International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 10 | Oct 2021 www.irjet.net p-ISSN: 2395-0072

STABILITY AND RELIABILITY OF AMPHIBIOUS HOUSE IN INDIA

Jevin Sosa John[1], Dr. K. E. Prakash[2]

[1]PG Student, Department of Civil Engineering, Shree Devi Institute Of Technology, Mangaluru, Karnataka ,India.
[2]Principal, Department of Civil Engineering, Shree Devi Institute Of Technology, Mangaluru, Karnataka, India.

Abstract – *Floods being one of the defining components of disaster is not completely preventable but the outcomes can be mitigated with innovative improvements in construction. The report will focus on the importance of amphibious house and know about materials, properties of soil, other climatic condition and load calculation by ETABS and analysis the structure has capable to hold load without failure. I hope this report will help more people living in coastal areas to understand Amphibious buildings so that rather than fighting the flood, they will have chance to mitigate risks.*

Key Words: **Amphibious building, Analysis, ETABS**

1. INTRODUCTION

India is a nation that has huge coastal areas and the majority of the climate comes under the diverse monsoon type. Especially, during 1998- 2018, India was affected by severe floods and thousands of people had lost their homes as an aftermath. Amphibious housing is one such life saving technology that helps us to significantly reduce the damages caused by floods. It is an innovative solution that introduces buoyancy foundation to building during floods. With this foundation, the building that is otherwise resting on a flat ground is capable of raising from the surface whenever a flood occurs. The entire structure rises or lifts up on its dock and floats on the flooded water, after water has drained, the structure will go back to the normal position, thus have no impact from the flood. Since the building has to completely raise off from the ground during floods, it has to be built with lightweight materials.

In Kerala, Gopalakrishnan Achari introduced Amphibious house near Changanassery, Allapey district, Kerala in 2017.

1.1 OBJECTIVES

1. To study the scope of amphibious house in flood effected area.
2. To know the design parameters of amphibious house.
3. To know about the structure is safe when external and dead loads are increased.
4. To know the stability of amphibious house by using analyzing software ETABS.

2. MATERIALS AND METHADOLOGY

2.1 MATERIALS PROPERTY

Based on Specification IS:4923 Square Hollow Section in GI Pipe, Multi- wood sheet, Bison panel and Plastic Barrel. Materials and construction design had taken from Chenganassery, Kerala's project.

2.2 METHADOLOGY

This project have focused on the regions in India where soil strength is the least. I have taken soil properties in Allapey, Kerala and wind speed is taken from maximum wind speed in India . Also, every year India is mostly affected with floods and the natural disaster with respect to wind, seismic movements are also less.

The highest wind speed is in the south west and north east regions, therefore this project has provided the wind effect in these two directions. Due to the reason that its mostly raining half a year in India, the use of wood materials are not feasible. Therefore, material used a combination of steel and multi- wood sheet as building materials and cost of steel is less than timber.

Use ETABS software to calculate whether amphibious structures, lightweight steel frames are capable to hold normal load and analyse external loads are affected to the building.

3. DESCRIPTION OF DESIGN

Design a Residential house of 1300sq.ft. Materials used for analysis are Steel, Wood and Bison Panel. Steel is used for tension and get more protection. Wood is used for wall and Bison panel used for floor. Soil properties is medium sensitive alluvial deposits and coastal areas. Internal and external loads are analysing ETABS Software.

Table – 1: Material size

MATERIALS	SIZE (mm)	THICKNESS (mm)
STEEL PIPE	50X 50 100X 100 150X 150 250X 250	4.50 5.00 5.00 6.00

BISON PANEL	2438X 1219	25
MULTI WOOD	2438 X 1219	25

3.1 ENVIRONMENTAL EFFECTS

The Indian climate is mostly considered as tropical monsoon. It means southern part changes wind direction according to season. This type mainly found in south and south east- asia. During the summer weather conditions the wind prominently blow towards the north east direction and from the south west direction. But during cold climatic conditions the wind blows towards the south west region from the north east direction.

Climate change from varying temperature and precipitation. Kerala has tropical climate with warm and moist air. Most part of India get rainfall during June to September. The Indian Meteorological Department have divided the monsoon climate into two different directions, they are North East and South West.

