

Emergency floating hut. Choza flotante de emergencia.

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ABSTRACT

In the run-up to the observance of the repeating flooding situation in Kerala, it is an urgent need to take adequate measure for this havoc. This project intends a well planned solution for this and named as "Emergency Floating Hut". Kerala is a place where floods occurs only during the monsoon season. That means, the flood is caused by rain. The hut is going to be constructed almost near the basement portion by separately providing beams or space in a creative way. The main feature of this design model is, there have spaces for keeping adequate food and medicines. The dimensional data for the hut are: diameter 3.5m and depth 1.2m for the prototype design. The materials used are weight less, low density, durable and with enough stability. The roof covering will be transparent fibre glass.

Keywords—types, material collection, shape of model, principles, design, casting.

RESUMEN

En el período previo a la observancia de la situación de inundaciones repetidas en Kerala, es una necesidad urgente tomar las medidas adecuadas para este caos. Este proyecto tiene la intención de una solución bien planificada para esto y se denomina "Choza flotante de emergencia". Kerala es un lugar donde las inundaciones ocurren solo durante la temporada de monzones. Eso significa que la inundación es causada por la lluvia. La cabaña se construirá casi cerca de la parte del sótano proporcionando vigas o espacio por separado de una manera creativa. La característica principal de este modelo de diseño es que tiene espacios para guardar alimentos y medicamentos adecuados. Los datos dimensionales de la cabaña son: 3,5 m de diámetro y 1,2 m de profundidad para el diseño del prototipo. Los materiales utilizados son menos pesados, de baja densidad, duraderos y con suficiente estabilidad. La cubierta del techo será de fibra de vidrio transparente.

Palabras clave: tipos, colección de materiales, forma del modelo, principios, diseño, fundición.

INTRODUCTION

"Floating" term in the foundation engineering is used when the soil beneath the footing does not experience any extra load, as the load of the structure is equal or less than the soil displaced. Floating hut or houses are similar in concept and normally defined those houses which are constructed on the water in a that the load of the structure is equal or less than the uplift force of the water which helps in floating the house on water.

This paper also includes floating foundation which are without supporting (soil stratum) and whose design has been modified to bear heavy weight and possible to connected to the buildings and it is used in the area where heavy flood occurs. These floating foundations are made of suitable concrete sections which eliminates the cost of excavation and footings so it leads to more economic.

Here the entire floating foundation transfers its load due to buoyancy. Which is made of concrete and it floats based on the principle of buoyancy. A modern floating hut may be constructed of wood, concrete, steel or a combination of materials, depending on the design requirements. In this project, using floating concrete as a floating foundation.

There are two types of floating houses, one which permanently float and other that float only during flood waters else get placed on ground, particularly during dry season if there is no water. Some houses which were constructed on stilts or piles due to safety requirements during floods in many parts of the world and in India too, like in West Bengal, Assam and other parts, are not actually floating houses in true sense.

"An experimental study on floating concrete", followed by Archimedes Principle (Law of Buoyancy) to support the structure at a moderate and convenient depth. Floating concrete structure is a solid body made of lightweight materials. This project deals about the preparation of mix design and various tests namely compressive strength, tensile strength, slump test, flow properties of concrete etc., because of its low density and moderate range of compressive strength, it can be used in non-structural application. In this study, floating concrete was developed for different proportions using the ingredients with less specific gravity than the conventional concrete. Casting is done and the testing is made for 7th day and 28th day (M.S. Dinesh Kumar et al, 2019).

The applications, research and development of the very large floating structures. They also presented main emphasis on the hydro elastic response, structural integrity and steady drift forces. The technological developments on the mooring systems, anti-motion devices and connector designs of very large floating structures over the past decades were highlighted. PiroozMohazzabi in his paper gives a general idea about the Archimedes principle which is the principle on which our structure floats on water. Basically, the principle states an object immersed in a fluid is buoyed up by a force equal to the weight of the fluid that it displaces (C.M. Wang and Z.Y. Tay et al, 2011).

