

Living with Water: Literature-Based Exploration of Stilt and Amphibious Housing as Resilient Architectural Solutions for Flood-Prone Communities in Pakistan

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ABSTRACT

Floods are frequently damaging natural hazards in Pakistan, where significant monsoon events in floodplains expose millions to displacement. Traditional post-disaster reconstruction often replicates vulnerable housing typologies, sustaining destruction. Architectural scholarship shows that innovative housing designs can mitigate flood impacts at the household scale. This paper adopts a literature-based approach to review global examples in flood-resilient housing and proposes two architectural solutions adapted to Pakistan's flood-prone settlements: stilt (hanging) housing and amphibious (ship-type) housing. Drawing on vernacular traditions in Southeast Asia and contemporary projects in the Netherlands and Bangladesh, based on design principles, socio-cultural advantages, and limitations of these typologies. Findings suggest that stilt housing offers cost-effective, culturally familiar, and rapid mobilization in areas with predictable flood levels and stable soils, while amphibious housing provides adaptability to variable flood depths which requires higher initial investment and community education. Both typologies highlight architecture potentials to reduce displacement, protect livelihoods, and improve resilience. The study concludes that literature supports the conceptual viability of these solutions in Pakistan but emphasizes the need for pilot projects, and policy integration in future research. By framing housing within disaster strategies, the paper contributes an architectural framework for "living with water" in the face of climate change and recurrent flooding.

Following this introduction, this article reviews literature on global and regional responses to flood-resilient housing, architectural solutions for stilt and amphibious housing typologies, literature-based methodology adopted for comparative suitability and policy challenges, recommendations for future research and integration into

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Pakistan's housing strategies.

Keywords: Flood, Resilient Architectural Solutions, Stilt Housing, Amphibious Housing, Vernacular Architecture

Introduction

Floods represent the most regular and high impact natural disasters worldwide, accounting for nearly half of all weather-related catastrophes recorded in the past three decades. According to the United Nations Office for Disaster Risk Reduction, an average of 250 million people are directly affected by floods every year, with damages exceeding billions of dollars. Several factors contribute to this growing risk. Climate change has increased rainfall fluctuations and extreme weather events. Rapid urbanization has resulted in the encroachment of floodplains, while deforestation and soil degradation have reduced natural drainage capacity. Together, these factors have created environments where floods are no longer rare “acts of God” but recurrent, systemic hazards.

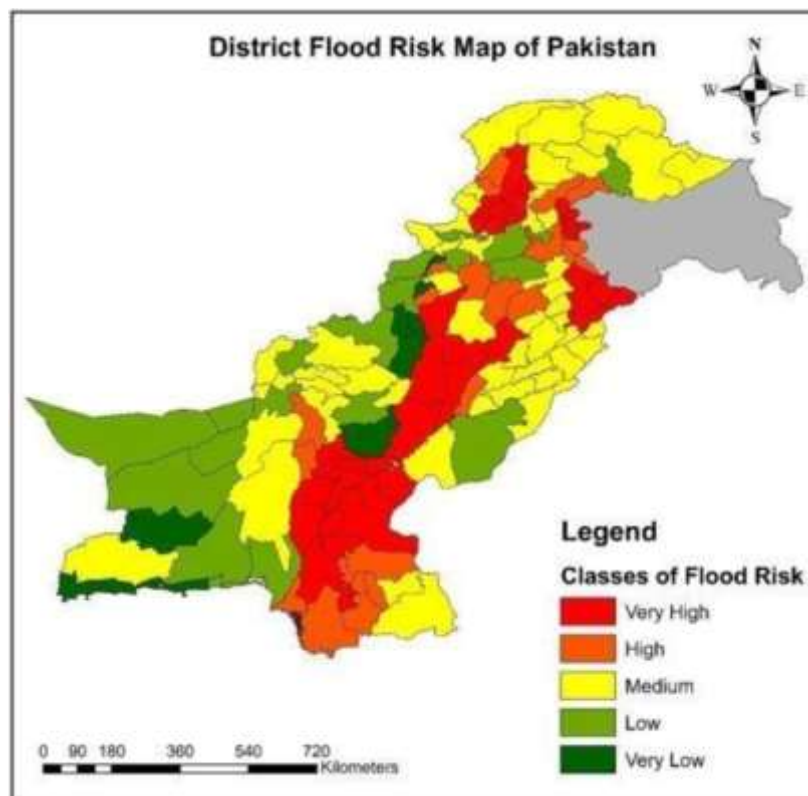


Figure 1: District-wise flood risk map of Pakistan. (Source: (Rana et al., 2021))

While large-scale infrastructural interventions such as dams, levees, and diversion channels continue to dominate flood management strategies, growing evidence suggests that such measures alone are insufficient. Structural defenses often shift risk downstream, require vast investments, and cannot address localized household vulnerabilities. Consequently, scholarship in disaster risk reduction increasingly

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emphasizes the importance of community-level and household-scale adaptations that complement infrastructural measures. Housing, as the physical and social core of community life, emerges as a critical site of intervention.

At the human scale, the consequences are severe. Families lose shelter, belongings, and livelihoods in a matter of hours. Children are forced out of school, women face heightened insecurity in overcrowded shelters, and livelihoods dependent on agriculture and livestock collapse. Reconstruction is slow and costly, often relying on external aid and rarely break the cycle of vulnerability. The majority of households rebuild using the same vulnerable materials—mud, sun-dried brick, unreinforced masonry—only for these to collapse again in the next flood event.

Flooding in Pakistan: Scale of the Challenge

Pakistan exemplifies the severity of flood risk in South Asia. The country's geography, dominated by the Indus River basin, combines monsoon-driven hydrology, glacial-fed tributaries, and extensive floodplains. Seasonal inundation has long been a feature of life in the region; however, demographic, ecological, and climatic changes have transformed seasonal flooding into recurrent disasters.

Historical events illustrate this trajectory. The 2010 floods, triggered by heavy monsoon rains, inundated one-fifth of Pakistan's land area, displacing 20 million people and destroying approximately 1.6 million homes. More recently, the 2022 floods, described as among the worst in the country's history, affected over 33 million people, with nearly 2 million homes damaged or destroyed. Economic losses from this single event were estimated at USD 30–40 billion. Projections from climate models suggest that such “once-in-a-century” floods are likely to occur more frequently, with shorter

recurrence intervals and intensified impacts.

Housing as the Epicenter of Vulnerability

Housing is both a symbol of security and the most tangible asset for households. Its destruction therefore has progressive impacts on well-being, livelihood stability, and community cohesion. In Pakistan's flood-affected areas, the inadequacy of housing stems from multiple factors: unregulated land occupation in high-risk zones, lack of resilient construction practices, limited financial capacity for safer building, and weak integration of housing into disaster management policies. Current strategies focus heavily on emergency relief. Temporary shelters, such as tents or protective sheets, provide short-term refuge but cannot substitute for durable housing. Post-disaster reconstruction programs, led by government agencies and international donors, tend to prioritize speed and cost-efficiency over resilience, often reproducing the very



Figure 2: Pakistan's Flood Disaster (Pakistan Today)



Figure 3: Flood Disaster Challenges in Pakistan (Daily Soon Times)

vulnerabilities they aim to address. As a result, the housing sector plays an important role for disaster resilience in Pakistan.

Global Architectural Responses: Lessons Learned

A review of global precedents demonstrates that architecture has historically played a pivotal role in adapting to floods. Vernacular traditions, particularly in Southeast Asia, illustrate how communities developed housing strategies in harmony with hydrological cycles. Stilt houses, widely found in Indonesia, Thailand, Vietnam, and the Philippines, and elevate habitable spaces above floodwaters, minimizing damage while allowing floods to pass unobstructed beneath. These structures rely on locally available materials such as bamboo and timber, and their designs are deeply integrated into cultural life.

Amphibious housing, though less widespread, represents another strand of adaptation. In the Mekong Delta, for example, houses built on bamboo rafts rise with the floodwaters, tethered by vertical poles. More recently, Bangladesh has become a testing ground for low-cost amphibious prototypes and floating schools, supported by NGOs and international partners. Evaluations of these projects underscore both their feasibility and challenges, particularly in terms of maintenance and material durability.

High-income countries have also innovated. The Netherlands, long synonymous with flood defense, has pioneered floating neighborhoods such as IJburg in Amsterdam. These communities demonstrate the scalability of amphibious and floating housing, though their cost and reliance on advanced engineering limit their applicability in low-income contexts. Nevertheless, they provide critical insights into design principles, mooring systems, and service integration.

Collectively, these examples highlight two lessons: (1) housing can be designed to coexist with water rather than resist it entirely; and (2) culturally resonant, locally adapted solutions stand the best chance of acceptance and sustainability.

The Gap in Pakistan

Despite Pakistan's acute vulnerability, architectural innovation has not been systematically integrated into housing or disaster risk management policies. Post-disaster programs, including the extensive reconstruction following the 2010 and 2022 floods, focused primarily on replicating conventional masonry or mud housing. While infrastructure projects (dams, barrages, embankments) have received attention, household-scale solutions remain underexplored. Academic literature identifies this as a critical gap: the absence of housing strategies that reduce vulnerability at the micro-scale, complement larger flood management systems, and align with cultural and socio-economic realities. This gap provides the rationale for the present study. By synthesizing literature on global architectural responses to flooding, and focusing on two typologies (stilt and amphibious housing) this paper explores how Pakistan might embed architectural resilience into its flood management strategies.

Aim and Objectives

The aim of this research is to identify and evaluate architectural solutions that can enhance resilience in Pakistan's flood-prone settlements through a literature-based

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review of global precedents.

The specific objectives are to:

Review international and regional literature on flood-resilient housing, with a focus on stilt and amphibious typologies.

Extract design principles, cultural considerations, and socio-economic factors relevant to Pakistan's context.

Compare the advantages and limitations of stilt and amphibious housing as conceptual solutions.

Provide an architectural framework that informs future technical validation, pilot projects, and policy integration.

Literature Review

Floods are globally recognized as the most frequent and destructive natural hazard, accounting for 44% of weather-related disasters over the past three decades. They affect an average of 250 million people annually and cause economic losses exceeding USD 60 billion each year. The vulnerability of human settlements to floods is shaped by multiple interacting factors. Climate change has intensified rainfall patterns and increased the likelihood of extreme precipitation events. Urbanization has accelerated encroachment onto floodplains, while deforestation and wetland loss have reduced the natural capacity of landscapes to absorb floodwaters.



