ADAPTING TO RISING WATERS

RESEARCHPLAN ON KINETIC ARCHITECTURE FOR ADAPTIVE HOUSING IN SYLHET

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INTRODUCTION
TOPOGRAPFY BANGLADESH'S

Bangladesh's geographical positioning and low-lying topography make it highly vulnerable to flooding. Located at the confluence of major rivers like the Ganges, Brahmaputra, and Meghna, approximately 80% of its landmass comprises floodplains, which experience recurrent and severe flooding, particularly during the monsoon season (Rana & Ilina, 2021). Annually, monsoon rains contribute to widespread flooding that can affect up to 68% of the nation, disrupting communities and economic activities significantly. This vulnerability is further exacerbated by climate change, which has intensified extreme weather events, leading to more severe and unpredictable flooding (Saha et al., 2021; Anik & Khan, 2012).

To address these challenges, there is a growing need for adaptive architectural solutions that not only mitigate flood damage but also enhance resilience and self-reliance within affected communities (Shafiq, 2023). Traditional static infrastructure has shown limitations under such dynamic environmental pressures, underscoring the potential of kinetic and amphibious architecture as effective alternatives. These architectural solutions allow structures to move, rise, or float in response to changing water levels, providing a flexible approach to the flood challenges that are integral to Bangladesh's landscape (Ameh et al., 2024). This research aims to explore and develop sustainable, practical solutions for flood resilience, focusing on pre-urban areas like Sylhet, where the impacts of climate-related flooding are particularly acute (Mannucci et al., 2022).

