iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: V Month of publication: May 2025

DOI: https://doi.org/10.22214/ijraset.2025.70444

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

Floating Architecture in Flood Prone-Area

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Abstract: The floating architecture allows for dealing with the damage that has been promoted to the environment and herbal resources by providing extra space and electricity assets for humans. A futuristic perspective starts evolvingby reviewing the want for floating systems and their scope for the improvement & increase of towns.

As known India is extremely prone to floods. More than 40 million hectares (MHA) are flood-prone. Floods are a common occurrence that kills many people and destroys livelihoods, property, infrastructure, and public services. Flood-related damage is on the rise, which is the reason for concern. This can be ascribed to a variety of factors, including rapid growth in population, rapid urbanization, increased development and commercial activity in flood plains, and global warming. (National Disaster Management Athority, India, n.d.)

In the northern regions where people are forced to relocate during the season as a preventive measure floating structures can be of great relief. Either by replacement in a few construction techniques or by incorporating certain techniques from the initial stage. Principles of Floating Architecture can be used to develop residential units for people who do not need to relocate annually, and floods cause less damage to the infrastructure.

Keywords: Floating Architecture, Floating Foundations, Modular Structures, Sustainable Architecture, Coastal Construction, Indian Floods, Flood Solutions.

I. INTRODUCTION

Floating architecture is a popular solution in flood-prone areas as it can lessen flood damage. Designing and constructing buildings that can rise and fall with the level of the water reduces the risk of damage.(Matsukawa, December, 2011)

Several design considerations need to be considered when designing floating architecture in flood-prone areas. These include the materials used, the structure's weight, and the foundation's stability.

Due to their lightweight and water resistance, materials like wood, plastic, and steel are frequently used in the construction of floating structures. To guarantee that the structure is both light enough to float and hefty enough to maintain stability, the weight of the structure must also be carefully addressed. Also, the structure's base needs to be built to withstand the forces of the water. The foundation may be built to float on top of the water or be fixed to the riverbed. Pontoons or other flotation equipment can be used to further stabilize the structure. When creating floating architecture in flood-prone areas, it's crucial to take local rules and building codes into account in addition to architectural concerns. It is crucial to speak with local authorities and subject-matter specialists because these laws may differ depending on the area.(Nakajima Toshio, August, 2021)

In general, using floating structures to minimize flood damage in flood-prone areas can be a good idea. To guarantee the stability and safety of the structure, thorough design considerations and respect for local requirements are crucial.

II. DEFINING FLOODS & FLOOD-PRONE AREAS

Floods are unavoidable natural disasters that happen when there is an overwhelming amount of water in a particular location, frequently as a result of severe rainfall, snowmelt, or coastal storm surges. Floods have the potential to destroy large portions of infrastructure, as well as houses, businesses, and even entire cities.

According to their severity and frequency, floods can be classified into several different groups. For instance, flash floods are catastrophic floods that happen at any time and suddenly, typically in low-lying areas. On the other hand, as water levels rise in rivers and streams, river floods become more sporadic and persist over a longer period.

In many places of the world, the frequency and intensity of floods have increased recently as a result of climate change. As a result, it is crucial for communities to be ready for the possibility of floods and to take action to lessen their effects, such as creating flood-resistant infrastructure.

Areas that are more likely to experience floods because of their location, terrain, and other environmental factors are known as flood-prone zones. Heavy rainfall, storm surge, and overflow from rivers, lakes, and other bodies of water are only a few of the causes of floods.

Some common examples of flood-prone areas include:

1) *Coastal regions*: Due to the possibility of storm surges, high tides, and rising sea levels, areas close to the coast are particularly vulnerable to flooding.
2) *River basins*: Locations near rivers with floodplains are more susceptible to flooding, particularly during severe rain or when the snow melts in the spring.
3) *Low-lying areas*: Areas that are lower in elevation than the terrain around them are more susceptible to flooding, particularly during periods of severe precipitation or storm surges.
4) *Urban areas*: Because of insufficient drainage systems and the abundance of impermeable surfaces like concrete and asphalt, cities and other highly populated places are susceptible to flooding.
5) Residents of flood-prone locations should have a plan in place, be ready for future flooding events, and heed any instructions from local authorities ordering an evacuation.

III. FLOATING ARCHITECTURE FOR FLASH FLOODS

Many people are working on solutions for flood-resistant architecture. Following Hurricane Katrina's damage to the state's important property, flood-proof housing was planned in the Netherlands. Where developers were constructing a collection of amphibious homes along the Maas River in a flood-prone area. The dwellings stood on massive steel pillars that were connected to hollow concrete boxes. The boxes would provide buoyancy during a flood, acting like the hull of a ship. The structures would float on the water's surface and slide up the pillars as the waters rose. The homes would drop to their former placements as the waters subsided. It was a sophisticated answer.