Figure 4: Families sit near their belongings surrounded by flood water, Jaffarabad, Pakistan (Source: The Times of India)



Figure 5: A representational image of displaced people living in makeshift tents without protection from mosquitoes. (The News International)

Literature emphasizes that vulnerability is not merely biophysical but also socio-economic: poverty, marginalization, and limited access to safe housing increase the exposure of households to flood risk.

In response, scholars and practitioners have explored diverse adaptation strategies, ranging from large-scale infrastructural defenses to community-based risk reduction. A growing body of work underscores the importance of **housing design** as a frontline measure that determines whether floods lead to temporary disruption or long-term displacement. Pakistan's hydrological context makes it acutely vulnerable to floods. The Indus River Basin, covering over 65% of the country's land area, is highly sensitive to monsoon variability and glacial melt from the Himalayas. Floodplains are densely populated due to fertile agricultural soils and proximity to water resources.

According to the World Bank (2022), more than 30 million Pakistanis live in areas classified as high flood risk.

Historical flood events reveal the magnitude of the challenge. The 2010 “super flood” inundated 20% of the country, affecting 20 million people and destroying 1.6 million homes. The 2022 floods displaced 33 million people, killed over 1,700, and caused losses estimated at USD 30–40 billion. These disasters illustrate not only the intensity of hydrological hazards but also systemic weaknesses in planning and housing.

National assessments highlight recurrent challenges:

Settlements expanding into high-risk floodplains.

Housing constructed from fragile materials such as mud or unreinforced brick.

Limited financial capacity for resilient construction.

Weak integration of housing into national disaster risk reduction frameworks.

Thus, while infrastructural defenses such as dams and embankments receive political and financial attention, housing remains the “weak link” in resilience strategies.

Literature emphasizes that repeated destruction of housing deepens poverty, perpetuates displacement, and undermines social stability.

Vernacular Responses to Flooding

Traditional architecture across flood-prone regions offers critical lessons in resilience. Vernacular designs emerged through generations of adaptation to local hydrological conditions, using locally available materials and community knowledge.

Stilt Housing

Stilt houses are among the most widespread vernacular responses to flooding. In Southeast Asia, the rumah panggung in Indonesia, bahay kubo in the Philippines, and bamboo stilt houses in Vietnam and Thailand elevate living spaces above predictable flood levels. These houses are constructed with lightweight timber or bamboo, allowing water to flow underneath during inundation. Their design reduces damage, facilitates ventilation, and provides shaded storage beneath the elevated floor.

The cultural embeddedness of stilt housing is significant. It reflects not only a technical adaptation but also a lifestyle oriented toward coexisting with seasonal floods. As literature notes, the durability of such practices lies in their low cost, ease of repair, and compatibility with local social structures.

Floating and Amphibious Traditions

Amphibious strategies have also appeared in vernacular forms. In the Mekong Delta, houses constructed on bamboo rafts or oil-drum pontoons float during floods while being tethered to vertical poles for stability. In Bangladesh, baira (floating gardens) and floating homes represent a localized response to recurring inundation. These practices illustrate the feasibility of “living with water” as an adaptive strategy rather than resisting floods through rigid structures.

Lessons from Vernacular Architecture

Scholars emphasize three recurring principles of vernacular flood-resilient architecture:

Elevation or buoyancy to reduce direct contact with floodwaters.

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Lightweight and flexible materials that minimize structural risk and are easily repairable.

Cultural integration, ensuring that housing remains socially acceptable and economically viable.

These principles provide a foundation for rethinking modern housing in Pakistan's flood-prone regions.

The Netherlands: High-Tech Floating Neighborhoods

The Netherlands has become a global leader in floating and amphibious housing. Projects such as IJburg in Amsterdam and the Maasbommel amphibious homes integrate advanced engineering, modular construction, and sophisticated mooring systems. These projects demonstrate the scalability of floating communities, with entire neighborhoods designed to rise with water levels.



Figure 7: A floating home in IJburg, Amsterdam



Figure 8: The Float, Sustainable House, Netherlands

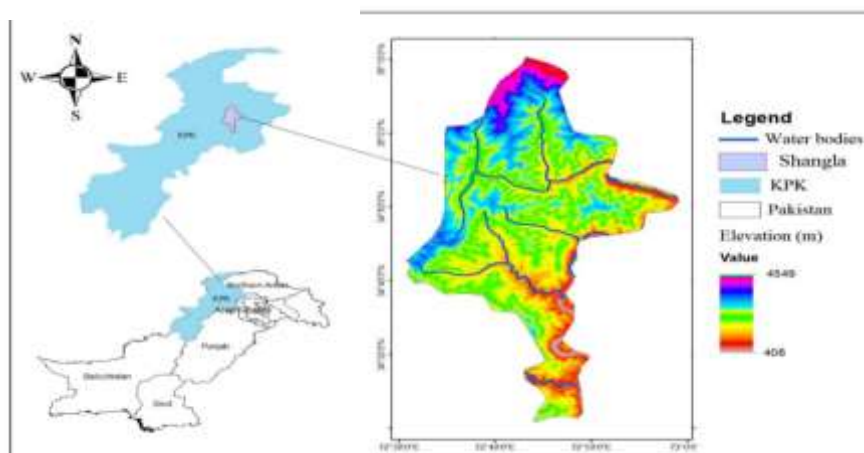


Figure 6: Study Area map of District Shangla; Khyber Pakhtunkhwa, Pakistan (Sustainability, 2021)

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While technologically impressive, such models are resource-intensive, relying on buoyant concrete foundations, advanced anchoring, and extensive infrastructure. Scholars caution against their direct transfer to low-income contexts but highlight their value in establishing design standards and technological benchmarks.

Bangladesh: Low-Cost Amphibious Prototypes

Bangladesh, with its deltaic geography and recurrent floods, has pioneered low-cost amphibious solutions. NGOs and universities have experimented with floating schools, clinics, and houses using bamboo superstructures and pontoons made from steel drums or ferrocement. Evaluations indicate mixed outcomes: while communities accept these designs and they provide safety during floods, challenges persist regarding durability, material quality, and long-term maintenance.

These projects remain highly relevant to Pakistan, given similarities in socio-economic and environmental contexts. They illustrate that amphibious housing can be developed at relatively low cost and with community participation.



Figure 9: The amphibious house (Flood Resilient house), Dhaka, Bangladesh

Example:-

A house in Bangladesh is a type of Amphibious which can grow, float and stay cool all year. It is best type of hotter and wetter future house.

Hybrid and Retrofitted Models

Literature also reports experiments with hybrid designs, such as amphibious retrofits of conventional houses. These involve adding buoyant foundations beneath existing structures, enabling them to float during floods. Pilot projects in Louisiana (USA) and in Bangladesh suggest this approach could reduce costs by leveraging existing housing stock. However, technical challenges, particularly ensuring structural stability and service continuity, remain barriers to large-scale adoption.

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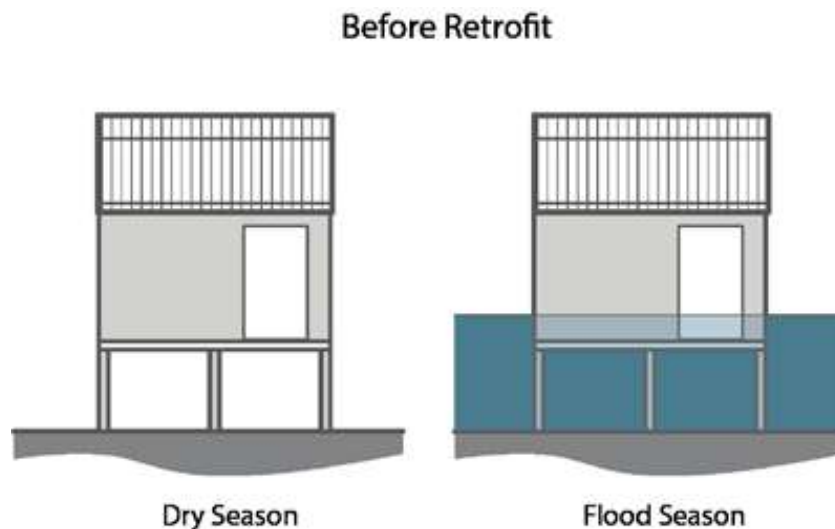


Figure 10: Diagram showing regular elevated house during flooding

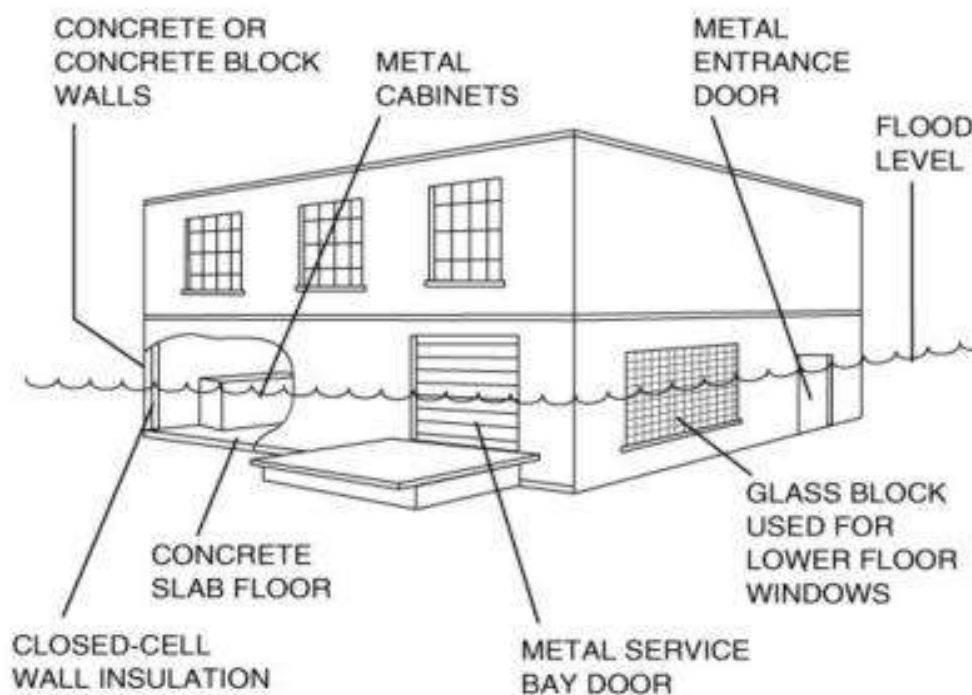


Figure 11: Flood damage-resistant materials include concrete and tile flooring, metal cabinets and doors, and glass-block windows (Source: Build with Flood Damage Resistant Materials, 2008)

Policy and Institutional Frameworks

Disaster risk reduction literature emphasizes the importance of integrating housing resilience into policy. The Sendai Framework (2015–2030) calls for “building back better” in recovery and reconstruction, urging governments to invest in resilient housing. Similarly, the World Bank and Asian Development Bank promote housing

solutions that combine technical resilience with socio-economic sustainability.