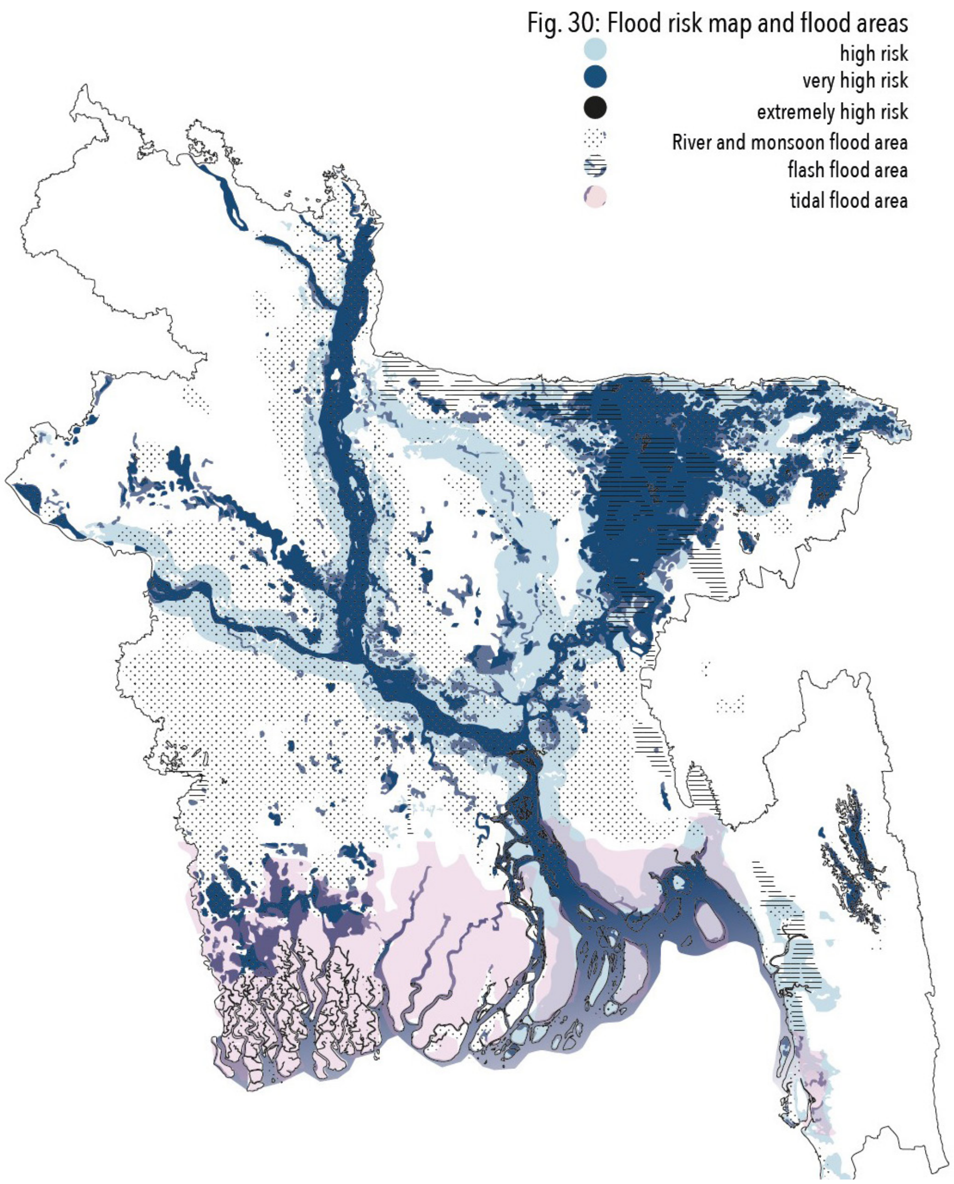

Figure 1: Floodrisk map of Bangladesh (Globale Housing Studio, 2023)

LITERATURE REVIEW
INTENSIVE FLOODINGS OF BANGLADESH.

Bangladesh is one of the most flood-prone countries globally due to its geographical location, low-lying topography, and dense river network. Positioned at the convergence of the Ganges, Brahmaputra, and Meghna rivers and bordering the Bay of Bengal, around 80% of Bangladesh's landmass comprises floodplains, making it extremely vulnerable to recurrent and severe flooding (Rana & Ilina, 2021). Approximately 20% of the country experiences flooding annually, but during extreme weather events, this can extend to as much as 68% of the land (Rana & Ilina, 2021). The combination of intense monsoon rains, river overflows, and cyclones contribute to these flood events, which severely disrupt lives, infrastructure, and economic stability (Rana & Ilina, 2021). In regions like Sylhet, annual monsoon floods and flash floods have been particularly damaging, a situation aggravated by climate change, which has intensified rainfall patterns and increased flood frequency and severity (Anik & Khan, 2011).

The socioeconomic impacts of flooding in Bangladesh are profound, as these events often displace communities, damage property, and heighten health risks associated with waterborne diseases. Limited access to clean water and sanitation during flood events compounds these issues, as recently illustrated when flooding affected millions and devastated critical sanitation infrastructure (IFRC, 2017). Moreover, the agricultural sector, on which rural communities heavily rely, suffers from flood-induced crop losses, exacerbating food insecurity and poverty (Rana & Ilina, 2021). The pressures of rapid urbanization further complicate these challenges, particularly in Sylhet, where unplanned growth limits the effectiveness of traditional floodplain systems, compromising their natural water absorption capacity (Alam & Rabbani, 2007; Majumder et al., 2010).

Figure 2: Bangladesh's Battle Against Devastating Floods: Every year, Bangladesh faces devastating monsoon floods that cause widespread destruction. (Akash, 2024)

In response to these persistent issues, there is increasing interest in adaptive architectural approaches capable of enhancing flood resilience in such vulnerable regions. Kinetic architecture represents one such approach, integrating dynamic structural elements that respond to environmental changes. For example, movable walls, floating components, or structures with adjustable elevations can reduce flood damage by accommodating fluctuating water levels (Fakharany, 2024). Though effective in various global contexts, the application of kinetic architecture in Bangladesh remains limited, emphasizing the need to adapt these innovations to local conditions and challenges. In addition, there is especially a lack of low tech solutions

Amphibious architecture offers another viable approach, where buildings rest on solid foundations during dry periods but float when submerged, as seen in the floating community of Maasbommel in the Netherlands (Amphibious Housing in Maasbommel, The Netherlands, z.d.). This design ensures buildings remain functional during floods, providing a promising solution for flood-prone regions like Sylhet. However, the potential for large-scale implementation in Bangladesh has not been fully explored.