The new idea of the Amphibious House which basically targets the concept of flood resistant house in low land areas. It provides safe shelter to the people living in the house. This concept is based on the principle of Buoyancy. The amphibious architecture helps in allowing water to flow rather than creating obstruction. Approaching this concept helps in planning and recognizing the beneficial aspects of seasonal and occasional flooding. It means that allowing not only to live with water, but to expand with it. The study also reviewed the methodology used for this idea which is based on buoyancy. It is found that, the first International Conference on Amphibious Architecture, Design and Engineering, ICAADE 2015, was held in Bangkok, Thailand in August 2015. The second ICAADE 2017 was held at the University of Waterloo in Canada in June 2017.

On 16 August 2018, severe floods affected the south Indian state Kerala, due to unusually high rainfall during monsoon season. It was the worst flood in Kerala in nearly a century. Over 483 people died, and 140 are missing regarding surveying. And about a million people were evacuated in recent year (figure 1 and figure 2). Hence it needs a solution for this considering as floating houses.

The aim of this study is to develop an innovative and sustainable floating system design which is environment friendly and can be built using locally available materials such as EPS. The concept is to design a floating system to cope with flood and corresponding water related disasters.



Figure 1. Flood occurred in Kerala



Figure 2. Water raises at roof level

- The sea level is said to have risen by 20 centimetres in the last century and is expected to rise by three times that amount in the 21st century. Therefore floating houses will not just be a fashionable lifestyle but a necessity.
- Safe in flood prone areas during floods.

Specific objectives are given below:

- To design a small compartment which is effectively used for rescue purpose when sudden flood is occur.
- To ensure the safety of life and protection from flood.

MATERIALS AND METHODS

➤ Literature study

The previous researches and literature study shows that the different types of floating structures that are existing. Houses which get uplift during floods and move down during conditions when no water is there are guided vertically telescopically. A steel frame that holds the floatation blocks is attached to the one side of the house.

➤ Materials collection

The materials collected are cement, EPS, reinforced bars, M-sand.

- 33 grade of cement is used.
- Expanded Poly Styrene is used to reduce the density.
- Steel wires are used as a reinforcement to take tension.
- M-sand is used as a fine aggregate.

➤ Shape of floating structure fixing

- The shape of the floating structure is fixed as semi spherical shape for required surface area of buoyant force. (Figure 3.)



Figure 3. Model of Semi Spherical shape (Image captured after casting)

➤ Designing of floating structure

The load and buoyant force are acted in the circular area while floats on water. Hence it designed as a circular slab. And also designed the floating pontoon load capacity.(Figure 4.)



Figure 4. Model of Floating structure floats on water

➤ Casting of floating structure

The mould is prepared and placed the reinforcement properly with required nominal cover and casted (Figure 5.)



Figure 5. Reinforced structure

PRINCIPLES OF FLOATING HOUSES

Floating houses do not require foundation and are based on the principle of buoyancy thus are also called buoyant homes. Thus the base of the structure should be such that it helps in floating as well is able to take the dead load of the house, live load and other loads to be encountered by the house. The houses may be constructed on boats, hollow pipes, light weight pads and similar materials which help in the floating as well taking up loads. Floating systems being used include log floats, solid styrofoam encased in rubber, foam filled steel pontoons, concrete pontoons, concrete and foam, wood and foam, polyethylene shell with solid core polystyrene block moulded inside, fibreglass etc.

➤ Archimedes's principle

Archimedes's principle states that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces and acts in the upward direction at the center of mass of the displaced fluid (Wikipedia)

➤ Pontoon principle

Pontoon principle in which one makes a solid platform, lighter than the water and the other based on the ship in which a hollow concrete box is created which is open on the top.

TERMINOLOGY RELATED TO FLOATING.

➤ Buoyancy

Buoyancy is the force that causes objects to float. It is the force exerted on an object that is partly or wholly immersed in a fluid.