A hollow foundation requires significant building work, but to what extent are these structures simple and affordable?

A non-profit organization known as the Buoyant Foundation Project started working with a group of architects and engineering students in 2006 to develop a strategy for converting neighborhood homes to have amphibious foundations. The researchers reasoned that because a typical New Orleans shotgun home rests on top of short piers, it might be raised off the ground by attaching a steel frame and a pair of foam buoyancy blocks.

Using poles that had been driven into the ground and fastened to the corners of the frame, the house could then be raised off the piers without floating down the street. The system's full-scale prototype was created and tested in the summer of 2007. The technique was straightforward and affordable; it could be erected by two relatively skilled individuals without the need for heavy machinery for $10 to $40 per square foot. It was more durable than permanent elevation, which may cost two or three times as much and makes a building more vulnerable to wind damage, and it virtually preserved the appearance and structure of a building.(Amily, 2018)

IV. HOW ECONOMICAL IS FLOATING CONSTRUCTION?

Due to several factors, floating construction can occasionally be less expensive than conventional construction techniques.

Less expensive land purchase, site preparation, and excavation costs are avoided with floating construction. This has a substantial impact on lowering building costs overall.

1) *Reduced foundation requirements*: Compared to building on the land, building on water requires less foundation work. Floating construction often makes use of more straightforward and lightweight foundation solutions as opposed to deep and complicated foundations.
2) *Prefabrication and simplicity of assembly*: It is possible to prefabricate floating building components off-site, which can reduce labor and material expenses. Also, it is typically quicker and simpler to assemble the prefabricated parts on-site than it is to use traditional construction techniques.
3) *Reduced regulatory requirements*: In some locations, the regulations governing floating construction may be less onerous than those governing more conventional construction techniques. As a result, the time and money required to get the relevant permits and approvals may be cut.
4) *Flexibility and adaptability*: Compared to conventional structures, floating structures are frequently more flexible and adaptive. If the structure needs to be relocated or modified in the future, it will be less expensive to move or modify them than demolish them and rebuild them.(Bhanumurthy P)

Overall, depending on the particular project, location, and other criteria, floating construction might result in different cost savings. Nonetheless, there are some circumstances where using floating construction might be a more economical and effective option than using conventional construction techniques.

V. STRUCTURE INSTALLATION BY THE COMMON MAN

Several variables, including the structure's size and complexity, location, and local laws, will affect how simple it is to install a modular floating structure. Yet, in general, with some basic DIY skills and the correct tools, modular floating constructions can be reasonably simple for the average person to install.

The pre-built units of modular floating buildings are readily carried to the location and put together there. They are made to be easily attached to form a larger structure, which allows for customization and makes them adaptable to various demands and settings.

The average person must adhere to a few fundamental procedures to install a modular floating structure:

1) *Decide on a good location*: The site must meet municipal standards and be appropriate for the sort of construction being erected.
2) *Site preparation* includes clearing and leveling the area, as well as installing any necessary utilities.
3) The building should be *anchored to the waterbed* or the beach to stop it from drifting away.
4) *Build the structure*: Bolts and screws make it simple to join the modular components.
5) *Complete the installation*: After the building is put together, any last-minute details, including plumbing and electrical connections, can be added.

It's crucial to remember that certain places can need permissions or authorization from local authorities, and it's crucial to make sure that the installation project is It's necessary to keep in mind that some places might need permission or approval from local government, and it's crucial to make sure that installation procedure conforms with local laws and safety requirements. (Tahtamouni, June 2014)

Ultimately, the average person can erect a modular floating structure rather readily with the correct planning, supplies, and instructions, creating a distinctive and practical living or working place on the water.

VI. THE TECHNICALITY OF A FLOATING STRUCTURE

Typically, there are two fundamental building principles for floating homes. The primary is the pontoon principle, which creates a solid platform this is lighter than the water, and the ship principle, which produces a hollow concrete container with an open top. The hollow concrete box has the advantage of improved space utilization inside as a part of the building, whilst the pontoon principle offers the benefit of its use in shallow water. Both varieties of floating homes are attached to the quay by a flexible connection, allowing the homes to rise and fall with the tide.

The homes are situated inside a wet dock made up of base slabs and retaining walls. Flooding causes the dock to fill with water, which causes the houses to rise. Similar to how when the water recedes, buildings collapse. Such homes all have flexible water, gas, electricity, and sewage disposal pipes, ducts, and wires that are made to continue working even when the home is raised several meters beyond its normal position. According to the architects, Factor Architecten, when the river is flooded, the dwellings will float up to 18 feet and then descend as the water recedes.