In addition, biomimetic architecture, inspired by natural forms and processes, introduces solutions that mirror nature's resilience strategies. The concept of "sponge cities," for instance, uses permeable materials and green spaces to absorb excess water, reducing urban flooding (York, 2024). This approach, implemented in cities like Shanghai, could offer valuable insights for adapting Sylhet's urban areas to better manage floodwaters (Li et al., 2017). Although effective in other regions, biomimetic approaches are not yet widely integrated into flood resilience strategies in Bangladesh, particularly in pre-urban areas with unique environmental and infrastructural needs.

Insights from historical architectural practices also underscore the effectiveness of adaptive designs in natural disaster contexts. Japanese pagodas, which date back over a thousand years, have survived earthquakes due to their central wooden pillar, or shinbashira, which allows the structure to sway and dissipate seismic energy (TSUWA et al., 2015). This example demonstrates the resilience potential in designing structures that adapt to natural forces. Applying similar low tech principles to flood-prone areas in Bangladesh, could significantly enhance local flood resilience.

Collectively, these innovative architectural approaches—kinetic, amphibious, and biomimetic—highlight new possibilities for enhancing flood resilience in Bangladesh's vulnerable areas. However, the integration of such adaptive designs within the local context, accounting for cultural, environmental, and economic factors, is still underexplored. Further studies are needed to determine how these architectural strategies can be feasibly implemented in Bangladesh, contributing to the development of sustainable, adaptive communities capable of withstanding the intensifying impacts of climate change.

PROBLEM STATEMENT
FLOOD RESILIENCE IN SLYHET

Flooding is a recurring and critical issue in Bangladesh, particularly affecting the Sylhet region due to its proximity to the Ganges-Brahmaputra-Meghna (GBM) delta. Bangladesh experiences frequent flooding exacerbated by climate change, which has led to significant and more intense precipitation patterns, increasing flood severity and frequency (Mannucci et al., 2022). In Sylhet, annual monsoon floods have had particularly severe impacts, affecting nearly 90% of the region in peak flood years (Mannucci et al., 2022). This flooding leads to extensive socio-economic consequences for the local population, as it disrupts agricultural activities, damages infrastructure, and displaces communities (Sajid, 2016). In 2022 alone, 6 million people across Bangladesh were affected by floods, resulting in substantial agricultural and economic losses (Sajid, 2016).

Impact of Urbanization

The Sylhet region's flood issues are further compounded by rapid and often unplanned urbanization. As the population grows, the expansion into low-lying and flood-prone areas has intensified. Urban expansion reduces the land's natural capacity to absorb rainwater, while the destruction of wetlands and drainage systems, which previously acted as natural flood buffers, has escalated the vulnerability to overspill flooding (Alam, 2018). For example, in urbanizing areas, such as Dhaka, approximately 40% of natural drainage canals have been filled or blocked due to construction, leading to more severe waterlogging and pluvial flooding (Sakib et al., 2023). This trend is evident in Sylhet, where encroachment on water bodies and inefficient drainage exacerbate flood risks during the monsoon seasons (Sakib et al., 2023).

Figure 3: Amphibiation housing in the Mekong River delta (The Buoyant Foundation Project, 2018)

Urbanization does not only alter the physical landscape but also increases the socio-economic vulnerability of the region's inhabitants (Sakib et al., 2023). The shift from agricultural land to urban developments often disregards sustainable building practices, resulting in structures unfit to withstand prolonged water exposure (Mannucci et al., 2022). Consequently, communities are exposed to severe health risks due to waterborne diseases, in addition to economic pressures from recurring property and infrastructure damage (Mannucci et al., 2022). For example, floods in 2021 caused damage to housing and critical infrastructure worth over USD 1 billion, and flood-prone communities continue to experience heightened levels of poverty and limited access to resources necessary for post-disaster recovery (Shafiq, 2023).