3.2 SOIL PROPERTIES

Based on previous studies conducted by experts and the Unified Classification System, the soil is categorized as an MH(silt of high plasticity). To test the safety and ensure durability, multiple tests are conducted to analyze the properties of soil. These soil properties are then verified precisely by the standard test requirements that come under the IS code before commencing the construction. Based on the IS code there are certain pre-defined requirements of soil property, the unique gravity of the soil is 2.22%. The soil compressive strength is 20.9kN/m^2 and the CBR Value should be 1.9%.Based on Kuttanad region Kerala, soil is medium sensitive alluvial deposits and coastal areas. So the CBR ratio and shear strength are extremely low therefore this project used site type 3 for my project.

3.3 WIND EFFECT

Wind load design based on IS: 857 (Part3) – 1987, Maximum basic speed in India have 50m/s. Terrain category taken to this project is 2 (sea coast with large sea waves and obstructions height between 1.5 and 10m). Wind load is not taken, when the height of the building is less than 50m. But here the structure is light weight so it has considered.

4. LOAD CALCULATION

4.1 EMPTY PLASTIC BARREL/ AIR TANK WEIGHT CALCULATION

Based on Archimedes principle, the weight of displaced fluid is equal to weight of object.

Weight of Air tank (G)= 9kg/pcs

Diameter of tank = 0.572m

Height of tank = 0.851m

Total weight of tank = 9kg x 10N/kg

= 90N

Calculate buoyancy of air tank with fully submerged

Buoyancy (Fa) of air tank= πd^2/4 x ρgh

= 22/7 x (0.572)^2/4 x 1000 x 10 x 0.851

= 2373.84 Newton/Pcs

= 2374

Total buoyancy of 1 air tank= (Fa- G)

=2374 – 90

= 2284 N/Pcs (upward direction)

Total floating force of 275 air tank = 275x 2284

= 628100 N (upward direction)

Stability structure control on floating footing after lied with Amphibious house

Total weight of Amphibious house structure

=408900N(downward direction)

Stability control (Fa/G) = 628100/408900

= 1.5

Therefore, it is safe and stable calculation. So the 275 air tank is declared safe.

4.2 Internal load calculation

Internal load given to the structure of dead and live load is 3KN/m3 and 2.4KN/m3 respectively.

4.3 External Load Calculation

Seismic load

The Seismic Load can be calculated under IS1893 2002 by using analysis software ETABS.

Direction: There can be multiple directions assigned

Stability Ratio = every diaphragms must precisely be 5%

The Zone factor for Seismic, Z= 0.36.

The reduced response rate, R= 5.

Importance or significance rate, I= 1.

Site or location Type = III.

The response time required for Seismic,

The time must be calculated= This is precisely done by the software

Spectral enhancement Coefficient, S_a /g [IS 6.4.5]

$S_a/g = 1+ 15T$

S_a/g= 1.795429.

Equal Side Forces

The Coefficient, A_h [IS 6.4.2]

$Ah = (ZI \times S_a/g)/2R$

Table – 2: Seismic load analysis

Floor	Height (M)	X- Axis(KN)		Y- Axis(KN)	
		x-dir	y-dir	x-dir	y-dir
Story2	6.4	0	0	0	0
Story1	3.2	25.225	0	0	25.225
Base	0	0	0	0	0

Wind load

We can calculate the lateral wind pressure for different patterns based on the Indian IS875:1987.

Structure standard = Class A

Region classification = Category 2

Breeze path= 0.90 degrees

Basic breeze acceleration, V_b [IS Fig. 1]

Windward Coefficient, $C_{p,wind}$

Leeward Coefficient, $C_{p,lee}$

V_b= 50m/s

$C_{p,wind} = 0.8$

$C_{p,lee} = 0.5$

Above Story = Story2

Below Story = Base

Include Parapet = No

Risk Coefficient, k_1 [IS 5.3.1]

Topography Factor, k_3 [IS 5.3.3]

$K_1 = 1$

$K_3 = 1$

Wind force, V_z [IS 5.3]

Wind Pressure, p_z [IS 5.4]