It can be difficult to provide utilities like electricity, toilets, and water supply in a floating home. Hence, the floating homes that employ non-traditional energy sources, make use of waste products, and recycle water must adhere to the green construction idea. Buildings with net zero energy are more practical since their whole energy needs are satisfied by on-site generation, which eliminates the need for extra energy from outside sources. Typically, solar panels are offered to meet electricity needs. Roof gardens are also growing in popularity due to energy efficiency requirements and aesthetic standards. Additional approaches include installing "incinolet toilets" that burn waste, installing geothermal pond loops on the floor, and installing filtration systems for rainwater collection. Due to the usage of water cooling systems, the Netherlands' "New Water" building was designed to consume 25% less energy than a conventional structure.(Soni, January 2016)

VII.ALTERNATIVE FOR MAKING THIS MORE AVAILABLE AND COST-EFFICIENT WITHOUT ALTERING THE TECHNIQUES

Using prefabrication and modular building strategies is one way to increase the accessibility and cost-effectiveness of floating structures without changing the methodology.

Prefabrication entails building the floating structure's parts in a factory or workshop before transporting them to the assembly location. By enabling mass production and component standardization, this approach can speed up construction and save costs.

The floating structure is designed using modules or pieces that may be quickly and easily linked on-site to create the finished structure. By enabling off-site fabrication, better quality control, and decreased waste, this technology also reduces costs.

Floating buildings can be produced more rapidly, effectively, and affordably by integrating prefabrication and modular construction methods while still utilizing the same fundamental technologies and materials. Also, this method might increase the end product's consistency and quality, which will appeal to more customers.

The operational costs and environmental impact of floating structures can be further decreased in addition to these building techniques by using sustainable design concepts and renewable energy systems, making them more affordable and accessible to a larger range of people. (Nakajima Toshio, August, 2021)

VIII. FLOATING ARCHITECTURE IN THE CONTEXT OF FLOOD-PRONE AREAS OF INDIA

Floating buildings can be produced more rapidly, effectively, and affordably by integrating prefabrication and modular construction methods while still utilizing the same fundamental technologies and materials. Also, this method might increase the end product's consistency and quality, which will appeal to more customers.

The operational costs and environmental impact of floating structures can be further decreased in addition to these building techniques by using sustainable design concepts and renewable energy systems, making them more affordable and accessible to a larger range of people. As a result, research can be used as a template for this kind of design. With these methods, lifeline structures can first be built in flood-prone locations. Even when they are shut off from outside power and water sources due to flooding, these structures will continue to function. Such homes will undoubtedly be embraced in the islands and coastal regions sooner or later, so Indian architects and designers should start gaining knowledge in this area to create such homes.

India might make a significant amount of money by building floating homes for tourists who would love to dwell in them.

IX. MATERIALS AND TECHNIQUES

Floating constructions frequently employ a variety of methods, including:

1) *Buoyancy*: The technique of Buoyancy, which is the upward force that keeps the structure afloat, is the most crucial one used in floating constructions. Designing the structure to move a volume of water equal to its weight results in buoyancy. Usually, hollow constructions are used for this, or buoyancy modules are added to the structure.
2) *Ballasting*: Ballasting is the process of changing the structure's weight to change its buoyancy. This is commonly accomplished by adding or removing water from inside-the-structure ballast tanks.
3) *Mooring*: The act of mooring involves anchoring the structure to the ocean floor or a permanent structure, such as a pier. This is often done using anchors, chains, and cables.
4) *Dynamic Positioning*: With this technique, the structure is maintained in a fixed position concerning the ocean floor or a particular spot on the water's surface. To change the position of the structure, thrusters or propellers are commonly used.
5) *Wave energy absorption*: Floating structures can be made to capture the energy of incoming waves from the ocean, which can then be used to generate electricity. Wave energy converters—devices that utilize the motion of the waves to generate electricity—are commonly used for this.
6) *Passive Anti-Rolling Tanks (PART)*: These tanks use water flow to counterbalance the motion of the sea to lessen the roll motion of the vessel.
7) *Active Motion Control*: Systems with active motion control are intended to lessen a structure's motion in reaction to waves or other outside influences. The position of the thrusters or other control devices is often adjusted in this way by utilizing sensors and control systems.
8) *Flexible Pipes and Risers*: To connect the floating structure to subsea wells or other equipment on the ocean floor, flexible pipes and risers are used. To prevent harm to the building or the equipment, these pipes and risers are made to flex and bend with the velocity of the waves.
9) *Composites*: Composites can be utilized to build floating constructions since they are strong, lightweight materials that won't corrode or degrade when exposed to seawater.
10) Overall, engineering, materials science, and oceanographic expertise are needed for the design and construction of floating structures to make sure the structure is secure, efficient, and useful for the intended purpose.

