

AMPHIBIOUS HOUSE

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ABSTRACT: Floods are the sources of massive scale destruction from the early stages of civilization. Due to increase in the population growth and urbanization which leads to deforestations and a high percentage of the paved surface which blocks the infiltration of water in case of precipitation. Flood is a natural process which cannot be ceased or restrict to occur, thus efficient flood preparation is the need of the time to minimize the damage in flood prone areas. In view of these problems, there are different techniques which prevent the flood destruction in urban areas and low land areas too. Through these techniques, people can face with flood rather than fighting with nature. The study concluded 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 the is idea which is based on buoyancy.

I. INTRODUCTION

Due to climate changes and global warming advances, level of sea rises gradually, which leads to heavy rain, severe hurricanes tsunami, flooding and other natural disasters. Therefore, there is need to adopt effective countermeasure against these disasters especially flooding. Regarding this, concept of Amphibious House has been adopted here, in which it refers to structures that will function both in land and water in response to flood in low lying areas. This configuration allows the houses to rise with the floodwater, mitigating the damage caused by the seasonal flooding. However, this concept is not new to world but still not introduced in our country "India". In this basically buildings, are made for land but same buildings become floating house for water. The idea of Amphibious House gives experiences of living in both water and land. In engineering languages, it can be said as hybrid structure, in which the weight of a structure is partially supported

by both land and water simultaneously. This house designed to be retrofitted to an existing house that is normal circumstances, but to rise with water and float on its surface when flooding occurs, then Settle back in to its original position as the water level decreases.

Kerala state in India occasionally experience heavy seasonal rain that results in flooding. Flooding in Kerala is characterized by heavy rainfall, large discharge from dams& landslides. The state has largest in terms of population in India. Being an area that receives seasonal heavy rains, the state has been facing challenge when they experience heavy downpours as the rain water results in flooding which cause havoc in the areas. Flooding can be defined as the subversion of an area in to water. It can also be defined as the over flow of water beyond, it is confines to area that are considered to be dry areas. Building practices have a great inter depending with the extent of destruction by flood. So, this project focus on how the house where damaged by floods can rebuilt, so as to prevent the impact of the flood on these building in a cost-effective way. It also aimed to check the feasibility of adaption of amphibious house in Kerala climate.

II. MATERIALS AND METHODS

A. WALL MATERIAL-PUF SANDWICHED WALLPANEL

In modern day construction, requirement of high-performance material is essential. High performance entails that the material is strong, yet lightweight, durable and also can be used in variety of applications. For this reliability, polyurethane

products can be one of the best options in this project compared to other available materials such as wood, light weight concrete panel. The density of PUF Sandwiched panel is 40.2Kg/m' compared to wood it is low (Density of wood is 800Kg/m³). PUF is rigid foam, which can unique insulation capabilities. This make PUF panels ideal for building walls and roofs. The insulation capability of PUF panels can save huge electricity costs, maintaining uniform temperature inside the building.

B. PUF SANDWICHED ROOF PANEL

PUF sandwiched roof panel is a structural roof panel with a trapezoidal profile on the top surface and a ribbed liner tray on the underside and a sandwiched insulation cover. Compared to other roof panel like fibred cement board the PUF roof panel is light in weight, more economic and heat and fire resistant.

C. COMPOSITE FLOORING

Composite floor and decking come in a variety of guises and is used to produce arrange of structurally and resource efficient flooring systems for an array of applications. It is constructed of slabs and beams acting compositely together. Composite floor consists of a concrete topping cast on to metal decking. Composite floor slabs use metal decking then concrete, either light weight or normal weight, is pumped on to the decking to makeup the composite system. The metal decking acts as long-lasting framework for the concrete, eradicating the need for props, and as a malleable reinforcement for the slab. Also, in the case of a fire, there are steel bars embedded in the concrete slabs, which prevent cracking and safe guards against degradation of the decking.

D. WOOD

Wood is a natural ecological material. Today, in architecture, wood is used not only in the traditional way but there are also present numerous products of wood industry. The modern method of treatment of the facades involves multi-layered facades as an assembly of a facade layer, which consists of several layers: the structural part, thermal insulation and final facade cladding.

E. STEEL

Steel frame is a building technique with a "skeleton frame" of vertical steel columns and horizontal I-beams, constructed in a rectangular grid to support the floors, roof and walls of a building which are all attached to the frame. The development of this technique made the construction of the skyscraper possible. I Section, steel channel, steel tubes are used for construction.