$V_Z = V_b x\ k_1 x\ k_2 x\ k_3$

$P_Z = 0.6V_Z^2$

$V_Z = 50$

Table – 3: Wind load analysis

Floors	Height (M)	X- Dir (KN)	Y- Dir (KN)
Story2	6.4	0	0
Story1	3.2	0	0
Base	0	0	0

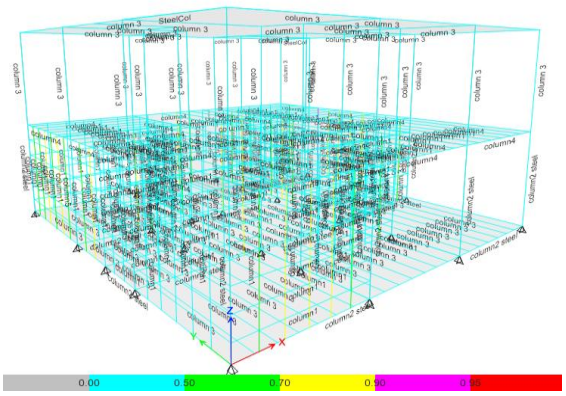

Fig-1: ETABS FRAME ANALYSIS

4.4 LOAD COMBINATION ANALYSIS

The given load combinations are classified into four different load types, they are wind load, self load, current load and seismic load.

The given load combinations are

1.5(DL+ LL+ SL)

1.2(DL+ SL)

1.5x DL + 1.2x SL

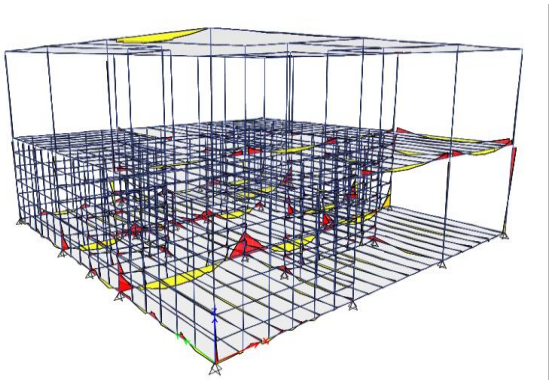

Fig-2: ETABS LOAD COMBINATION ANALYSIS

5. RESULT AND DISCUSSION

5.1 RESULTS

Amphibious houses are safe on both low strength soil as well as when the external loads increases (wind load, seismic load). Therefore, this concept is highly effective in flood prone regions and is also stable under every other climatic conditions.

5.2 DISCUSSIONS

When analyzed, light weight material show its safe to use but if the weight exceeds the proposed limit then the structure will fail. Therefore, building large structures are not feasible with light weight materials. These structures are appropriate for the flood prone areas in India. Also, can be leveraged in areas where the soil strength is low such as coastal areas etc.

6. CONCLUSIONS

1. Areas in India that would significantly benefit for coastal areas.
2. Due to the severe climate changes, more resilient homes are required in India.
3. This type of structures can be easily implemented in India.
4. The introduction of innovative technology and tools such as ETABS has significantly helped in seamlessly building amphibious homes.
5. The homes are cost effective to build and will help people mitigate the cost of flood damage, rehabilitation and livelihood.
6. Even with the numerous benefits, amphibious houses are still not popular in India because of the lack of awareness.
7. Reports and studies such as these, will help developers and rural planners focus more on building amphibious houses.

REFERENCES

[1] IOP Conf. series: Earth and Environmental science 498 (2020) 012066. Indian codes IS 456: 2000, IS 800, IS: 857 (Part3) – 1987, IS 1893: 2002.
[2] Elisabeth English, Natasha Klink and Scott Turner, "Thriving with water: Developments in Amphibious Architecture in North America,"
[3] Case study of 'The Thames Amphibious House'. www.construction21.org
[4] Construction of amphibious house in Kerala.
[5] Sandhya K. "Amphibious Architecture in India," Da Vinci School of Design and Architecture, Karapakkam, Chennai.
[5] Buoyant Foundation Project Inc, www.buoyantfoundation.org
[6] ETABS Software and google.
[7] ISSN: 2278-0181, Vol. 5 Issue 09, September-2016