The Need for Adaptive Architecture

Given these challenges, there is a pressing need to transition from static architectural designs to more adaptive, resilient solutions. Conventional buildings are often unsuited to the dynamic flood conditions of Sylhet, which are increasingly unpredictable (Hemmati et al., 2021). Adaptive architecture, including kinetic and amphibious structures, provides a proactive approach to flood resilience. Unlike traditional designs, kinetic architecture adapts by shifting or elevating in response to rising waters, while amphibious structures are designed to float as floodwaters rise, reducing water damage and allowing residents to remain in their homes during floods (Hemmati et al., 2021).

Kinetic and amphibious architectural solutions present the opportunity to mitigate flood impacts while enhancing community resilience. By integrating these designs, local communities can improve their capacity to withstand flooding without relying solely on emergency responses (Shafiq, 2023). This is crucial in Sylhet, where 80% of the region's population resides within flood-prone areas and faces long-term risks from climate change-related flood events (Shafiq, 2023). Furthermore, community-led initiatives and participatory planning can enhance the sustainability of these adaptive measures, enabling residents to take an active role in designing solutions that are both practical and culturally relevant (Hemmati et al., 2021).

THEORETICAL FRAMEWORK

KINETIC AND AMPHIBIOUS ARCHITECTURE

Flooding is an intensifying crisis in Bangladesh, where communities face the compounded effects of flash floods and river overflows, increasingly exacerbated by climate change. In 2022, for instance, over six million people were impacted by extreme flooding (Rana & Ilina, 2021). Traditional flood mitigation measures, such as embankments and levees, are inadequate for addressing the unique environmental challenges in regions like Sylhet, as these static structures are unable to adapt to rapidly changing water levels and weather conditions (Saha et al., 2021). In response, this research explores kinetic and amphibious architectural solutions as dynamic alternatives to conventional flood management. These adaptive approaches enable buildings to adjust physically to fluctuating water levels, fostering resilience through principles of adaptability, biomimicry, and systems thinking (Ameh et al., 2024). The theoretical foundation for these strategies is grounded in Resilience Theory, Biomimicry and Bioinspiration, and Systems Theory, each of which provides a framework for enhancing flood resilience and community self-reliance.

Resilience Theory

Resilience Theory, developed by C.S. Holling, examines how systems absorb disturbances, adapt, and reorganize to maintain functionality under stress (Holling, 1973). In architecture, resilience theory is especially relevant for tackling unpredictable flooding, as it emphasizes the need for structures that can adapt to and recover from environmental challenges rather than simply resist them. This approach advocates for proactive adaptation, where buildings are designed to dynamically adjust to flooding conditions, thus reducing dependency on post-disaster interventions.

Kinetic and amphibious architecture embody resilience by incorporating adaptability directly into the built environment. Kinetic structures, for instance, introduce flexibility through movable walls, retractable roofs, and elements that can elevate or rotate, allowing buildings to respond to rising water levels in real-time (Fakharany, 2024). Such flexibility minimizes the likelihood of flood damage and displacement, as structures can shift to accommodate environmental changes as they occur (Megahed, 2017). Meanwhile, amphibious architecture enhances resilience by employing buoyant systems, which enable buildings to rise and fall with water levels, thus preserving structural integrity during extreme inundation (Proverbs & Lamond, 2017). These systems facilitate continued functionality during flooding, reducing disruptions to daily life and supporting community stability (Shafiq, 2023).