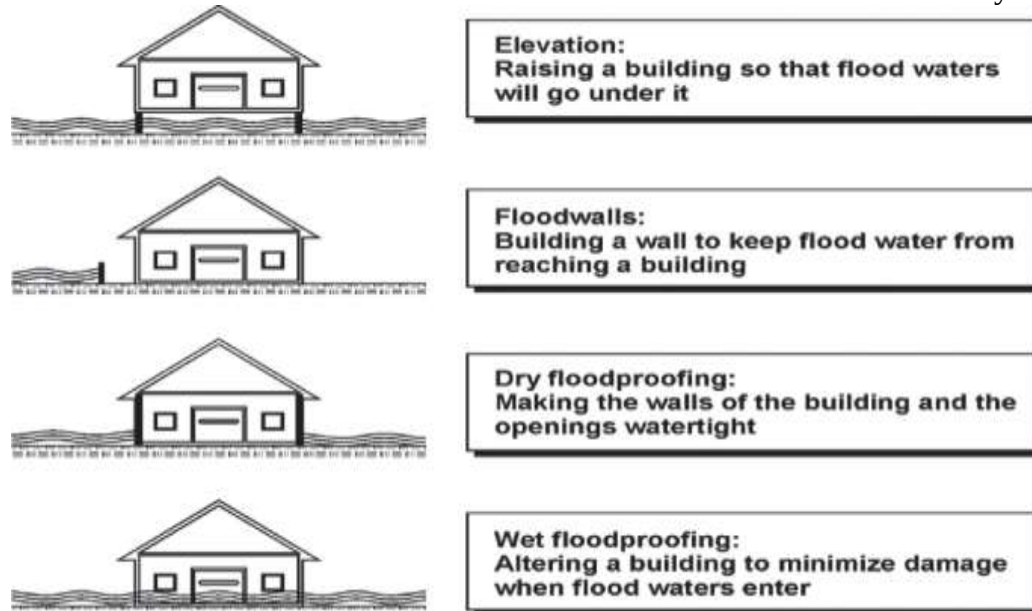


Figure 12: fighting floods techniques in the cities. UNESCO. Fighting floods in cities; Project training material for disaster reduction; Report, Delft, Holland; 1995.

In Pakistan, however, policy integration remains limited. Post-disaster reconstruction following the 2010 and 2022 floods prioritized rapid rebuilding of conventional houses, often replicating vulnerabilities. While international donors encouraged climate-resilient housing, implementation was fragmented and lacked architectural innovation. Scholars note that reconstruction programs often neglect local cultural practices and vernacular knowledge, leading to solutions that are neither durable nor socially embedded.

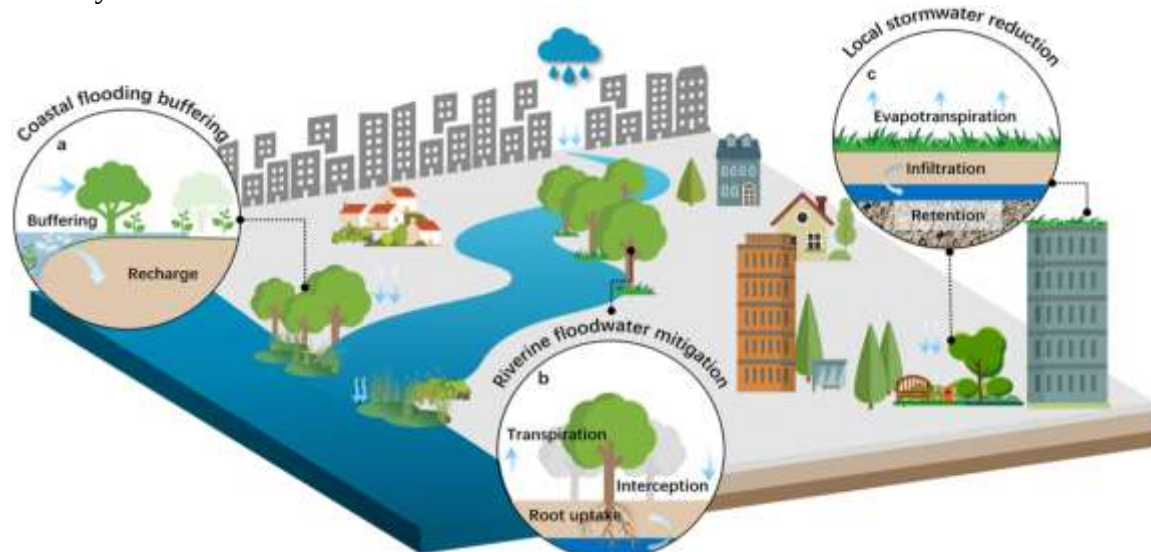


Figure 13: a mangrove protection to buffer coastal surges; b tree planting in riparian areas to mitigate floodwaters; c rain gardens and green roofs to regulate local stormwater runoff. (Source: Urban Sustainability Journal)

The literature therefore identifies a critical policy gap: the absence of systematic integration of flood-resilient architectural typologies into Pakistan's housing and disaster management frameworks.

Comparative Insights from Literature

Synthesizing global experiences, the literature offers comparative insights relevant to Pakistan:

Stilt housing is cost-effective, culturally familiar, and relatively easy to construct with local materials. However, it is limited by soil suitability and fixed elevation, which may fail during extreme floods.

Amphibious housing provides adaptability to varying flood depths and prolonged inundation but requires higher upfront investment, maintenance of buoyant components, and community awareness.

Floating neighborhoods in high-income countries demonstrate advanced design possibilities but are financially and technically unfeasible for low-income rural settlements in Pakistan.

Vernacular practices illustrate the importance of cultural resonance, community participation, and reliance on local materials.

Gaps in Knowledge

Despite the rich body of literature, several gaps remain:

Pakistan-specific research on architectural flood resilience is scarce. Most studies focus on hydrology, infrastructure, or emergency response rather than housing design.

Comparative evaluation of stilt versus amphibious typologies in South Asian contexts is limited.

Socio-cultural dimensions of acceptance, affordability, and livelihood integration are underexplored in design research.

Policy linkage between architectural innovation and national flood management strategies remains weak.

Implications for the Present Study

This literature review underscores the urgent need to explore architectural solutions for Pakistan's flood-prone communities. By focusing on stilt and amphibious housing, this study builds on global precedents while addressing identified gaps. The findings provide a conceptual framework for resilient housing, offering pathways for integration into Pakistan's housing and disaster management policies.

Architectural Solutions

Flood-resilient housing solutions can be conceptualized as a spectrum of approaches, ranging from **elevating dwellings above predictable water levels** to **designing houses that adapt dynamically to fluctuating water depths**. Within this continuum, two typologies—**stilt (hanging) housing** and **amphibious (ship-type) housing**—emerge as particularly relevant for Pakistan's flood-prone communities. This section examines these typologies in detail, analyzing their design principles, precedents, cultural compatibility, and potential application in Pakistan.

Stilt (Hanging) Housing

Stilt housing elevates the habitable portion of a dwelling on vertical supports, typically wooden, bamboo, or concrete posts. The central principle is **elevation above maximum expected flood levels**, thereby ensuring that floodwaters can pass beneath the structure without damaging the living space.

Key features include:

Raised platforms: 1–3 meters above ground in traditional contexts; higher in areas with extreme floods.

Lightweight superstructure: Bamboo, timber, or lightweight concrete reduce load on stilts.

Ventilation and shading: Elevated floors improve airflow and create shaded storage/work areas below.

Accessibility: Ramps, ladders, or stairs connect the dwelling to ground level.

The concept is simple yet effective: by removing living areas from direct contact with water, structural damage and displacement are minimized.

Global and Regional Precedents

Stilt housing has a long history in flood-prone areas of Southeast Asia. In Indonesia, rumah panggung houses elevate entire families and livestock above floodwaters. In Vietnam and Cambodia, bamboo stilt houses are common in riverine settlements, offering resilience during annual monsoon floods.

Closer to Pakistan, vernacular examples exist in Gilgit-Baltistan and parts of Sindh, where homes are occasionally raised on stone plinths or wooden piles to mitigate seasonal flooding. While less developed than Southeast Asian traditions, these practices illustrate cultural familiarity with elevation as a resilience strategy.

Advantages

Affordability: Materials such as bamboo, timber, or reinforced concrete posts can be sourced locally.

Simplicity: Construction requires limited technical expertise, making it feasible for community self-building.

Cultural resonance: Elevated living aligns with traditional practices in parts of South and Southeast Asia, easing social acceptance.

Dual use of space: The undercroft provides shaded storage for tools, livestock, or fuel.

Limitations

Fixed elevation: If floods exceed the predicted height, dwellings may still be inundated.

Soil suitability: Soft or waterlogged soils in some floodplains may limit the stability of stilts.

Exposure to wind: Elevated structures are more vulnerable to high winds, requiring careful bracing.

Accessibility concerns: Raised floors may challenge elderly or disabled residents without proper ramps.

Example of Stilt house:-

Traditional Historic Stilt House, a Case of Dong Minority Dwelling, China:-

Vernacular dwellings represents cultural legacies that reflects and preserve human civilization. Their efficient climatic responsive nature and human-centered comfort has influenced modern architecture. Influenced by mountainous terrain, subtropical climates and regional culture, these stilt houses are prevalent in Guangxi, Yunnan, and across Southeast Asia and tropical islands including Laos, Guam, Malaysia, Thailand, and Hawaii.

Design Improvements for Living Environment of Stilt House:-

Stilt houses are built in highly humid environments experiencing peak moisture levels during morning and night time. To control indoor humidity, moisture-resistant membrane or air barrier on the inner face of the exterior wall to reduce effectively indoor humidity by restricting outdoor moisture. Using a single-layer wooden board as wall enclosure results in poor thermal insulation performance of west facing walls where summer surface temperatures may rise to 60 °C. This will significantly influences in indoor air temperature.

The use of locally sourced wood effectively lowers carbon emissions by minimizing material transportation. The single-layer wood structure should be upgraded to a composite wood structure. Adding rock wool or glass wool within wall layers enhances thermal insulation in both summer and winter which leads to better indoor thermal comfort. Natural ventilation is the method to regulate indoor temperatures in traditional houses.