X. CONCLUSION

Floating Structure configuration upholds numerous opportunities for energy-proficient plans, for example, tackling wind energy, flowing energy, and photovoltaic cells on the ocean that can be utilized to produce power. Besides, making a floating design and giving such an encounter to the client can likewise give various advantages in the way of life of the client.

Albeit, through different existing contextual investigations and the ongoing information got on these designs, one can convey the end that there are not many existent issues connected with drifting engineering concerning double-dealing of another asset and that it is another worldview contrasted with the idea of development on the land. Yet, through economical arrangements and by building and fostering these designs we could sluggish the speed of corruption of environment, and land and simultaneously reward the climate by utilizing the appropriate innovation accessible to make these designs energy proficient.

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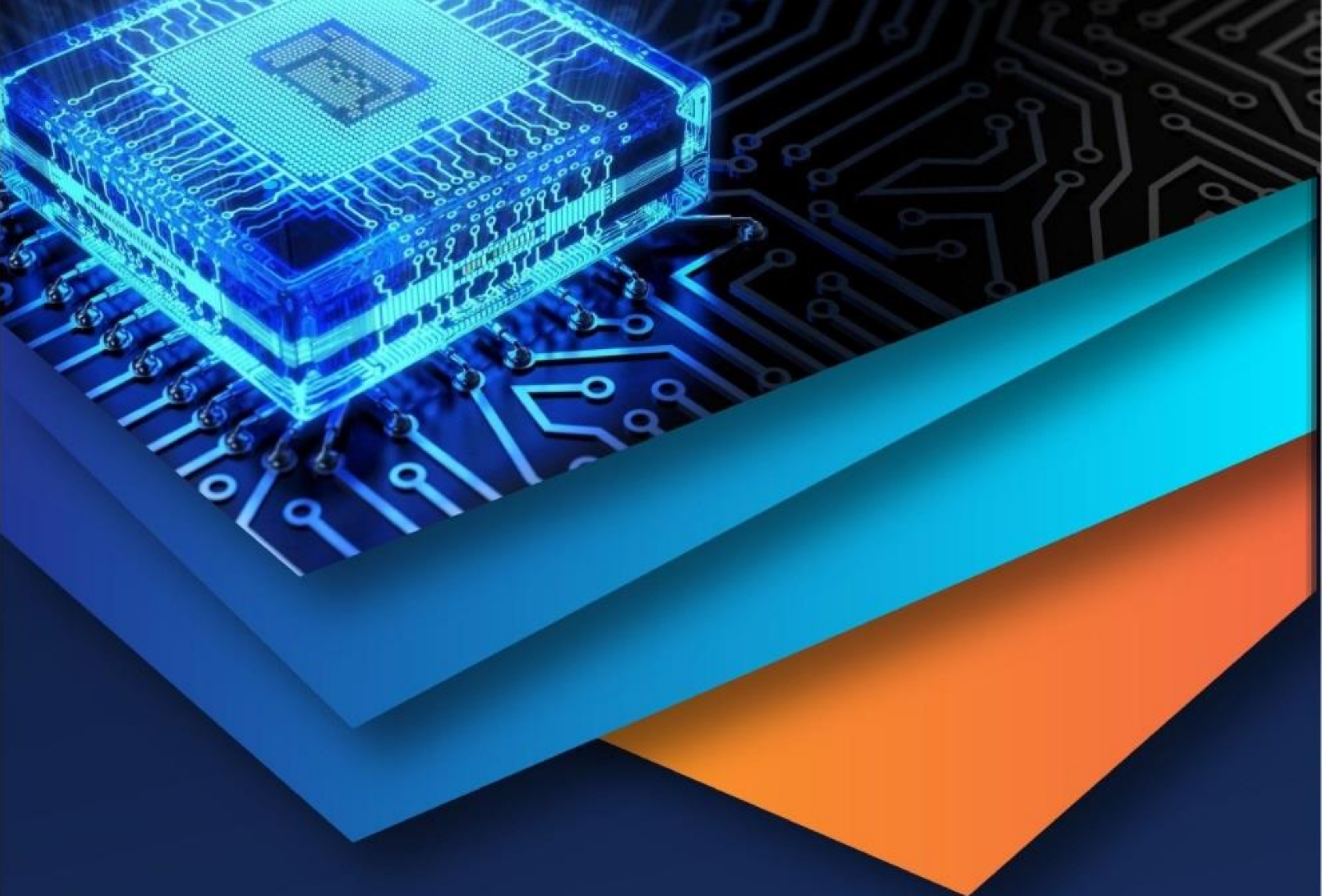

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