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Research Article

Design Of Amphibious Structure

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ABSTRACT

Amphibious structures, also known as floating or flood-resistant structures, have emerged as a promising solution to mitigate the devastating impacts of flooding in low-lying and flood-prone regions. This abstract presents an overview of the design considerations and strategies employed in the development of amphibious structures, focusing on enhancing resilience and minimizing damage during flood events. The design of amphibious structures encompasses several key aspects. First, the foundation is designed to provide stability and buoyancy. Various techniques such as elevated platforms, stilts, or buoyant materials are utilized to elevate the living space above the flood level while allowing the structure to rise and fall with changing water levels. This design approach minimizes structural damage, reduces flood risk, and protects occupants and belongings.

Keywords: -Floods, Flood Mitigation measure, Amphibious House.

1 INTRODUCTION

1.1 CONTEXT OF FLOOD

A flood is an overflow of water on land which is Usually dry. Sometimes a water resource (river, lake or pond) gets flushed with too much water. Unusually heavy rain sometimes causes floods. When there is too much water, it may overflow beyond its normal limits. This water then spreads over land, flooding it. Extreme flooding can also because by a tsunami or a large storm that causes a storm surge. Floods that happen quickly are called flash flood. During a flood, people try to move themselves and their most precious belongings to higher ground quickly. The process of leaving homes in search of a safe place is called evacuation.

1.2 EFFECTS AND CAUSES OF FLOOD

Causes Occurrence and Reoccurrence of prolonged heavy rain shower has resulted to floods all over the world Flood are caused by many factors: heavy rainfall, high accelerated snow melt, severe wind over water, unusual high tide, tsunamis, or failure of dams, retention ponds, or other structures. Climate changes also an attribute that cause flooding because when the climate is warmer it results in heavy rains, relative sea level continue to rise around most shore, extreme sea levels will be experienced more frequently. Therefore, climate changes are likely to increase flood risk significant and progressively over time. Effects The primary effects of flooding include loss of life and damage to buildings and other structures, including bridge, roadways, and canals. Floods also frequently damage power transmission and sometimes power generation which then has knock-on effects caused by the loss of power. This includes loss of drinking water treatment and water supply; it may also cause the loss of sewage disposal facilities. Lack of clean water combined with human sewage in the flood waters raises the risk of waterborne diseases, which can include typhoid, many other diseases depending upon the location of the flood. Damage to roads and transport infrastructure may make it difficult to mobilize aid to those affected or to provide emergency health treatment. Flood waters typically inundate farm land, making the land unworkable and preventing crops from being planted or harvested, which can lead to shortages of food both for humans and farm animals.

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1.2PROBLEM FACED BY INDIA DUE TO FLOOD

India is one of the world's most flood-prone countries, with 113 million people exposed to floods. According to a United Nations report, India's average annual economic losses due to disasters are estimated at US$9.8 billion (S$13.1 billion), of which over US$7 billion can be attributed to floods. Flooding in urban areas is most visible in the monsoon season, which extends from June to September every year. In the past decade, major cities such as Kolkata, Chennai, Delhi, Guru gram and Bengaluru have suffered havoc similar to that seen in Mumbai. Climatic impact on urban environments demands greater scrutiny and better planning. India has failed to offer any long-term solutions. India's southern state of Kerala is suffering its worst monsoon flooding in a century, with more than one million people displaced, and more than 400 reported deaths in the past two weeks. Aid agencies and government groups have set up more than 4,000 relief camps, while rescue personnel are making their way to submerged villages in helicopters and boats, bringing supplies, and evacuating those they can find. Only in recent days have floodwaters begun to recede, allowing more access for aid workers and rescuers. As of 18 July, incessant rain in the southern Indian state of Kerala has forced more than 34,600 people to seek refuge in 265 relief camps across the state, with flood.

1.3WATER DWELLING TECHNOLOGIES

- TERP DWELLING
- STATIC ELEVATION
- PILE DWELLING
- AMPHIBIOUS DWELLING

2 AMPHIBIOUS STRUCTURE

2.1 An amphibious house, also known as a floating house or flood-resistant house, is a unique type of residential structure designed to withstand flooding and adapt to changing water levels. These houses are built on a platform or structure that allows them to float during flood events, minimizing the risk of damage to the property and providing a safe living space for occupants.

Here are some key features and details about amphibious houses:

1. Foundation and Structure: The foundation of an amphibious house typically consists of a buoyant platform or a series of buoyant elements, such as pontoons or concrete chambers. This allows the house to rise and fall with the water level, preventing it from being completely submerged during floods.