When natural ventilation is insufficient, mechanical ventilation via fans is used and only a few occupants rely on air conditioning. Data analysis indicates that large south-facing windows and small high windows (25–30 cm tall, one bay long) series on north wall has created an effective natural ventilation mechanism in the fire pool space. A small high window above the door may be installed and opened during the summer. Effective ventilation is done even when windows and doors are closed.

The kitchen should be located along an external wall with high windows along with a roof vent that enables indoor smoke may be rapidly removed outside y using stack effect. The roof is made up of sloped double-tile structure with built in tiles installed directly on the supporting purlins. By double-layered structure, air layer used to remove heat through outdoor wind movement which reflects traditional residential architecture

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Figure 14: Wooden exterior wall and Double-tile roof (Source: Sustainability, 2021)



Figure 15: Traditional and modern stilted dwelling of Chamorro, Guam. (Source: Sustainability, 2021)



Figure 16: Dai House, Xishuangbanna, Yunnan, China



Figure 17: Dai house in Jingne

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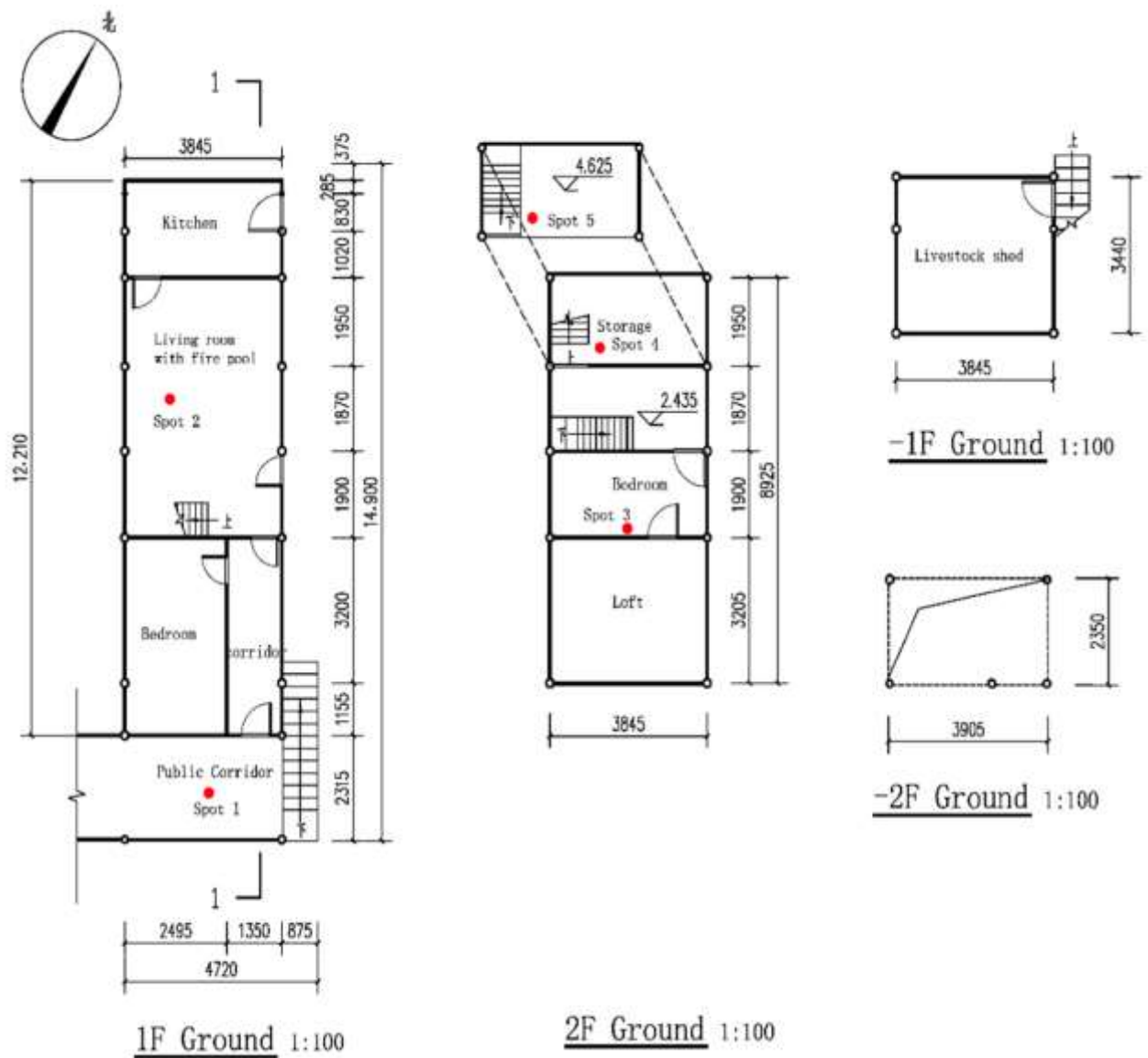
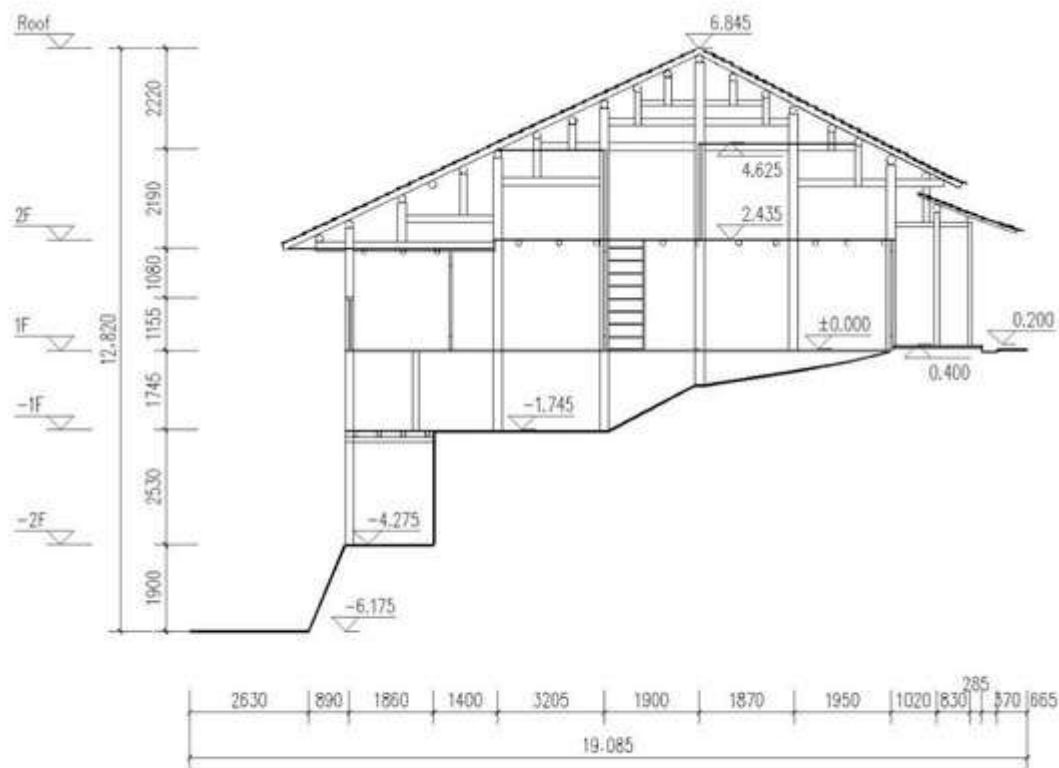


Figure 18: The layout of Dong Village dwelling with five monitoring



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Figure 19: The section of traditional Dong village stilt dwelling.

3.2:

Wooden exterior wall and Double-tile roof:-

ASHRAE defines thermal comfort as the state of the thermal environment where individuals experience psychological satisfaction. Thermal comfort refers to the subjective perception of the thermal environment which is influenced by physical, psychological, physiological, and social factors. Thermal comfort is determined by four indoor climate factors: temperature, air flow, humidity, and average radiant temperature.

Remarks:-

These traditional stilt dwellings naturally respond to the local climate. Passive design represents key fundamental strategy to address functional and comfort routines of occupants.

However, certain traditional functional spaces fail to satisfy the needs of modern lifestyles.

Many traditional stilt houses in Dong villages have long been neglected causing material structural damages.

Following this analysis, key conclusions are given below:-

These Stilt houses are normally found in humid and hot climates. Questionnaire data based on survey of 472 residents showed that just 7.2% reported APMV values

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between -0.5 and 0.5 (most comfortable), while 42.6% of responses lies between 1 and 1.5, indicates comfortable condition. Analysis reveals that residents of stilt houses experience wider range thermal comfort as compared to urban inhabitants.

Natural wind flow can effectively reduce indoor temperatures. However, the small windows on the exterior walls (especially on the south side, with none on the east or west) front porch existence limit the effective removal of indoor heat consequently, indoor temperatures are often higher than comfortable levels particularly during the afternoon. High indoor temperatures also elevates air vapor pressure with more indoor humidity. The interaction of these two factors is the primary cause of the low thermal comfort experienced in Dong village dwellings in the summer months.

To optimize natural ventilation place larger south-facing windows and a row of small high windows on the north wall to establish an effective ventilation mechanism within the fire pool space. The single-layer wood structure should be substituted with a composite wood structure.

Wood functions as a non-directional acoustic material with high sound absorption properties. "The tight joints between the boards allow some sound to enter the room, influencing the indoor acoustic environment." Traditional houses obtain mostly natural light through side windows and modest skylights on the roof. More than 40% of occupants were fairly satisfied with the indoor natural lighting, particularly in the kitchen, guest bedroom, and other secondary spaces. A larger glazed surface can improve natural illumination which may cause glare strategically placing openings in the east and west gables to enhance indoor daylight.

Applicability in Pakistan

For Pakistan, stilt housing is particularly suited to:

Villages in Sindh and Punjab floodplains, where seasonal inundation is predictable.

Areas with firm soils that can support vertical loads of stilts.

Low- to middle-income households, who can adopt low-cost versions using bamboo, timber, or reinforced concrete.

Community acceptance is likely to be high, given cultural familiarity with plinth-raising in many rural contexts. However, widespread adoption would require training in safe construction techniques and government support for subsidizing durable materials

Amphibious (Ship-Type) Housing

Nowadays, the earth is sick and becomes worse as time pass by. Global warming, climate change, that makes typhoons, flashfloods and other natural disasters stronger are the complications of its illness. The Philippines is situated beside the Pacific Ocean where large amount of rain is produced and typhoons are born, thus makes the country more vulnerable to natural disasters which lead to flashflood and extreme devastation of houses, infrastructure, and establishment.

