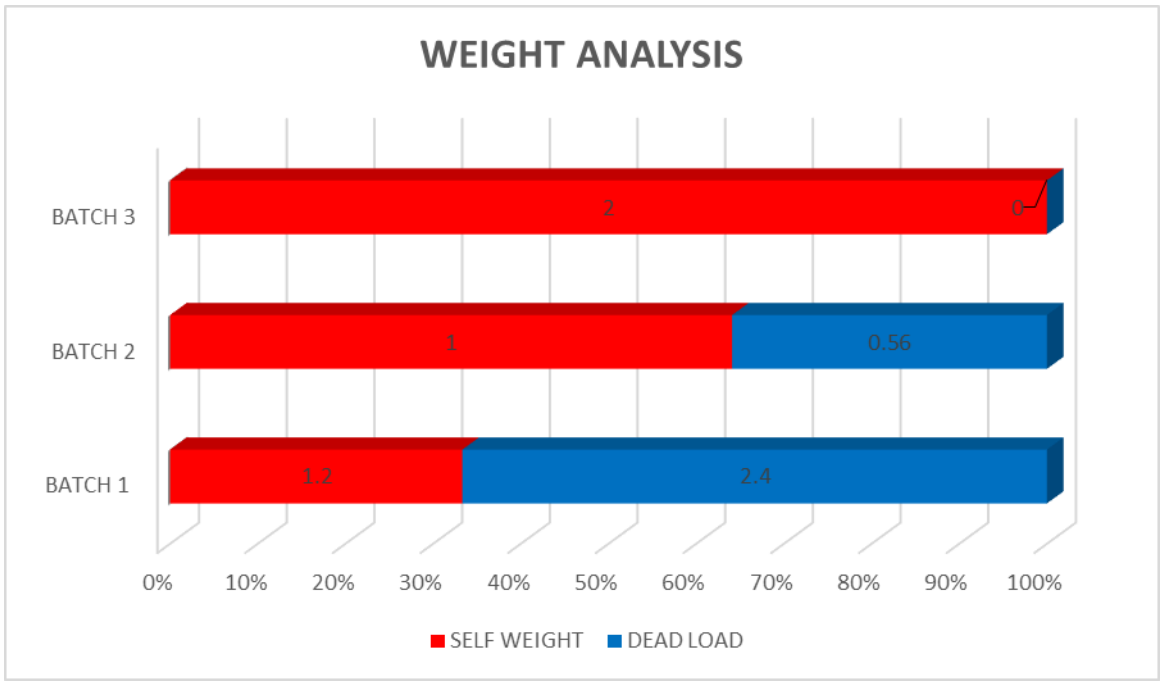
https://drive.google.com/folderview?id=1smDGOBKqm0-ocEiBfR-l4f9Zcz7hp46L


RATIO
40%
20%
40%
CEMENT
SAND
WOOD DUST


RATIO
CEMEN
T
50%
CEMENT
SAND


RATIO
31%
63%
CEMENT
SAND
STEEL SLAG


ROUGH COMPRESSION ESTIMATES
BATCH 3
BATCH 2
BATCH 1
0
2
4
6
8
10
12
14
16
18
20
ROUGH COMPRESSION ESTIMATES


WEIGHT ANALYSIS
BATCH 3
BATCH 2
BATCH 1
2
0
1
0.56
1.2
2.4
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
SELF WEIGHT
DEAD LOAD

From the data procured it is clear that Batch 2 can bear more Dead Load, as when compared with Batch 1 and 3, on the contrary Batch 1 can sustain maximum Total Load, with Moderate Dead Load sustaining efficiency. Batch 3 being more of trial batch, can barely sustain its own weight due to the introduction of Mesh of steel.

OBSERVATIONS:

Below are some of the observations that were made while Pre during and Post casting of floating concrete. Some of the below discussions are also made from referring previous research papers, and their shortcomings are tried to accomplish.

1) With the Thermocol being at the core, the chance of water to erode the thermocol is reduced.
2) Unlike Perlite, thermocol doesn't absorb water. As a result, using perlite can afloat your concrete slab, but may not be useful in long term floating.
3) Keeping thermocol at chief, most of the slab is made of Thermocol, making it an efficient structure to make use of Non degrading thermocol.
4) Floating test was carried 24 hours after the casting, after 7 seven days the remaining water retained in structure also vanished making it lighter, although didn't make any significant changes in the Self Weight and Dead Load Retaining capacities.
5) Complete exposure of the concrete to sea water is under study, giving us a head start as, buoyancy of normal water is less compared to Sea water, thereby increasing the Dead load carrying capacity of the structure.
6) Soap solution acts as a natural air entraining admixture, thereby avoiding use of harmful admixtures in various forms.
7) Wood with less absorption capacity is best suited for this, as the extended exposure of wood in the concrete can result into absorption of unnecessary water. Thereby increasing weight, affecting load Dead Load carrying capacity of Structure.
8) Keeping a closed void in the structure is not recommended, it is hard to achieve, secondly any micro cracks can cause the water to seep into it, again affecting floating efficiency.
9) Thermocol and Wood having natural tendency to float can act better than introduction of air void in concrete. Also, another main reason to avoid air void is it reduces strength of concrete to a great extent.
10) Steel slag can surely be increasing compressive strength but is not recommended for use in floating concrete.

3. CONCLUSIONS

Based on the study following conclusions can be drawn:
1) Thermocol slab and chunks and fines can be used as raw materials to make a concrete slab floating
2) Soap solution can be used as for inducing pores and can act as air entraining reagent.
3) Floating concrete can sustain around 41.5% to 55% of its Weight.
4) Load sustaining capacity of these structures increases in sea water.
5) Wood can definitely make the structure lighter, besides its water retaining capacities.
6) Slabs can be constructed according to the desired sizes, in order to have maximum span, it is advised to join the different advisable slab dimensions with pipe fittings.

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BIOGRAPHIES:

Author 1:
Student at PVPIT Budhgaon, civil engg dept.

Author 2:
Student at PVPIT Budhgaon, civil engg dept.

Author 3:
Student at PVPIT Budhgaon, civil engg dept.

Author 4:
Student at PVPIT Budhgaon, civil engg dept.