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Design of Amphibious Homes

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Abstract: *India is a peninsular country three sides covered with water. It faces a heavy monsoon season that causes large scale destruction throughout the country. Perennial rivers such as Ganga, Brahmaputra, etc. always causes flooding in north India and cyclones and heavy monsoon are the reason for flood in southern parts of India. India is the one of the vulnerable country for climatic change. It should work to provide flood proof, safe and affordable structures for all citizens.*

For centuries, the coastline has been the focus for variety of activities including industries, agriculture, recreation and fisheries. All the major cities in India have developed along the coastline. Over the past centuries, the sea level increased nearly eight inches in the coastal area and the scientists suggest a constant increase in sea level due to climatic change. There are two major factors for sea level rise, melting of ice sheets and thermal expansion of ocean. These factors are the result of global warming which cannot be changed easily. The sea level rise will have multiple impacts like migrating from coastal areas, frequent flooding, erode beaches; the net result will be migration from this densely populated areas.

This report will explore and documents the various ways of protecting and creating a sustainable living environment for seaside and riverside residents. This will document the projection sea level rise and in change in climate will increase the frequencies of flood. This dissertation will answer the questions like "How can a structure sits in ground can survive during floods?" The techniques to provide low flood residents Amphibious housing functioning both in land and water. Amphibious Architecture is cost effective and safe alternative for permanent static elevation and it is achieved by buoyant foundations.

Keywords *– Amphibious Homes, Buoyant Foundation, Floating Construction, Flood proof, Marine Structure.*

I. INTRODUCTION

1.1 General

India being a peninsular country. It is quite prone to flood. As per Geological Survey of India (GSI) the major flood prone areas covers 12.5% of total country area. Flood, the most common disaster of India causes immense to country's property and lives every year. The major flood prone areas in India are river banks and deltas of Ravi, Yamuna, Gandak, Sutlej, Ganga, Ghaggar, Kosi, Teeste, Brahmaputra, Mahanadi, Mahananda, Damodar, Godavari, Mayurakshi, Sabarmati and their tributaries. Cyclonic storms can cause floods in Andhra Pradesh, Orissa and Tamil Nadu. The monsoon rain causes heavy rainfall and flooding in southern eastern a part of country.

Humans rely on heavy engineering, tidal barriers and riverside and costal defense to protect our built environment from flooding. In order to protect our residents from floods and rising sea water, alternative design options for coastal residents should be implemented. As much as 90% of 100 largest cities are located near the sea. These cities have large amount of water in form of lakes, rivers, canals, harbour. A new residence for coast side and riverside should be designed to withstand the rising sea water and frequent floods. Those residents should be safe, flood proof, eliminating the rebuild process after flood and thereby provide healthier and stable family. One of solution is Amphibious Homess. The solution will also include waterproof material and protection of vital utilities, design of buoyant foundation, vertical guidance pole attached to the foundation, which provides resistance from lateral force caused by wind and water. Amphibious Architecture adapts to dry and wet conditions without causing any damage during or after flood. The development of an amphibious community is a long time strategy that will minimize the potential risk of flooding in coastal residences.

1.2 Objective

- To find sustainable solution for flooding conditions in India .
- To make affordable upgrade to coastal regions of country.
- To create awareness about new construction technologies.
- To explore affordable materials for this concept.
- To study importance of Amphibious construction in India.

II. LITERATURE REVIEW

Mohamad Ibrahim Amphibious Homes, a Novel Practice as Flood Mitigation Strategy in South- East Asia May 2012[1] In this paper they have concluded that in Malaysia amphibious Homes with concrete pontoon is the most appropriate. Pre-cast concrete pontoons, which are filled by expanded polystyrene blocks (EPS) are one of the approaches towards economic.

Elizabeth English, Thriving with water: Developments in amphibious architecture in North America August 2015 [2] Amphibious construction, though not a new concept, has been growing in popularity over the past decade. The implementation of buoyant foundations as both retrofit and new construction could provide benefit to communities at high risk of chronic flooding.

Changho Moon Article A Study on the Floating Homes for New Resilient Living October 2015[3] To investigate the resilient features of floating Homess & to review the possibility of floating housing as a new form of resilient living, and to suggest some reference ideas for the planning and design of floating housing projects.

Gursewak Dass, Review Paper on Ferro-cement in Construction May 2017 [4] when we compare Ferro-cement with RCC (Reinforced Cement Concrete) it perform better against crack, because wire messes that were used in Ferro-cement will cover the macro part of Ferro cement structure and avoid cracking. Pre-cast Ferro-cement structure are in light weight as compared with RCC and sometime pre stressed concrete structure, considerably reduce the cost hence ferro-cement is most appropriate in pre-cast industry.