Incorporating resilience theory into adaptive architecture promotes a shift from reliance on reactive measures to fostering community-led resilience. By integrating kinetic and amphibious systems, buildings become self-sustaining during extreme weather events, lessening the need for immediate external assistance. This proactive approach mitigates socioeconomic disruptions, allowing communities to maintain access to habitable spaces and thereby supporting resilience in a manner that static infrastructure cannot (Megahed, 2017; Ameh et al., 2024).

Biomimicry and Bioinspiration

Biomimicry and Bioinspiration, as popularized by Janine Benyus, involve studying and replicating nature's adaptive strategies to create sustainable solutions (Benyus, 1997). This approach is particularly relevant for low-tech, resource-efficient designs in flood-prone regions, where complex mechanical systems may not be feasible. By mimicking nature's time-tested resilience, biomimetic architecture offers solutions that are both sustainable and well-suited to the socio-economic realities of vulnerable areas.

In the context of flood resilience, biomimetic principles are exemplified in amphibious designs inspired by ecosystems that thrive in aquatic environments (Proverbs & Lamond, 2017). For instance, buoyant foundations that allow buildings to float and adapt to rising water levels mimic the resilience of mangroves, which stabilize themselves in fluctuating conditions through extended root networks (Proverbs & Lamond, 2017). This natural adaptation is mirrored in architecture that relies on buoyancy-driven systems to maintain stability during floods, reducing the need for costly repairs and rebuilding (Proverbs & Lamond, 2017; Ameh et al., 2024). Furthermore, biomimetic design can extend to material choices. As Ameh et al. (2024) discuss, low-tech kinetic systems might incorporate materials that swell or contract in response to moisture, enabling passive adaptation without complex engineering. Such materials offer a sustainable solution that reduces maintenance costs and provides resilience in a cost-effective manner (Megahed, 2017).

Through biomimicry, adaptive architecture can achieve resilience by aligning with the socio-economic context of communities. Low-tech, nature-inspired designs address the limitations of resource availability and maintenance capacity, while enhancing flood resilience in a manner that is affordable and accessible. Biomimetic principles, therefore, contribute to creating a sustainable, locally appropriate model of flood adaptation that can be scaled across similar contexts.

Systems Theory

Systems Theory, introduced by Ludwig von Bertalanffy, conceptualizes entities as dynamic systems made up of interconnected parts that continuously interact with their environment (Bertalanffy, 1968). In adaptive architecture, this theory provides a framework for viewing buildings as cohesive, responsive systems that can adapt to external inputs, such as fluctuating water levels. This perspective is critical for designing resilient structures in flood-prone areas, where built environments must respond dynamically to changing conditions.

Applying systems theory to architecture involves designing buildings as integrated systems that maintain balance and functionality amidst shifting environmental pressures. Kinetic components — such as hinged walls, collapsible partitions, and floating floors — enable the structure to adapt to rising water, reducing structural strain and preserving integrity during floods (Megahed, 2017). For instance, retractable roofs can shield interior spaces during heavy rainfall, while floating foundations allow buildings to rise in tandem with floodwaters. By operating as a unified, responsive system, adaptive architecture becomes resilient to environmental fluctuations, preserving functionality during flood events (Ameh et al., 2024).

Systems theory also underpins the principle of multi-functionality, a crucial feature of adaptive architecture in flood-prone settings (Megahed, 2017). Multi-functional buildings can transition between different states, such as remaining elevated during floods and returning to ground level during dry periods (Ngo et al., 2020). This flexibility ensures that structures remain useful throughout varying environmental conditions, thus supporting community resilience by providing year-round relevance (Ngo et al., 2020). Such adaptability reduces reliance on emergency responses and allows residents to rely on the inherent flexibility of their built environment.

The integration of resilience theory, biomimicry, and systems theory within the architectural framework provides a comprehensive approach to adaptive flood resilience. Resilience theory underscores the need for buildings that can absorb and recover from disturbances, supporting a shift from emergency dependence to community-led stability. Biomimicry offers low-tech, sustainable solutions by replicating nature's adaptive strategies, ensuring economic feasibility for communities with limited resources. Systems theory, by conceptualizing buildings as responsive, interconnected systems, facilitates the integration of adaptive elements that dynamically respond to environmental changes.