2. Design and Construction: Amphibious houses are carefully designed and constructed to withstand floodwaters. They are typically built with lightweight and durable materials, such as timber or steel frames, which provide strength and flexibility.

3. Buoyancy and Ballast: To ensure stability, amphibious houses incorporate various buoyancy and ballast mechanisms. Buoyancy elements, such as air-filled containers or foam blocks, help the house float during floods. Ballast elements, such as concrete or water tanks, provide stability during non-flood periods.

4. Vertical Guidance Systems: Amphibious houses employ vertical guidance systems that allow them to rise and fall vertically with changing water levels. These systems can include vertical guideposts, poles, or rails that guide the house's movement.

5. Utilities and Services: Amphibious houses require specialized infrastructure to ensure the provision of utilities and services during floods. For example, flexible utility connections are used to accommodate vertical movement, and provisions are made for sewage and wastewater management.

6. Flood-Resistant Design: The design of an amphibious house incorporates flood-resistant features, such as waterproofing materials, flood barriers, and watertight doors and windows. These measures help to minimize water infiltration and protect the integrity of the structure.

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7. Accessibility: Amphibious houses are designed to ensure accessibility for occupants during both normal and flood conditions. This includes the use of elevated walkways or ramps that connect the floating house to the land, allowing residents to enter and exit safely during floods.

8. Environmental Considerations: Amphibious houses often prioritize environmental sustainability. They may incorporate energy-efficient features, such as solar panels, rainwater harvesting systems, and passive heating and cooling strategies, to reduce their ecological footprint.

9. Regulatory Compliance: Construction of amphibious houses must adhere to local building codes and regulations related to flood resilience, buoyancy, and safety. These regulations vary across different regions and countries.

10. Benefits and Limitations: Amphibious houses offer several advantages, including increased flood resilience, reduced risk of property damage, and the ability to remain habitable during flood events. However, they may require higher initial costs compared to conventional houses, and maintenance and insurance considerations should be taken into accounts

2.2 Common materials employed in the construction of buoyant foundations:

1. High-Density Closed-Cell Foam: Closed-cell foam, such as extruded polystyrene (XPS) or polyethylene foam, is a popular choice for creating buoyancy in the lower portion of an amphibious house. It is lightweight, water-resistant, and provides excellent buoyancy while maintaining structural integrity. The foam can be shaped into blocks or panels and installed within the foundation structure.

2. Sealed Plastic or Metal Containers: Watertight containers, such as plastic drums or metal tanks, can be incorporated into the foundation design. These containers are filled with air or another buoyant material, such as foam beads or polystyrene balls, to create buoyancy. They are strategically positioned and securely sealed within the foundation structure to prevent water infiltration.

3. Pontoons: Pontoons are large, buoyant structures typically made of steel, concrete, or fiberglass. They are designed to provide buoyancy and stability to floating structures. Pontoons can be integrated into the foundation design, either as separate units or as interconnected compartments, to support the amphibious house and ensure flotation during flooding.

4. Fiberglass Reinforced Plastic (FRP): FRP materials, such as fiberglass composites, offer excellent strength-to-weight ratio and corrosion resistance. FRP panels or shapes can be used to construct buoyant elements within the foundation. They are lightweight, durable, and can be custom-made to fit specific design requirements.

5. Air-Filled Chambers: Another approach is to incorporate air-filled chambers within the foundation structure. These chambers can be created using airtight membranes or inflatable materials. The air-filled chambers provide buoyancy and can adjust to changing water levels, allowing the house to float during flooding.

3 ANALYSIS AND DESIGN

3.1DESIGN PARAMETERS

Number of storey	**2**
Storey height	3m
Floor area	75m²
Concrete	M20
Type of concrete	Light weight
Steel	Fe500
Beam	230X450mm
Column	230X450mm

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3.2 To determine the base reaction in Etabs, follow these general steps:

1. Model Creation: Create a 3D model of your structure in Etabs, including the columns, beams, slabs, walls, and any other structural components. Specify the material properties and section properties for each element.