➤ Buoyancy force

Buoyancy is caused by the differences in pressure acting on opposite sides of an object immersed in a static fluid. It is also known as the buoyant force. Buoyancy is the phenomena due to Buoyant Force.

➤ Center of buoyancy

Instead of looking at all of the forces caused by the hydrostatic pressure, it's mathematically simpler to look at the pressure acting across the entire surface as a single force acting at a single point. That single point is called the center of buoyancy. The center of buoyancy is the point where if you were to take all of the displaced fluid and hold it by that point it would remain perfectly balanced, assuming you could hold a fluid in a fixed shape. This point is also called the center of mass. The center of buoyancy for an object is the center of mass for the fluid it displaces.

➤ Metacentre

The Metacentre may be defined as a point about which a floating body starts oscillating, when given a small angular displacement. It is denoted by M.

➤ Metacentric height

The metacentric height is the distance between the centre of gravity (G) of the floating body and the metacentre (M). Mathematically, metacentric height,

$$GM = \frac{I}{V} - BG = BM - BG$$

where,

I = Moment of inertia of the sectional area of the floating body at the water surface.

V = Volume of the body submerged in water, and

BG = Distance between the centre of buoyancy (B) and the centre of gravity (G).

EQUILIBRIUM OF FLOATING BODY

➤ Stable equilibrium

When a body is given a small angular displacement, i.e. it is tilted slightly by some external force and then it returns back to original position due to internal forces. Such equilibrium is called stable equilibrium (Fluid mechanics: Lesson 10)

➤ Unstable equilibrium

If a body does not return to its original position from the slightly displaced angular position and moves further away when give a small angular displacement such equilibrium is called an unstable equilibrium.

➤ Neutral equilibrium

The body remains at rest in any position to which it may be displaced, no net force tends to return the body to its original state or to drive it further away from the original position, is called neutral equilibrium.

ADVANTAGES AND DISADVANTAGES

The main advantages of this Emergency floating hut is that it helps in emergency rescue process.

- Buoyant foundation project has proved it can withstand extreme flooding by fitting the EPS block to the existing house.

- Low density but it gives high strength.
- It will not break down so it will not spread into surrounding soil.
- It can be installed by hand using simple tools.
- This eliminates the investment and operation costs of heavy machinery.

Some of its disadvantages are as follows:

- This cannot be constructed as a multi-storeyed building.
- Also, it is subjected to strong external loadings due to wind, rain, ice and other environmental conditions.
- There are restrictions to aesthetic view as there is limitations of size and shape of the house.
- Height limitations are restricted to the mooring post height.

CONCLUSION

The most destructive flood conditions in Indian history where Kerala received heavy monsoon rainfall, which was about 75% more than the usual rain fall in Kerala, on the mid-evening of August 8, resulting in dams filling to capacity; in the first 24 hours of rainfall the state received 310 mm (12 in) of rain. Almost all dams had been opened since the water level had risen close to overflow level due to heavy rainfall, flooding local low-lying areas. Hence floating houses may be the need for the future in coastal areas and flood prone areas in Kerala.

The long term view that is necessary in taking account of climate change also enables us to view other issues with the same horizon of opportunity facilitating new solution to spatial planning and the location of settlements, best practice in building design, infrastructure development and environmental flood defence. Therefore, it is time to evolve a new relationship with water to ask what is possible of design and construction and begin to look toward a flooded future with confidence and imagination. Government aided schemes should provided for the wide implementation of emergency floating hut. Because they will not just be a fashionable lifestyle but a necessity.

ACKNOWLEDGEMENT

Firstly, We would like to express our sincere appreciation to our guide, Ms. Anusha P, Assistant Professor, Department of civil Engineering for the support and guidance she has extended to us in the completion of this paper work. We extend our sincere thanks to the faculty and staff members for their valuable suggestions and help throughout our project work. Besides these, we like to express our sincere thanks to our friends and family for their help and support towards the successful completion of this paper work.

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Received: 30th January 2021; Accepted: 14th March 2021; First distribution: 01th April 2021