Mayank Patel, Floating Concrete by Using Expanded Polystyrene Beads [5] Polystyrene is a versatile plastic used to make a wide variety of consumer products. As a hard, solid plastic, it is often used in products that require clarity, such as food packaging and laboratory ware.

III. METHODOLOGY & CALCULATIONS

3.1 Amphibious Dwelling

Amphibious dwelling these type of structure are capable of floating on water while the water level rises and it can also stay on ground when water level is back to normal level. The key part of this types of structures is the Buoyant Foundation. There many different types of design for buoyant foundation are widely applicable along with wide range of materials such as pontoons, dock formations, rafts foundation etc. and materials such as PVC pipes

concrete hull etc. We are making the use of EPS block for the construction of Buoyant Foundation. EPS block have high capacity for floating and they are easy to handle which provides high workability. Although skilled manpower is necessary as this concept differs from our traditional construction techniques and materials,

The Amphibious system consists of three basic elements:

- Buoyancy blocks underneath the Homes that provide flotation,
- Vertical guideposts that prevent the Homes from going anywhere except straight up and down, and
- A structural sub-frame that ties everything together.

There are many factors to be considered while making Homes to be able to float. To restrict the structure from flowing with the direction of water there are guiding post provided which are sturdy enough to hold the structure in its place but these guiding post are free to move in Y axis, which allows the Homes to smoothly float with rising water and when the water level decreases it will bring back the Homes to its original ground level.

It is important that the structure must be as light as possible but also durable enough therefore we are making the use of ferro cement and light weight concrete for the sub structure.

3.2 Calculations required for design of Buoyant Foundation

Considerable incoming loads in the Homes

The total weight of the family members 4 Members (60kg, 50kg, 55kg, 65kg)	= 235kg
Weight of food (one month)	= 250kg
Weight of seed of different crops	= 200kg
Self-weight of the structure	= 900 kg
Weight of stored drinking water	= 80kg
Weight of the utensils, cloth and others	= 200 kg
Total weights	**= 1810Kg**

3.3 Calculation for the weight of the Homes using Ferro cement and other essential materials

Floor LL+DL = 3 + 3 = 6 kN/m2
Ceiling LL+DL = 1.5 kN/m2
Wall DL = 0.4 kN/m2
Area = 6m x 7.6m = 45.6 m2
Floor = 45.6m2 x 6 = 273.6 KN
Ceiling = 45.6m x 1.5 =68.4 KN
Sub Total = 273.6 + 68.4 = 342 KN
½ Total = 342/2 =171kN

Wall weight of ferro-cement = 3m (height) x 0.2 m (thickness) x1m (Unit Length) =0.6 m3

Density of Ferrocement = 1332.09 to1457.89 kg/m3
Density of Ferrocement = 13.3209 to 14.5789 KN/m3
0.6 x 14.5789 = 8.7473 KN
8.747KN x 160m = 1399KN (Since 160m is the total length of wall)
Total load = 273.6 KN + 68.4 KN + 1399 KN = 1741 KN
174100 kg
i.e. 24000/2.205 =
10886.217 kg

The standard EPS-blocks are of **48" x 48" x 96" [1.22m x 1.22m x 2.44m]** Full-size maxima are **48½" x 48½" x 194" [1.23m x 1.23m x 4.92m].**

Standard EPS blocks 48”x48”x 96”
i.e. 1.22m x 1.22m x2.44m = 3.66 m3
Using EPS Density 24 kg/m3

From Table the Buoyancy force 976 kg/m3 for EPS22
Therefore, No of blocks required = 3 x 5.4 x 7.3/3.66 = 32.31 m3
Approx. 34 blocks of EPS22 of Dim 1.22 x 1.22 x 2.44 are used

SUMMARY

A floating Homes is a building structure that floats on the water surface by leaning to drowned area weight as the weight parameter which the structure could handle. This research is done to analyze the material platform
To increase the buoyancy of the platform material, the width and height of the platform can be enlarged. Floating architecture provides certain advantages for the planning of sustainable design, such as:

- New approach to modify flood prone areas.
- Improvements in construction technologies.
- Working with water rather than fighting against it.
- Use of different materials and methods inspired from marine construction

Future Scope

The future scope of Amphibious Homes involves

- Increasing number of floors.
- Making necessary arrangement for Parking.
- The concept can also be elongated into Green Homes.

- Also the material used for the construction of the building of architecture can be more lightweight

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