F) Methods

This house is raised during flood by the principle of buoyancy. Buoyancy or up thrust, is an upward force exerted by a fluid that opposes the weight of an immersed object. In a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. Thus, the pressure at the bottom of a column of fluid is greater than at the top of the column. Similarly, the pressure at the bottom of an object submerged in a fluid is greater than at the top of the object. The pressure difference results in a net upward force on the object. The building has mainly divided two parts one is super structure and sub structure. The super structure should be made weightless materials discuss above and the sub structure in which an existing structure is retrofitted to allow it to float as high as necessary during floods while remaining on the ground in normal conditions. The system consists of buoyancy blocks such as foam block underneath the house that provide flotation, vertical guideposts that prevent the house from going anywhere except straight up and down, and a structural sub-frame that ties everything together. It has a structural sub frame that attaches to the underside of the house and supports the flotation elements, or buoyancy blocks. Extensions of the structural sub frame attach to the



tops of vertical guidance poles near the corners of the house that telescope out of the ground to provide resistance to lateral forces from wind and flowing water. When flooding occurs, the foam blocks lift the house by the principle of buoyancy. Retaining wall provided on ground and the structural subframe lying inside the retaining wall without contact retaining wall. And the retaining wall also resist soil erosion. Fix sensor for alerting mechanism to inform about the flood condition in that area to fire force police or other related departments. This floating home provide safe shelter to people during flood conditions Add one more section for stability calculations and other technical parts and about the floating set up arranged beneath the structure by accommodating below basement formed by a retaining wall set up. Also center of Gravity and about the structural calculations of light weight steel done by a software, Staad Pro.

III. CALCULATION OF STABILITY

A body is said to be in stable state if the metacenter Mm lies above the center of gravity .in other word the metacentric height (M.G) is positive Centre of gravity=sum of moments/total weight of body.

$$\begin{aligned} \text{Sum of moments} &= -(15.4^{3.75}) \\ &+(11.381^{3.75}) \\ &+(11.053^{3.75}) -(14.274^{4.1}) \end{aligned}$$

$$- -27.153 \text{ KNM}$$

$$\text{Total weight of body} = 13957$$

$$\text{Centre of gravity} = -0.002\text{m}$$

$$\text{Weight of fluid displaced} = \text{weight of body}$$

$$d \times A \cdot p$$

$$d (7.5^{8.2})^{997}$$

$$d = 13957$$

$$= 13957$$

$$-0.23\text{m}$$

$$MB = I/Vs$$

$$= bd^3/12/A^d$$

$$= 8.2^{7.5} / 12 / 7.5^{8.2 \cdot 0.23}$$

$$= 24.36$$

The center of buoyancy (C.B) will be half of the MG height of the submerged part of the body.

$$= 24.36 - (-0.117)$$

$$= 24.477\text{m} > 0$$

CB

$$=0.23/2$$

$$=0.115m$$

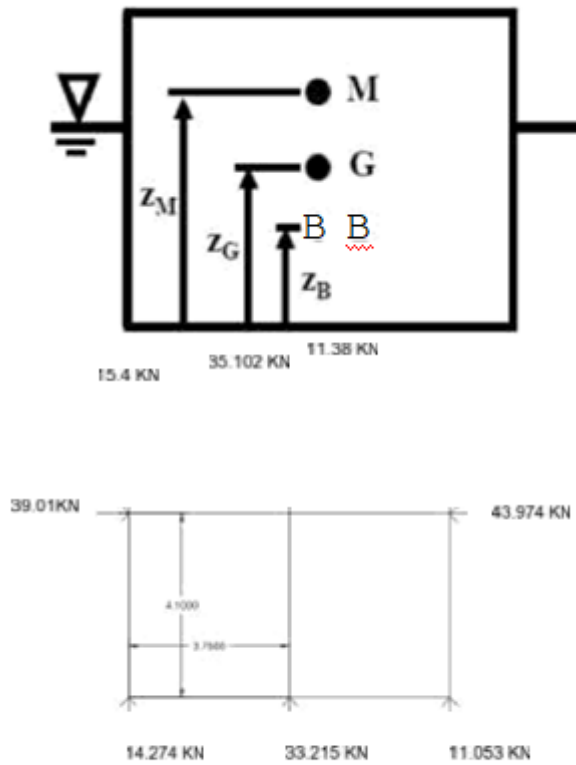


Fig. 1: center of gravity of home

$$MG = MB - GB$$

$$GB = CG - CB$$

$$= -0.002 - 0.115$$

$$= -0.117m$$

$$MG > 0$$

IV. SANITATION — TRIPIKON

We have used Tripikon technology for sanitation of amphibious home. Tripikon is chosen because of its simplicity in installation, low operational and maintenance costs, and it has been implemented in some sand filter is used as an external filtration unit in both septic tank and Tripikon places in Indonesia with BOD reducing efficiency of almost 30% to 40%.