The first amphibious house was in the United Kingdom and is situated along the riverbank. The structure was designed by the London-based Baca Architects. During the flood event the whole house will raise gently like a boat and will keep all of the habitable spaces safe above the flood level. People have always enjoyed living near water, because of the soothing sounds and wildlife and for fishing and sailing – but

the downside is it is vulnerable to flooding (Coutts, 2012).

Design Principles

Amphibious housing represents a more adaptive approach: houses rest on the ground under normal conditions but rise with floodwater, floating temporarily until water recedes. This is achieved through a **buoyant foundation system** (commonly pontoons, barrels, or buoyant concrete) combined with **vertical guidance posts** that keep the structure stable during flotation. Key features include:

Amphibious foundation: Incorporates buoyant materials beneath the dwelling.

Guidance system: Poles or tracks ensure stability and prevent lateral drift.

Lightweight superstructure: Reduces the load to enhance buoyancy.

Dual state functionality: Operates as a conventional house during dry conditions and as a floating house during floods.

This dual adaptability allows dwellings to withstand unpredictable flood depths that might overwhelm stilt structures.

Global and Regional Precedents

In Bangladesh, amphibious prototypes have been piloted in flood-prone areas by NGOs such as Shidhulai Swanirvar Sangstha. Floating schools and homes, often constructed from bamboo and steel drums, have provided safe havens during extended floods. In the Netherlands, advanced amphibious housing developments at Maasbommel showcase how houses can seamlessly shift between land-based and floating conditions. These projects integrate buoyant concrete foundations and sophisticated mooring systems. Elsewhere, amphibious retrofits in Louisiana (USA) demonstrate the feasibility of adapting existing homes with buoyant foundations. While technologically varied, these precedents confirm the viability of amphibious housing across contexts.

Advantages

Adaptability: Houses rise with water levels, ensuring protection even during extreme floods.

Minimal land loss: Unlike permanent floating housing, amphibious designs allow land use in dry seasons.

Psychological security: Residents can remain in their homes rather than relocating to temporary shelters.

Innovation potential: Offers long-term resilience as climate change increases unpredictability of flood magnitudes.

Limitations

Higher costs: Buoyant foundations and guidance systems increase initial investment.

Technical expertise: Requires engineering input for safe design and stability.

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Maintenance: Buoyant elements, particularly low-cost drums, may deteriorate and require replacement.

Social acceptance: Communities may hesitate to adopt unfamiliar “floating” technologies.

Example:-

Kerala is most significant example of flood disaster in Indian history Having extreme monsoon rainfall of about 75 % more than usual rainfall on the mid-evening of August 8 causing dams to fill quickly 310 mm (12 in) of rainfall was recorded in the first 24 hours. During a century it was most destructive flood in which over 483 people died, 14 dislocated and a about million people rescued. Intense rainfall forced opening of nearly all dams to pushed water level to critical flooding in vulnerable low-lying zones. Communities practiced to live long by pile supported house construction, retrofitting boats and amphibious architectural designs. Water dwellings are effective resilient housing solutions in severe flood situations. Amphibious House



Figure 20: Kerala Houseboat



Figure 21: Fishing ZAWRAQ Boat, West Coast, India

construction is cost effective as compared to conventional homes. Globally, communities are living on or nearby water but its relatively new in India. Due to delta region of Bangladesh, it experiences regular flood events. The combination of river overflow, poor drainage and heavy monsoon rains in Bangladesh displace millions of people and causes high mortality. Low income communities in informal urban settlements suffer great damages during floods. Due to rapid urban population growth, about 3.5 million residents in low income communities are forced to live in slums or custom built house boats due to insufficient housing. Kerala’s houseboats are large, slow-moving barges designed for tourism trips and were used to convenient means of transportation for rice and spices from one place to other place in early times. The boat measures about 60-70 feet in length and 15 feet wide at center. The hull is made of wooden planks tied tightly with ropes and coconut fibre to ensure durability. The hull is made of wooden planks that are held tightly by ropes and coconut fiber. The roof is constructed by using bamboo poles and palm leaves. The exterior surface of boat is made protected with cashew nut oil coating. Increasing housing demands results in transformation of fishing boats into floating homes.

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Figure 22: (Source: Alleppey Houseboats, Kerala)

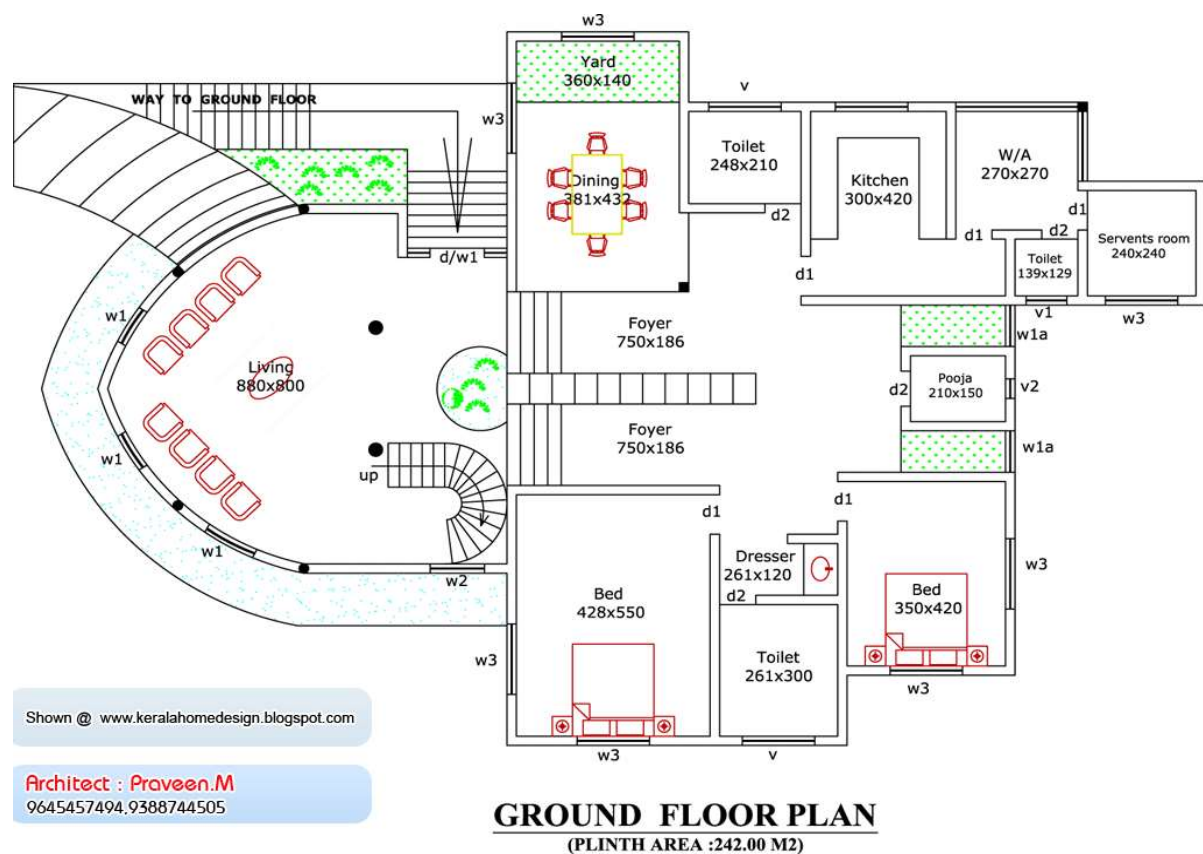


Figure 23: Ground Floor Plan (Kerala Floating Boat House Sample)

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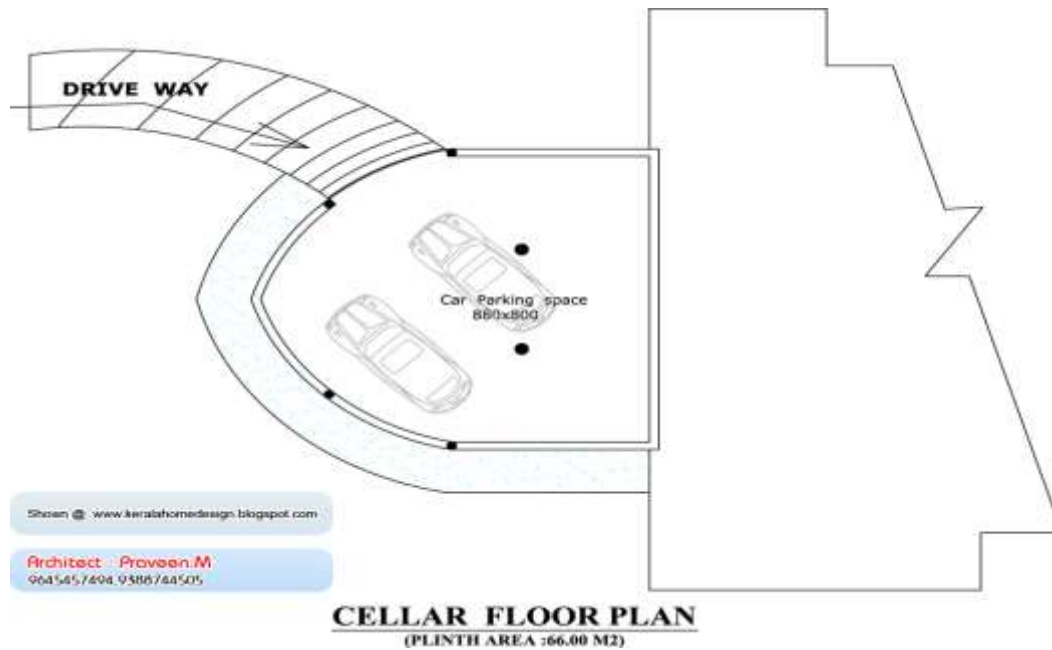


Figure 24: Cellar Floor Plan (Kerala Floating Boat House Sample)

Figure 25: Front Elevation (Kerala Floating Boat House Sample)



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Figure 26: Front Elevation (Kerala Floating Boat House Sample)

Figure 27: Front Elevation (Kerala Floating Boat House Sample)

Figure 28: Front Elevation (Kerala Floating Boat House Sample)

