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CONSTRUCTION OF LIGHT WEIG3HT CONCRETE FERRY BOAT BASED ON PRINCIPLE OF BOUYANCY AND FLOATATION

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Abstract: *In design of concrete structures light weight concrete plays prominent role in reducing its density, which relates to both structural integrity and serviceability. More environmental and economic benefits can be achieved if materials used to replace with light weight aggregate. In this technique thermocol beads are used for preparation of light weight concrete ferry boat into laboratory and density is reduced to attain maximum efficiency. The light weight concrete normally has the density of 380-1850 kg/m^3, where as we got concrete density of 611Kg/m^3. This concrete boat will have more life and maintenance free in comparison to present use of barge and pontoons of other materials. This light weight ferry boat can carry approximately 1.5 to 2 times the load of its own weight, which is sufficient to carry the construction equipment in it with proper mountings for offshore construction works.*

Keywords*-Lightweight concrete, Thermocol beads, Air entraining agents, Density, Buoyancy and floatation principles, ferry boat, Cement , Loading capacity.*

I. INTRODUCTION

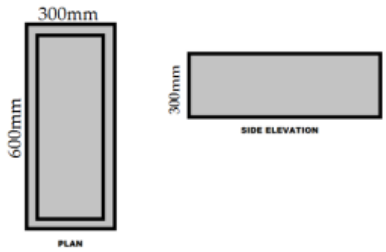
The construction industry everywhere faces the problems and challenges, two-third of the world surface is covered with water. It is therefore not surprising that there has been much activity with concrete in the sea in recent decades. The disadvantage of the conventional concrete is the high self-weight concrete, whereas the density is in the order of 2200 to 2600 Kg/m^3. In this technique the self-weight of the concrete is reduce to attain the efficiency of the concrete as structural material. The light weight concrete has the density of 300 to 1850Kg/m^3, it helps to reduce the dead weight of the structure. This project mainly aims that the conventional boats and the ferry made of steel and timber must be replaced by a light weight concrete which is a new invention of the concrete in the construction world. It has more economic results then the other materials ferry. The life span of light weight concrete boat is also more. It also has many advantages onshore and offshore of the water bodies. As it is also light in weight its construction is economical and transportation is easy.

1.1 Materials Used.

The materials used in the following experiments are as follows:

- Cement OPC-53 Grade Ultratech.
- Air entraining agents.
- Fine Aggregates (sand confirming to zone-II).
- Water.
- Fly ash.
- Thermocol beads.
- Concrete Cover 50mm.
- Plywood Shuttering.
- Shuttering oil.
- Other tools and equipment needed for casting purpose.

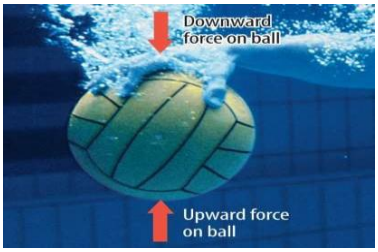
1.2 Design of the ferry boat.



According to principles of buoyancy and material density we calculated the size of ferry boat as shown in plan and side elevation as above.

II LITERATURE REVIEW AND STUDY

2.1 Study on buoyancy principles:
When a body is immersed in fluid, an upward force is exerted by the fluid on the body.
This upward force is equal to the weight of the fluid displaced by the body and is called the force of buoyancy.



2.2 Study of various light weight materials which reduces density of concrete:
Pumice stone:
One of the most significant of the advantages of pumice aggregate concrete is its lightweight quality—up to one-third lighter than conventional sand-and-gravel concrete. This trait contributes to a decrease in structural steel costs and, consequently, job costs. Larger volumes of concrete can be handled by lighter equipment with less wear and tear on the equipment. The reduction of dead load on structural supports, trusses, girders and slabs can allow extra stories on buildings where dead load is a governing factor. Lightweight Hess pumice concrete also reduces the live load on formwork and falsework. And of course, the inclusion of fine-ground pumice pozzolona adds the proven advantages of pumice pozzolana.

Air entraining agents:

Air-entraining admixtures cause small stable bubbles of air to form uniformly through a concrete mix. The bubbles are mostly below 1 mm diameter with a high proportion below 0.3 mm. The benefits of entraining air in the concrete include increased resistance to freeze-thaw degradation, increased cohesion (resulting in less bleed and segregation) and improved compaction in low-workability mixes. The volume of air entrained depends on the application and the mix design. After mixing, air can be lost during transport and pumping. Allowance should be made for this so that the correct level of air is obtained in the hardened concrete. This may mean testing at the point of discharge rather than at the batching plant. Air entrainment reduces the density of the mix and increases yield. This needs to be taken into account when batching and mixing. For every 1% of additional air entrained, concrete strength will fall by around 5%. At normal air entrainment levels, most other properties of the concrete including drying shrinkage and creep are not significantly affected. The main reason for using entrained air is to improve freeze-thaw and scaling resistance and so prolong service life. The improved cohesion and compaction can also enhance quality and durability.