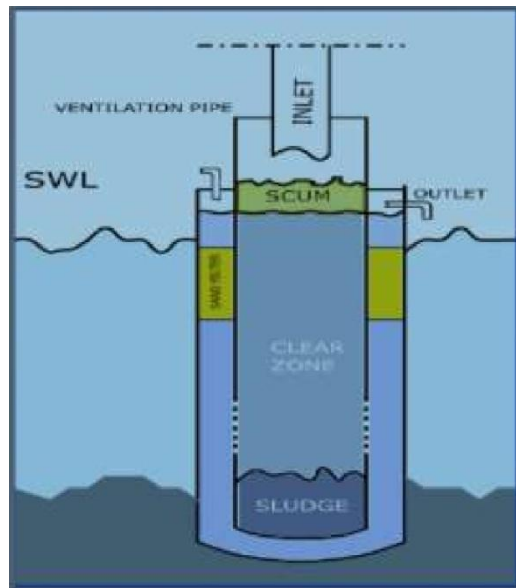


Fig. 2: Three Layers of Tripikon

The main design of Tripikon is focused on the dimension of the central and outer pipe as a storage for sludge from physical settling, which requires two to four-day detention time similar to that for the conventional septic tank. Hence, the central pipe should have enough space/depth in order to make sure that there is no turbulence that could disrupt the process. Normally, the depth of Tripikon must be higher than the highest sea water level during the high tide to make sure that sea water does not get into the Tripikon. In this research, Tripikon was designed with depth of 4 m and required diameters of the central pipe are given in the Table 1. Another important aspect that was also considered was internal sand filtration. A single filter medium using sand material with effective size of 0.3 mm and uniformity coefficient of 3.2 was installed between the central and the outer pipe.

Table 1 Minimum Tripikon Dimensions (h=4 m).

Table.1 Minimum Tripikon dimensions

3	3	0.23	0.056	0.268	11
5	3	0.38	0.094	0.346	14
6	3	0.45	0.113	0.379	15
7	3	0.53	0.131	0.409	16

V. FINDINGS & RECCOMENDATION

- The Amphibious home will allow people to keep their belongings and family dry from the flood without damage.
- Amphibious homes can react to flood through a unique system that allows the building to rise significant flood conditions ensuring that all habitable space and access to and from the building is dry and above the flood level.
- Amphibious home can be built in areas usually unsuitable for traditional house construction and very prone to flood areas.

- Kerala have large amount of water in the form of rivers, lakes and high density of population those will increase the frequency of flood and sea level rise increase the danger of coastal, river side & low land areas. Due to above all Amphibious homes are highly beneficial.
- A new building typology can be implemented in Kerala which can be the answer for climate changes.
- For tourism developments and for recreation purpose Amphibious homes can also be considered as water front developments.
- Govt agencies and NGOs have to promote thro exhibitions and show rooms for different approaches.

VI. FURTHER STUDY AND FUTURE SCOPE

- This new building typology (Amphibious homes) further study requires for large infrastructures like warehouses, hospitals, industrial enterprises, parking facilities etc
- More study is required for the lighter materials which can be used for the construction. So that the load balancing become easy

VII. CONCLUSION

Amphibious buildings are proven low impact flood protection strategy that gives a community enhanced flood resilience and improves its ability to recover from disaster. When flooding occurs, the water dwelling vertically rises with the water levels to remain safely above water the settles back into places as the water recedes. 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.

Amphibious foundations are a proven, low- cost, low-impact flood protection strategy that can increase a flood-prone community's resilience in the face of disaster. This low impact technology thus provides houses with an even greater resilience to rising flood levels than PSE, without increasing the exposure of the structure to the more regularly occurring strong winds.

REFERENCES

- [1] English. E. "Amphibious Foundations. And the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing", *Paper presented at the International Conference on Urban Flood Management sponsored by UNESCO-IHP and COST Action C22, Road Map Towards a Flood Resilient Urban Environment*, November 25-27, 2009, Paris, France.
- [2] Mohamad Ibrahim Mohamad, Mohammad Ali Nekooie, Zuhilmi Bin Ismail, RoohollahTaherkhani. "Amphibious Urbanization as a Sustainable Flood Mitigation Strategy in South- East Asia", *Advanced Materials Research*, ISSN: 1662-8985, Vols. 622-623, pp 1696-1700,27/12/12.
- [3] Tejas Urkude, Amarchand Kumar, Apoorva Upadhye, Madhura Padwal. "Review on Amphibious House", *International Research journal of Engineering & Technology (IJERT)*, e-ISSN: 2395-0056, p-ISSN: 2395- 0072, Volume: 06, Issue: 1, Jan 2019.