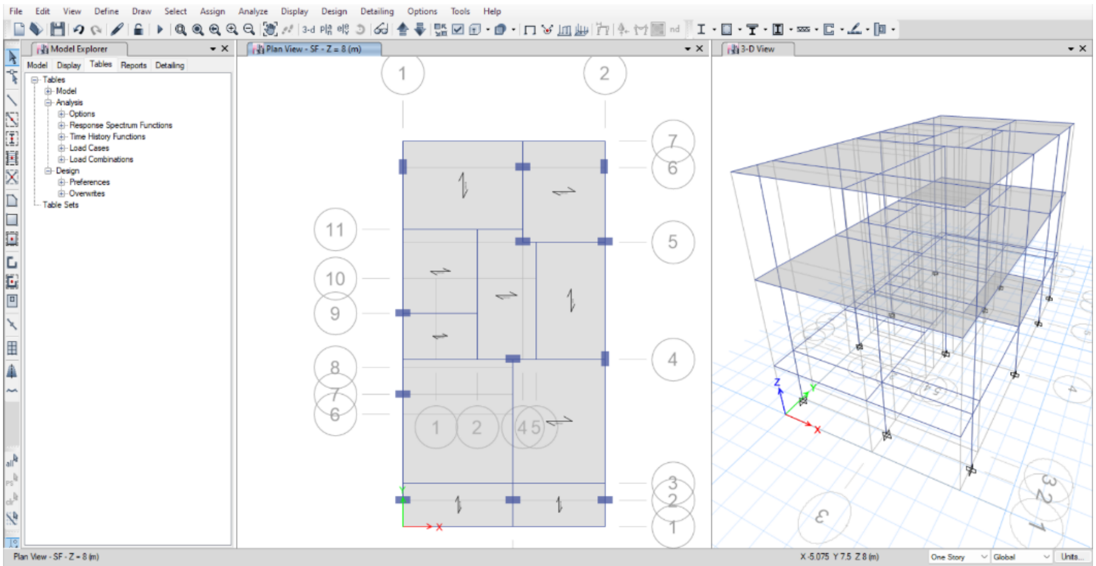
2. Load Assignments: Apply the appropriate loads to the model, such as dead loads, live loads, wind loads, and seismic loads. You can define loads manually or use load generators within Etabs to automate the process.

3. Define Support Conditions: Assign appropriate support conditions to the foundation or base of your structure. This typically involves fixing or constraining the degrees of freedom (translations and rotations) at the base supports to simulate the interaction with the ground.

4. Analysis Options: Configure the analysis settings, such as the analysis type (static or dynamic), the method of analysis (linear or nonlinear), and any relevant parameters related to the specific analysis method chosen.

5. Run Analysis: Initiate the analysis in Etabs to compute the structural response of the building to the applied loads. Etabs performs a comprehensive analysis, considering the interaction of all structural components and applying the specified loads.

6. View Analysis Results: Once the analysis is complete, you can access various output results, including the base reactions. Etabs provides detailed reports, tables, and diagrams to visualize and interpret the forces and moments acting on the foundation.