Collectively, this theoretical foundation promotes a self-sustaining model for flood adaptation, ultimately fostering resilience, stability, and economic security within vulnerable communities (Ameh et al., 2024; Megahed, 2017). Through these integrated approaches, adaptive architecture not only meets immediate flood resilience needs but also offers a prototype for similar applications in flood-prone regions, advancing a sustainable model of climate resilience for the global South.

RESEARCH QUESTION

ADAPTABLE HOUSING DESIGN

2. Learning from Global Successes

1. Understanding Local Challenges

"How can kinetic and amphibious architectural solutions be designed to mitigate the impacts of overspill flooding in the pre-urban areas of Sylhet, to enhancing resilience and self-reliance for local communities?"

3. Adapting Design to Environmental Need

4. Building Community Resilience and Self-Reliance

1. Understanding Local Challenges

What are the specific flood-related challenges in Sylhet's pre-urban areas, and how do they affect local communities?

2. Learning from Global Successes

What are the most effective kinetic and amphibious architectural strategies identified in global case studies for flood resilience, and how can they be adapted to the unique environmental challenges of Sylhet?

3. Adapting Design to Environmental Needs

How do the characteristics of overspill flooding in Sylhet's pre-urban areas influence the selection of materials and technologies for kinetic and amphibious architectural solutions?

4. Building Community Resilience and Self-Reliance

In what ways can these architectural solutions promote resilience and self-reliance among Sylhet's pre-urban local communities?

HYPOTHESIS
ADAPTIVE DESIGN PRINCIPLES

This research hypothesizes that the implementation of kinetic and amphibious architectural solutions will effectively mitigate the adverse impacts of overspill flooding in the pre-urban areas of Sylhet, while simultaneously enhancing resilience and promoting self-reliance within the local communities. By adopting kinetic design elements—such as movable walls, flexible foundations, or elevating structures—buildings can dynamically adjust to rising water levels, minimizing structural damage and displacement during flood events. Additionally, amphibious structures, designed with buoyant systems that allow them to float and adapt passively to fluctuating water levels, will help communities remain inhabitable and functional during periods of inundation.

The anticipated outcome is a set of adaptive design principles that align with local cultural practices and utilize accessible, low-tech solutions. These principles aim to empower Sylhet's communities to construct more resilient buildings that can adapt to environmental changes, reducing dependency on emergency interventions and minimizing recovery costs after floods. Moreover, drawing on biomimetic principles, such as the natural stability of mangroves in submerged environments, the research will explore design adaptations that integrate with the flood landscape, fostering sustainability and long-term economic benefits.

Ultimately, the research seeks to develop context-specific architectural guidelines that not only mitigate flood damage but also promote year-round usability and enhance the community's capacity for self-reliant recovery. These guidelines will provide a foundation for future design projects in Sylhet, contributing to a broader understanding of adaptive architecture in flood-prone regions and offering practical, scalable solutions for climate resilience.

GOAL/AIM
KINETIC AND AMPHIBIOUS PRINCIPLES

The goal of this research is to develop a set of adaptive design principles for kinetic and amphibious architectural solutions specifically tailored to mitigate the impacts of overspill flooding in the pre-urban areas of Sylhet, Bangladesh. This research aims to explore how these architectural strategies can enhance both resilience and self-reliance within local communities, providing a sustainable model that can be adapted for similar flood-prone areas in the global South.

To achieve this goal, the study will focus on investigating design approaches that respond dynamically to fluctuating water levels, reducing structural vulnerability and allowing continued habitation during flood events. By analyzing Sylhet's unique environmental and socio-economic challenges, the research will seek to identify suitable materials and techniques that are both culturally relevant and feasible within the local context. Moreover, the study intends to examine how kinetic and amphibious elements—such as elevating or floating foundations, movable walls, and flexible building components—can be integrated into local architecture to improve flood resilience and minimize recovery costs.