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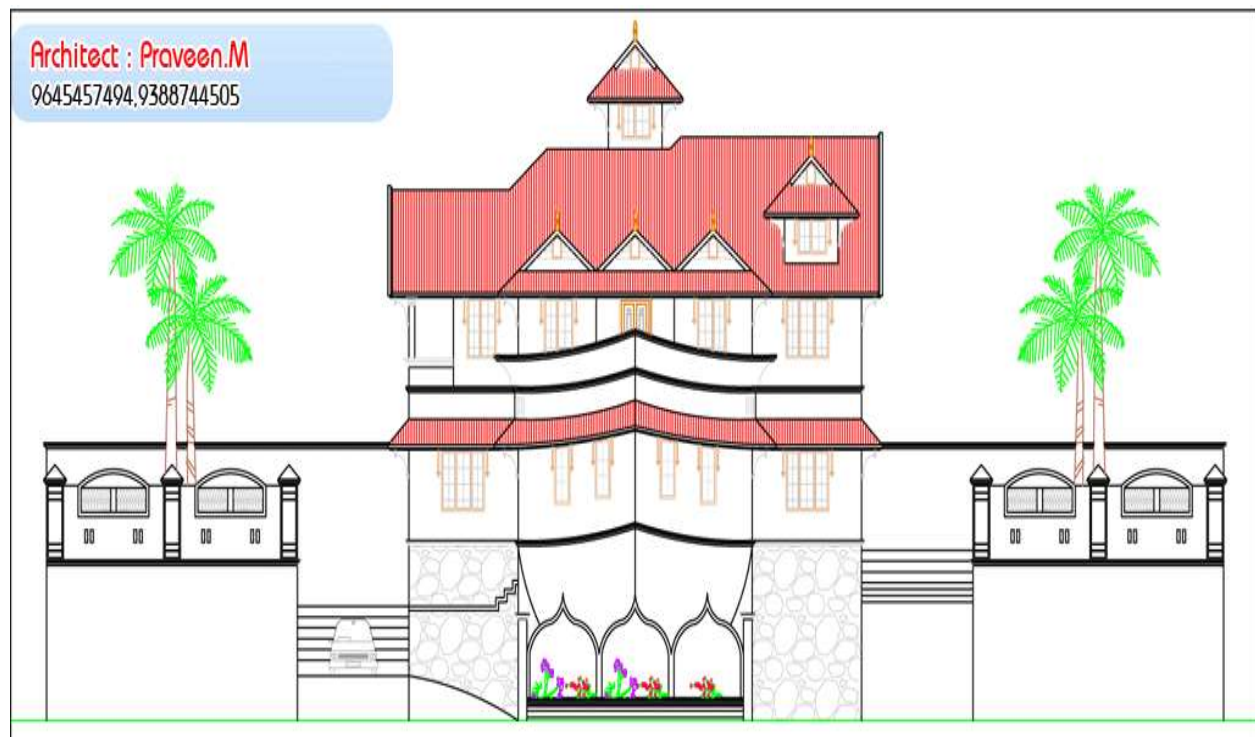


Figure 28: Front Elevation (Kerala Floating Boat House Sample)

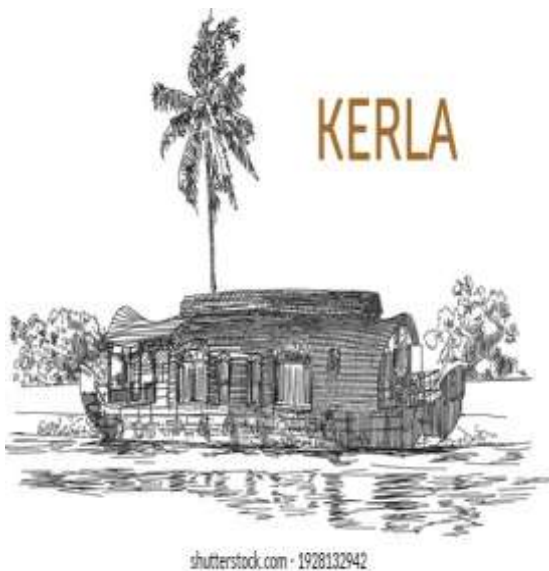


Figure 29: Alappuzha Houseboat, Kerala



Figure 30: Alappuzha Houseboat, Kerala

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Figure 31: Alappuzha Houseboat, Kerala



Figure 32: Alleppey Lake Houseboat



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Figure 31: Alleppey Lake Houseboat (Sitting Area)

Figure 33: Alleppey Lake Houseboat (Kitchen & Dining Area)

Figure 37: Alleppey Lake Houseboat

Figure 38: Alleppey Lake Houseboat

Figure 39: Alleppey Lake Houseboats

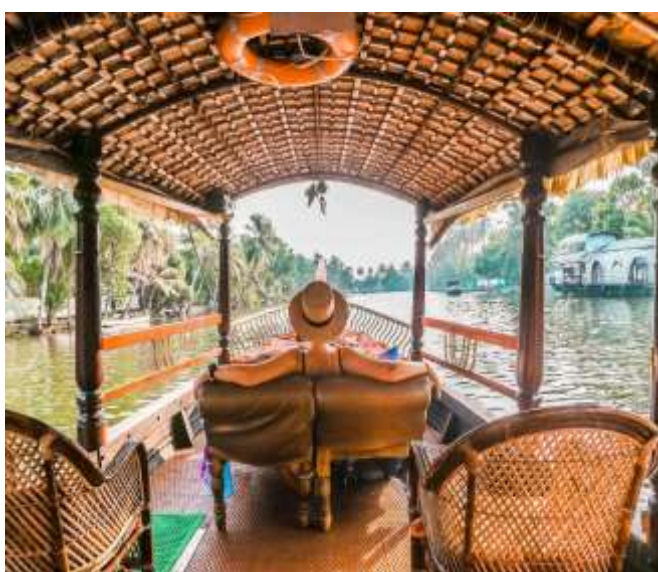


Figure 36: Alleppey Lake Houseboat (Exterior)





Applicability in Pakistan

Amphibious housing could be particularly relevant in:

Areas with highly variable or deep flooding, where stilt elevations are insufficient.

Settlements along river channels and lakes, where flood depth and duration are unpredictable.

Pilot projects supported by NGOs or research institutions, given the higher upfront costs and technical requirements.

For widespread adoption, community engagement and government subsidies would be essential. Pilot programs could demonstrate benefits, gradually building social trust in the technology.

Comparative Framework

Table 1:-A comparative evaluation of stilt and amphibious housing highlights their relative strengths and trade-offs:

Criteria	Stilt Housing	Amphibious Housing
Flood Adaptation	Protects against predictable flood levels	Adapts dynamically to varying flood depths
Cost	Low to moderate; affordable with local materials	Moderate to high; buoyant systems add expense
Technical Expertise	Basic carpentry/masonry skills sufficient	Requires engineering input for safe buoyancy/stability
Cultural Acceptance	High; culturally familiar in many rural contexts	Moderate; unfamiliar but can gain acceptance with pilots
Maintenance	Minimal; routine upkeep of stilts and flooring	Higher; buoyant elements require replacement/upkeep
Scalability	High for rural and peri-urban communities	Moderate; requires institutional and financial support
Best Contexts	Predictable floods, firm soils, resource-constrained households	Deep/variable floods, high-risk zones, NGO/government-supported programs

Toward Contextualized Solutions for Pakistan

The comparative framework suggests that both typologies have significant potential, but their suitability depends on local conditions:

Stilt housing is immediately applicable as a low-cost, community-driven solution. It aligns with cultural traditions, uses accessible materials, and provides an effective response where floods are seasonal and predictable. Policy could support this approach through training, microfinance, and material subsidies.

Amphibious housing offers a longer-term innovation pathway. It is particularly relevant for regions experiencing deep or unpredictable flooding, such as settlements along the Indus and its tributaries. While costs and technical requirements are higher, pilot projects could test feasibility and build local acceptance. Over time, technological adaptation and economies of scale may reduce costs, making amphibious housing more viable for wider adoption.

Integrating Architectural Solutions into Resilience Strategies

Flood-resilient housing cannot be pursued in isolation. Literature emphasizes that architectural solutions must be integrated into broader resilience strategies:

Policy integration: Embedding resilient housing typologies into national disaster risk reduction and housing policies.

Community engagement: Ensuring designs reflect local needs, practices, and preferences.

Technical support: Providing training and capacity-building for safe construction.

Financial mechanisms: Introducing subsidies, microcredit, or public–private partnerships to lower costs for households.

Pilot-to-scale pathways: Using demonstration projects to build awareness, refine designs, and guide scaling-up

Research Design

This study adopts a **literature-based research design**, which is appropriate for exploring architectural responses to flooding in the absence of field-based prototyping or technical simulations. The approach emphasizes **narrative synthesis** of global precedents and critical analysis of their applicability to Pakistan. Unlike systematic reviews that aim for exhaustive coverage, this study applies a **focused narrative review** strategy, prioritizing sources that directly address architectural design for flood resilience, vernacular precedents, and contemporary innovations.

The methodological orientation aligns with the aim of this paper: to conceptualize housing typologies as architectural solutions for Pakistan's flood-prone communities. It recognizes that architecture, unlike purely technical fields, must also integrate **cultural, social, and contextual factors** that may not be captured in quantitative datasets alone.

Literature Search Strategy

A structured search process was undertaken across multiple databases, including **Google Scholar, Scopus, JSTOR, and Research Gate**, supplemented by grey literature from international organizations such as the **UNDP, World Bank, and Asian Development Bank**. NGO project reports and case studies, particularly from Bangladesh and Southeast Asia, were also included due to their direct relevance to low-income flood-prone contexts.

The following keywords and combinations were used:

Flood-resilient housing, stilt housing, amphibious housing, floating housing

Pakistan flood reconstruction, Indus flood vulnerability, vernacular flood architecture

Disaster-resilient housing, living with water, climate adaptation housing

The search covered literature published between **1990 and 2025**, capturing three decades of academic and practical knowledge on flood-resilient housing. This timeframe was selected to encompass both earlier vernacular studies and recent climate adaptation innovations.

Inclusion and Exclusion Criteria

To maintain focus and relevance, sources were selected using the following criteria:

Inclusion:

Publications addressing **housing design for flood resilience** (vernacular, contemporary, or policy).

Studies or case reports from **South and Southeast Asia**, with additional reference to high-income innovations (e.g., the Netherlands) for comparative purposes.

Grey literature documenting **NGO pilot projects** and post-disaster reconstruction in flood-prone contexts.

Peer-reviewed journal articles, conference papers, books, and institutional reports.

Exclusion:

Publications focusing exclusively on **large-scale engineering infrastructure** (dams, levees) without reference to housing.