Thermocol beads:

The Expanded Polystyrene is a stable, low density Foam, which consists of 98% of air and 2% of polystyrene material. It has closed structure and cannot absorb water. It has good impact resistance. Polystyrene is packaging material in medical industry. Polystyrene is non-biodegradable material, so it creates disposal problems. Utilizing crushed polystyrene in concrete is good waste disposal method. The polystyrene beads can be easily merged into mortar or concrete to produce lightweight concrete with a wide range of density. An application of polystyrene concrete includes walls, cladding panels, tilt up panels and composite flooring. Polystyrene concrete was used to produce load bearing concrete wall, also as the material of construction for floating marine structures. Expanded polystyrene beads concrete was popular through the ages. One of the main problems associated with the use of conventional lightweight aggregates produced from clay, slate and shale in concrete is that these porous aggregates absorb very large amount of the water mixed in concrete. This is affecting the performance of the concrete, apart from the fact that it is difficult to maintain specific water content during the casting. Also, this absorption of water by the aggregates will mean that the additional water will be required to maintain the slump at acceptable levels. These increased water contents requires higher cement contents, even without any benefit.

Foaming agents for concrete:

A chemical which facilities the process of forming foam and enables it with the ability to support its integrity by giving strength to each single bubble of foam is known as foaming agent. It may categorize in two parts Protein and Synthetic.

Uses and formation: Protein based is commonly used for the low density and for higher densities synthetic foaming agents were preferred. Foam can create through forcing the chemical, air and water by restriction which results foam formation. Synthetic foam requires less energy while protein foams need more. Energy required during the foam formation decides its quality.

Protein Based Foaming Agent It made to form light weight concrete and other concrete materials. Foam produce no reaction on concrete but it serves as a layer which is air trapped and forms no fumes or toxic. Protein based foaming agent requires comparatively more energy to make foam. It is prepared with raw material in presence of $Ca(OH)2$ and a small portion of $NaHSO3$. For improving the stability of foaming agent it is modified with the addition of several kinds of gel and surfactants. Few significant improve the workability of foaming agent such as addition of alkyl benzene sulfonate etc.

Synthetic Foaming Agent CLC concrete has very good potential which helps to structure the cellular lightweight applications. Using right category of foaming agent makes a huge difference in products such as the mechanical properties of concrete and it resistance etc. Synthetic foaming agents are such chemicals which reduce the surface tension of liquid and commonly used globally to make blocks, bricks, CLC concrete etc. where the high density is needed and it requires less energy for formation as compared to other foaming agents. It is highly recommended to use in the constructional fields where requirement of light weight concrete is increasing by time.

III TECHNICAL DATA OF EPS BEADS:

Composition:
• 1. Solid Styrenic Polymer (polystyrene)-Particulate thermoplastic
• 2. Blowing Agent: Pentane(C_5H_{10}), 3% to 8% by weight liquid hydrocarbon.

Property:
• Softening point = 100^0C
• Flash point= -49^0C
• Density=0.626kg/m^3
• Color = white
• Compressive strength= 100 to 390 kN/m^2
• Tensile strength = 150 to 680 kN/m^2

IV METHODOLOGY UESD IN CONSTRUCTION OF FERRY BOAT

Step 1: The material for the construction of boat was collected on the site of casting and various other tools and equipment required was also brought.

Step 2: The shuttering work with the help of carpentry work is done on the site and the shuttering oil is applied on all the internal faces of plywood where the concrete would come in contact are applied. Because of this application of small amount of oil the process of deshuttering will be easy.

Step 3: The concrete preparation according to the design is prepared by mixing various materials like cement, fine aggregates, water, air entraining agents and thermocol in a bucket. The mix is stirred for 15 mins so that the

Step 4: After being concrete is mixed then its poured into the designed shuttering of size 600mmx300mmx300mm and proper compaction with help od small and thin iron rod is done so that the concrete air voids are removed the concrete is placed with help of trowel and hand.

Shuttering and casting of ferry boat

IV RESULTS


Weight of boat


Weight of payload


Weight of payload + Boat

The above prototype shows that the weight of payload is 1.7 times than the weight of the boat and it floats in the water.


Floating of sample in to laboratory


Floating of ferry boat without pay load in pond of college premises.

Floating of ferry boat with pay load in pond of college premises.

V CONCLUSION

From our study, we found the density of light weight boat as 611Kg/m3 which is sufficient to float in water with payload of construction equipment and carry out the project tasks for offshore work. The compressive strength of the light weight concrete used in ferry boat is 11.5MPa. From our floatation into small pond we conclude that the boat can carry 1.5 to 2 times more weight than it self-weight with designed draft of 12cm. Also, it is observed that the cost of the light weight concrete used in construction of ferry boat is less than the conventional concrete by 30%.

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