model creation

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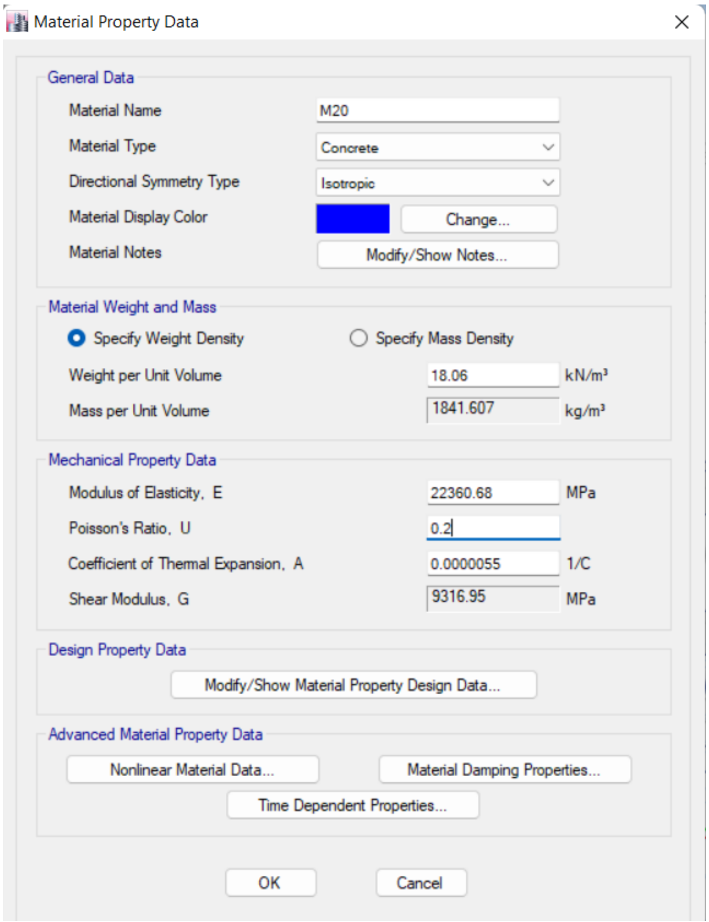
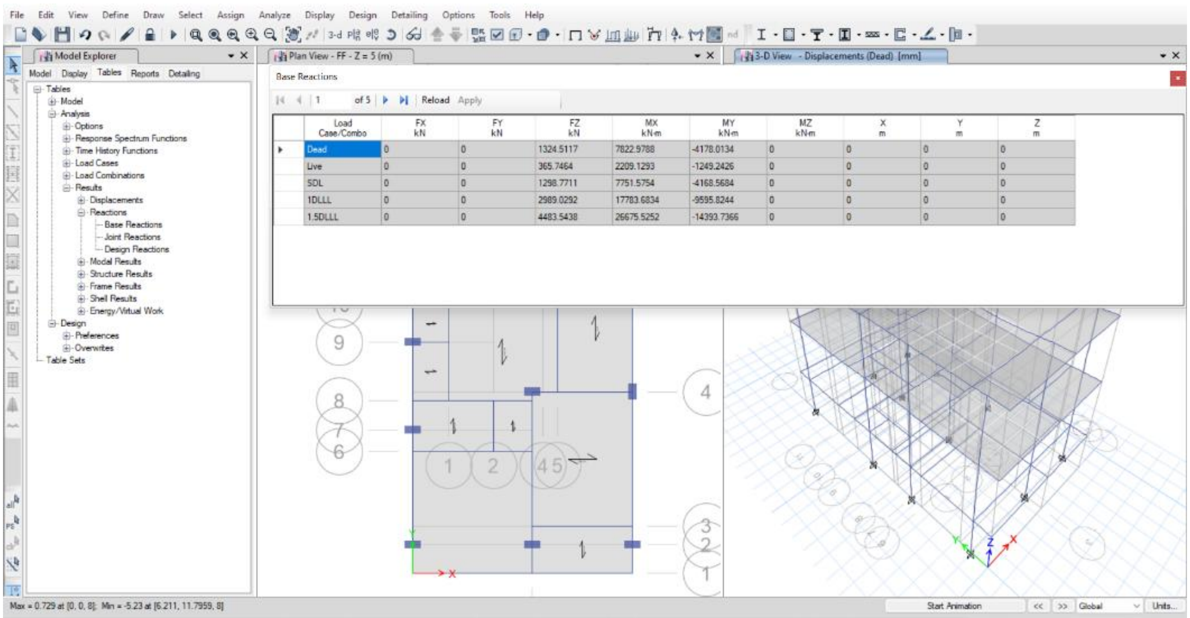


Light weight concrete



Base reaction

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Base reaction = 1690.2 KN

Design of amphibious foundation

The principle of a buoyant foundation is based on the Archimedes' principle, which states that an object immersed in a fluid experiences an upward buoyant force equal to the weight of the fluid displaced by the object. In the context of a buoyant foundation for an amphibious house, the principle is applied to create a foundation that can float or rise with the water level during flooding, reducing the risk of structural damage.

The key principle behind a buoyant foundation is to design the lower portion of the structure to be less dense than the surrounding water. By ensuring that the weight of the structure, including the foundation, is less than the weight of the water it displaces, the foundation can achieve buoyancy and float during a flood event.

CALCULATION OF FLOATING PLATFORMS WITH PLASTIC BARRELS

The calculation analysis of plastic barrels floating footing is conducted to identify the power of the floating footing to be able to withstand the weight of the floating house structure, so it can be identified how many plastic barrels needed to withstand the load of the floating house, with a defined amount of structural stability.

Calculate the Weight of Empty Plastic Barrel

Weight of Plastic Barrel (G) = 8.6 kg /pcs

Diameter of Plastic Barrel = 0.58 m

Height/Length of Plastic Barrel = 0.93 m

Total Weight of Plastic Barrel in Newton = 8.6 kg x 10 N/kg

= 86 Newton

Calculate Buoyancy of fully submerged plastic barrel

Buoyancy (Fa) of Plastic Barrel = π. d2/4. e.g. L (d =inner diameter)

= (22/7) x (0,58)2/4 x 1000 x 10 x 0.93

= 2456 Newton /pcs

So the total buoyancy of 1 Plastic Barrel is (Fa - G)

= 2456 - 86

= 2370 Newton/ pcs (upward direction)

Therefore, to resist 1690200 N of structural weight number of barrels required are

1690200/2370 = 714 barrels

4 CONCLUSION

Recently many type of flood resistant techniques come forward all around the world. It is observed that amphibious foundation is a new innovative way to reduce damages caused by massive floods.

Amphibious foundation also enable to develop safe structures near water bodies/flood zone area

It can be concluded that an rcc residential structure of 75m² can float on water by buoyant foundation of 714 plastic barrels

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