Sources limited to **emergency shelter design** without long-term housing relevance.

Duplicated studies or those lacking sufficient methodological detail.

Through this process, approximately **60 sources** were initially reviewed, with **35 core references** forming the backbone of the analysis.

Analytical Framework

The analysis was guided by a typological and thematic framework, structured around four key dimensions:

Design Principles – Core architectural strategies (e.g., elevation, buoyancy, material choice).

Socio-Cultural Factors – Community acceptance, traditional practices, and integration into daily life.

Economic Feasibility – Cost, scalability, and material availability.

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Policy and Institutional Relevance – Linkage to disaster risk reduction strategies and housing policies.

This framework enabled comparative analysis of stilt and amphibious housing typologies across contexts, highlighting both advantages and limitations. It also ensured that technical design aspects were considered alongside cultural and policy dimensions, which are crucial for contextual transferability.

Strategies of the Literature-Based Approach

Several limitations are acknowledged in this methodological design:

Absence of empirical validation: The study does not involve field-based prototyping or engineering simulations. As such, conclusions remain conceptual rather than technical.

Dependence on secondary data: Findings rely on existing literature, which may be uneven in quality or detail. Some NGO reports, while rich in practice-based insights, lack rigorous peer review.

Contextual transferability: Lessons from Southeast Asia or the Netherlands may not translate directly to Pakistan due to differences in socio-cultural or ecological conditions.

Dynamic hazard patterns: Climate change introduces uncertainty in flood recurrence and intensity, which may outpace the scenarios described in the reviewed literature.

These limitations underscore the role of this paper as a **conceptual foundation** rather than a prescriptive technical manual.

Ethical Considerations

Although this study is literature-based, ethical considerations were incorporated by ensuring that all sources were properly cited, avoiding plagiarism, and respecting intellectual contributions of prior research. The use of grey literature, particularly NGO case reports, was approached cautiously, with acknowledgment of their context-specific nature and potential limitations.

Positioning of Methods within Research Objectives

By adopting this literature-based methodology, the study directly addresses its objectives:

Reviewing global precedents (achieved through broad search strategy).

Identifying design principles and cultural dimensions (guided by analytical framework).

Comparing typologies (enabled by thematic synthesis).

Providing a conceptual architectural framework for Pakistan (delivered in discussion and conclusion).

This methodological choice therefore ensures coherence between research aims, objectives, and outputs, while laying the groundwork for future empirical phases involving prototyping, technical validation, and pilot implementation.

Positioning Housing within Flood Resilience

Flood resilience in Pakistan has traditionally been conceptualized in terms of large-scale infrastructure; dams, barrages, levees, and embankments. While these systems are essential, they have limitations: they are costly, require long construction periods, and may displace vulnerabilities downstream. More importantly, they cannot address the micro-scale vulnerabilities experienced by households whose homes are destroyed with each flood cycle. Literature underscores that **resilient housing represents the first line of defense** for communities, directly influencing whether floods result in temporary disruption or long-term displacement.

By examining global precedents of stilt and amphibious housing, this paper contributes to reframing resilience in Pakistan: not merely as resistance to floods through barriers, but as **coexistence with water through architectural adaptation**. This shift resonates with the broader discourse of “living with water” increasingly emphasized in climate adaptation literature.

Suitability of Stilt Housing for Pakistan w.r.t Cultural and Vernacular Resonance

Stilt housing aligns with cultural precedents in South and Southeast Asia and, to some extent, in Pakistan itself. In rural Sindh and southern Punjab, households often raise mud-brick plinths to protect against minor floods. Extending this logic into full stilt structures represents a culturally acceptable evolution. Literature highlights that cultural resonance enhances adoption rates, as communities are more likely to embrace solutions that do not radically disrupt existing lifestyles.

Economic and Material Feasibility

One of the greatest strengths of stilt housing lies in affordability. Bamboo, timber, or reinforced concrete posts can be sourced locally at reasonable costs. Lightweight superstructures reduce material demand and construction complexity. In rural Pakistan, where self-building remains the dominant mode of housing production, this simplicity is advantageous. Households can construct stilt houses with limited technical assistance, particularly if training programs are introduced.

Spatial and Functional Benefits

Elevated dwellings not only protect against water damage but also create usable space beneath. In Pakistan, this undercroft could serve as shaded storage for livestock, crops, or tools, aligning with agricultural livelihoods. Ventilation benefits also improve indoor comfort in hot climates.

Challenges

Despite advantages, stilt housing has notable limitations:

Fixed elevation may fail in years of extreme flooding, such as 2010 or 2022, when water levels far exceeded historical averages.

Soil conditions in some floodplains (silt-rich, waterlogged) may undermine the stability of stilts.

Accessibility issues for elderly or disabled residents must be considered in design.

Therefore, while stilt housing is well-suited to predictable seasonal floods, its

effectiveness diminishes in contexts of **increasingly unpredictable flood magnitudes** driven by climate change.

Suitability of Amphibious Housing for Pakistan w.r.t Adaptability to Unpredictable Flooding

Amphibious housing directly addresses the central challenge of climate-induced flooding: unpredictability. By rising and falling with water levels, such dwellings offer protection against both moderate and extreme floods. For Pakistan, where flood magnitudes vary dramatically across regions and years, amphibious solutions provide adaptability that fixed-elevation stilt housing cannot guarantee.

Psychological and Social Stability

Displacement is one of the most traumatic consequences of floods. Amphibious housing reduces the need for evacuation, allowing families to remain in their homes during floods. Literature on Bangladesh's floating schools and houses indicates that this continuity fosters psychological security, preserves social networks, and minimizes disruption to livelihoods and education.

Innovation and Pilot Potential

Amphibious housing also aligns with Pakistan's emerging climate adaptation agenda, signaling innovation. Pilot projects could serve as testbeds for scaling, attracting support from international donors and NGOs. The symbolic value of demonstrating "future-ready" housing could also build momentum for policy adoption.

Barriers and Constraints

Challenges to amphibious housing in Pakistan are significant:

Higher upfront costs for buoyant foundations and guidance systems.

Requirement for technical expertise in design and construction.

Durability concerns, especially if low-cost materials such as oil drums are used for flotation.

Potential skepticism from communities unfamiliar with the concept of "floating houses."

These barriers suggest that amphibious housing is unlikely to be immediately scalable in rural Pakistan. However, as a targeted solution for high-risk areas with deep or prolonged flooding, it holds transformative potential.

Comparative Implications for Pakistan

The comparative framework reveals that **neither typology is universally superior**; rather, their suitability depends on context.

Stilt housing is best suited for rural settlements exposed to **seasonal, predictable floods**. It offers affordability, cultural resonance, and rapid deploy-ability. However, its limitations under extreme conditions make it insufficient as a standalone strategy.

Amphibious housing is better suited to **areas with deep or variable flooding**, particularly along major river channels or lakes. While more costly and technically demanding, it provides adaptability that can withstand climate uncertainty.

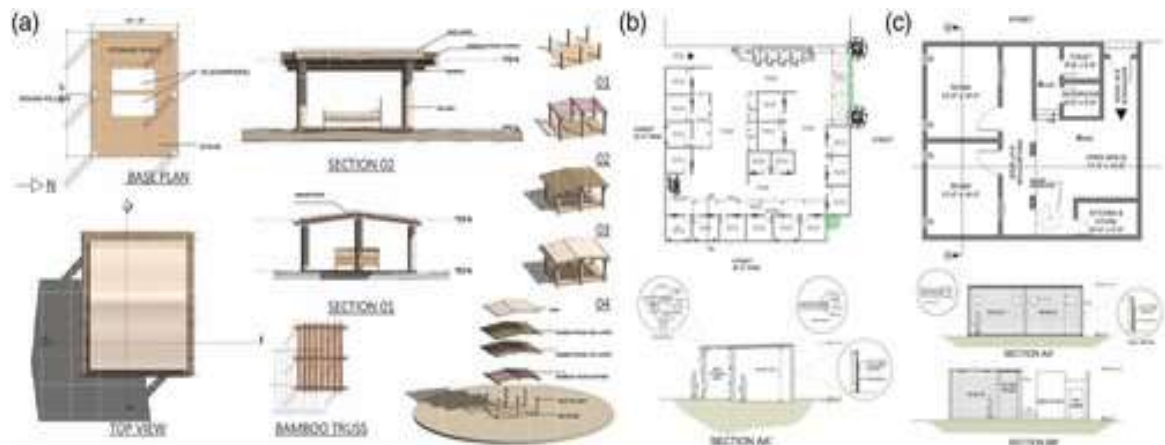


Figure 40: Details of Case Study 1 house (a) Construction details of temporary structure made by flood victims (b) Mud houses made by the local community (c) A resilient house made by a local community member.

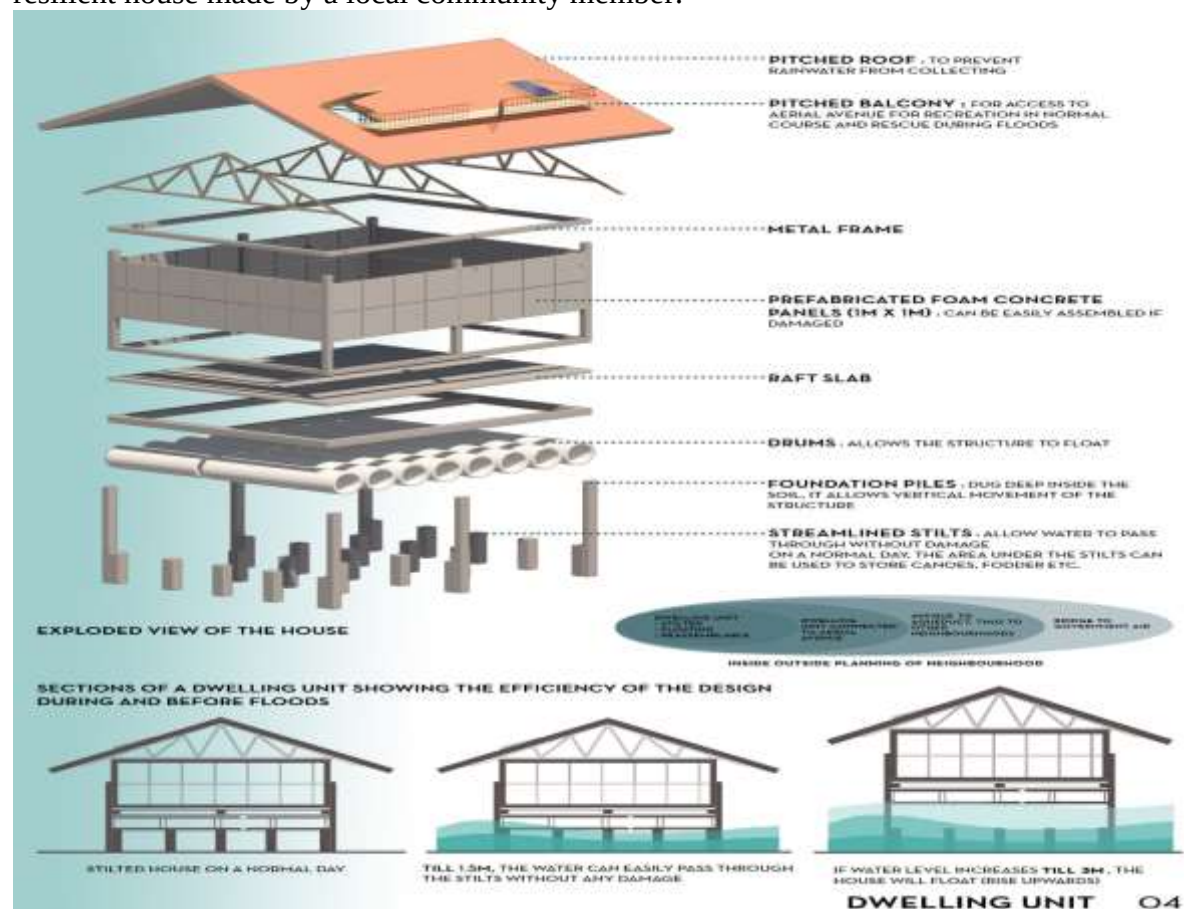


Figure 41: Flood house design

Thus, a **dual strategy** is most appropriate: scaling stilt housing as a community-driven baseline, while piloting amphibious housing in selected high-risk zones.

Policies & Integration into National Frameworks

Pakistan's disaster management strategies emphasize rapid relief and conventional reconstruction. To break cycles of vulnerability, flood-resilient housing typologies must be explicitly integrated into policies. This could include:

Incorporating resilient housing into **National Disaster Risk Reduction Policy**.

Developing **building codes or guidelines** for stilt and amphibious housing.

Encouraging NGOs and international donors to fund demonstration projects.

Financing and Affordability

For households to adopt resilient typologies, financial support is critical. Possible mechanisms include:

Microfinance loans tailored for resilient housing construction.

Government subsidies for durable stilt posts or buoyant foundations.

Public-private partnerships to scale production of low-cost buoyant materials.

Capacity Building and Training

Technical training is necessary to ensure safe construction. Community workshops, vocational programs, and NGO-led training could disseminate knowledge of stilt and amphibious construction techniques.

Community Engagement

Literature highlights that top-down housing interventions often fail due to lack of cultural fit. Engaging communities in co-design processes ensures that housing solutions reflect local needs, preferences, and aesthetics. This is particularly important for amphibious housing, where unfamiliarity may otherwise limit acceptance.

Risks of Architectural Solutions

While stilt and amphibious housing offer promise, they are not panaceas. Risks include:

Overreliance on housing: Without complementary flood management infrastructure, even resilient houses may be overwhelmed by extreme events.

Equity concerns: Better-resourced households may adopt resilient typologies, leaving poorer families trapped in vulnerable housing.

Maintenance challenges: Both stilts and buoyant foundations require ongoing care, which may be difficult in resource-poor contexts.

Changing hazard profiles: Climate change may create new hazards (e.g., prolonged waterlogging, salinity intrusion) that challenge both typologies.

Thus, architectural solutions must be embedded within broader **multi-scalar resilience strategies** encompassing infrastructure, land-use planning, and social

protection.

Toward a Pakistani Framework for Living with Water

This study supports the idea that Pakistan must move beyond reactive reconstruction toward proactive adaptation. A **framework for flood-resilient housing** would involve:

Baseline strategy: Promote stilt housing as an affordable, culturally resonant option in predictable flood zones.

Innovation pathway: Develop pilot projects for amphibious housing in highly vulnerable areas, supported by NGOs and research institutions.

Policy integration: Embed resilient housing in national disaster management and housing policies.

Capacity-building programs: Train communities and local builders in resilient techniques.

Financing mechanisms: Establish microfinance, subsidies, and donor partnerships to reduce costs for vulnerable households.

Adopting such a framework would transform housing from a recurrent liability into a proactive instrument of resilience.

Contribution to Academic and Practical Discourse

This discussion makes two key contributions:

Academic contribution: By synthesizing literature across vernacular traditions and contemporary innovations, this paper positions architecture as central to disaster resilience discourse in Pakistan. It highlights the underexplored potential of housing typologies as adaptive strategies.

Practical contribution: For policymakers, NGOs, and practitioners, the findings offer a comparative evaluation of two typologies and a roadmap for integration into resilience planning. The emphasis on cultural resonance, community engagement, and financing provides actionable insights for pilot implementation.

Future Research

This study set out to explore how architecture can contribute to flood resilience in Pakistan, a country repeatedly devastated by seasonal and extreme floods. While much of the policy discourse focuses on infrastructural defenses and emergency relief, this paper argues that **housing represents the most immediate site of vulnerability and adaptation**. Drawing on global literature, the study examined two architectural typologies; **stilt (hanging) housing** and **amphibious (ship-type) housing**; as potential solutions for Pakistan's flood-prone communities.

The review highlighted that **stilt housing** offers affordability, cultural resonance, and

relative simplicity. It is particularly well-suited to predictable, seasonal floods in rural areas where communities already practice plinth-raising or similar adaptations. However, its fixed elevation limits effectiveness under extreme or highly variable floods.

In contrast, **amphibious housing** provides adaptability, rising and falling with water levels. This makes it especially relevant in contexts where flood magnitudes are unpredictable, such as along major rivers and lakes. Yet its higher costs, technical complexity, and limited community familiarity present barriers to widespread adoption.

A comparative framework demonstrated that both typologies are complementary rather than mutually exclusive. Stilt housing should be prioritized as a baseline strategy for most rural settlements, while amphibious housing should be pursued through targeted pilot projects in high-risk zones. Together, these approaches provide a **dual strategy** for “living with water” in Pakistan.

Contribution to Knowledge

The paper makes three primary contributions:

Conceptual reframing of resilience: It positions housing not merely as a victim of floods but as an active instrument of resilience. By doing so, it expands the discourse beyond infrastructure and relief to include everyday architectural design as a climate adaptation strategy.

Integration of global precedents: By synthesizing vernacular traditions from Southeast Asia, innovations from Bangladesh, and high-tech experiments from the Netherlands, the study situates Pakistan’s housing challenge within a global continuum of adaptive strategies.

Architectural framework for Pakistan: It provides a structured evaluation of stilt and amphibious housing in terms of design principles, cultural acceptance, economic feasibility, and policy relevance. This framework can guide policymakers, NGOs, and practitioners in considering architectural solutions as part of disaster management planning.

Practical Implications

The findings have several practical implications for Pakistan’s flood resilience agenda:

Policy Integration: Resilient housing typologies should be explicitly integrated into national disaster risk reduction strategies and housing policies. Guidelines for safe stilt and amphibious design could be incorporated into building codes.

Community Engagement: Adoption of new housing forms requires co-design with communities. Building on familiar practices (e.g., plinth elevation) enhances acceptance, while pilot projects can build trust for more innovative typologies like amphibious housing.

Capacity Building: Technical training for local builders, carpenters, and masons is essential to ensure safe construction and maintenance. Universities and vocational institutes could play a role in disseminating knowledge.

Financing Mechanisms: Microfinance loans, subsidies, and donor partnerships are needed to lower the entry cost of resilient housing, especially for poor households who face the greatest vulnerability.

By embedding these measures, housing can shift from a recurrent liability to a cornerstone of resilience in Pakistan's flood-prone regions.

Study Considerations:-

This research has several limitations that must be acknowledged:

It is **literature-based** and does not include empirical testing or prototyping of housing designs. Conclusions remain conceptual rather than technical.

The analysis is limited by the **availability and quality of secondary data**, which may vary across sources, especially NGO case reports.

Contextual transferability remains a challenge: lessons from Bangladesh or the Netherlands may not fully align with Pakistan's cultural or ecological realities.

The study focuses on two typologies, but other solutions (such as elevated earthen mounds, modular housing, or hybrid designs) also merit exploration.

Recognizing these limitations, the paper frames itself as a **first step** toward embedding architecture within Pakistan's resilience strategies.

Directions for Future Research

Building on this foundation, several avenues for future research are identified:

Technical Validation: Pilot projects should test stilt and amphibious prototypes under real flood conditions in Pakistan. Engineering studies could evaluate structural stability, buoyancy, durability of materials, and maintenance requirements.

Socio-Cultural Acceptance: Fieldwork is needed to explore community perceptions of these typologies, identifying potential barriers to adoption and strategies for cultural integration.

Economic Feasibility Studies: Cost-benefit analyses could compare resilient housing with conventional reconstruction cycles, providing evidence for policymakers and donors.

Policy and Governance Research: Future studies should investigate how housing innovation can be embedded within Pakistan's disaster management, housing, and climate adaptation policies.

Hybrid Solutions: Research could explore combining elements of stilt and amphibious housing, or retrofitting existing dwellings with buoyant foundations, to create scalable middle-ground solutions.

Climate Change Scenarios: Simulation studies could assess how these housing typologies perform under projected increases in rainfall variability, river discharge, and flood recurrence.

By pursuing these research directions, Pakistan can move from conceptual frameworks toward actionable strategies that reduce vulnerability and enhance resilience.

Conclusion:-

Floods will remain an unavoidable feature of Pakistan's future, intensified by climate change and unregulated settlement in floodplains. Continuing with business-as-usual reconstruction (rebuilding fragile houses that collapse every few years) will perpetuate cycles of poverty, displacement, and loss. This paper has argued that architecture offers an alternative pathway: designing houses that coexist with water rather than resist it.

By embracing **stilt housing** as an affordable baseline and **amphibious housing** as an innovative frontier, Pakistan can reimagine its relationship with floods. While challenges of cost, policy, and acceptance remain, the conceptual evidence is clear: resilient housing is both possible and necessary. The task ahead lies in translating this vision into practice through pilot projects, community engagement, and policy reform. Ultimately, living with water" is not only a design challenge but a paradigm shift. It demands that Pakistan move beyond reactive reconstruction to proactive adaptation, embedding resilience into the very walls, floors, and foundations of the homes where its people live.

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