Ultimately, this research aims to produce actionable design guidelines for architects, planners, and policymakers that address the specific flooding issues in Sylhet. If successful, the principles developed here could serve as a prototype for other flood-prone regions, promoting climate-adaptive architecture as a sustainable solution for vulnerable communities. By enhancing the capacity for self-reliant flood management, these design recommendations have the potential to foster long-term resilience and economic stability in Sylhet and beyond.

METHODOLOGY
THEORETICAL AND EMPIRICAL PERSPECTIVES

The methodology adopted in this study integrates multiple research methods to provide both theoretical and empirical insights, aiming to develop adaptive design principles for kinetic and amphibious architectural solutions that address the specific flooding challenges of Sylhet's pre-urban areas. This research is driven by the objective of fostering resilience and self-reliance within local communities, and the chosen methods are tailored to answer distinct sub-questions that collectively guide this aim. Through a combination of a literature review, case study analysis, comparative analysis, and semi-structured interviews with local residents, this methodology is constructed to yield actionable, context-sensitive recommendations.

Literature review

The literature review establishes the foundational knowledge base, focusing on the socio-environmental vulnerabilities specific to Sylhet. Documenting the particular challenges faced by Sylhet, including limitations of static infrastructure in adapting to dynamic environmental pressures, the review aligns with the first research question regarding local flood-related challenges (Saha et al., 2021; Alam, 2018). The literature review also draws from global architectural strategies, identifying kinetic and amphibious designs that offer flexibility and adaptability, core principles essential to flood resilience. High-tech and low-tech adaptive strategies are evaluated in this context to assess their potential relevance to Sylhet. For instance, Ameh et al. (2024) highlight buoyancy mechanisms in amphibious structures, which allow buildings to float during floods, thereby preserving structural integrity and minimizing disruption. This phase not only clarifies theoretical concepts such as resilience theory, biomimicry, and systems theory (Holling, 1973; Benyus, 1997; Bertalanffy, 1968), but also contextualizes these theories within Sylhet's socio-economic and environmental realities. In doing so, the literature review provides a theoretical framework for identifying solutions that are both adaptable and sustainable, guiding the subsequent empirical stages of the study

Case Study

Following the theoretical groundwork, the case study analysis examines kinetic and amphibious architectural examples from regions facing similar flood risks, offering practical insights into effective global strategies and addressing the second and third research questions on strategic adaptation and local applicability. This analysis covers both high-tech and low-tech approaches to demonstrate a spectrum of resilience-focused designs. For instance, the buoyant foundations of self-floating homes in the Netherlands serve as exemplars of high-tech systems capable of responding to extreme flooding events by allowing buildings to rise and settle with fluctuating water levels (Megahed, 2017). Conversely, floating houses in Southeast Asia present low-tech, resource-efficient alternatives that utilize simple buoyant foundations and locally sourced materials, highlighting feasible solutions for resource-constrained settings (Ngo et al., 2020). Each case is scrutinized for its design adaptability, cost implications, and environmental fit, allowing the research to discern the practical challenges and successes that inform the applicability of these systems to Sylhet. Notably, the case study analysis is not limited to a binary assessment of high-tech versus low-tech approaches but rather seeks to extract adaptable principles from high-tech solutions that may be feasibly modified to suit Sylhet’s context. This approach ensures that the case study findings offer both innovative and contextually appropriate strategies that align with Sylhet’s environmental and socio-economic constraints.

Comparative analysis

The comparative analysis builds upon insights gained from the case studies to evaluate the suitability of different adaptive architectural solutions for Sylhet. By systematically comparing resilience factors, cost-effectiveness, cultural compatibility, and material availability, this phase identifies the most viable options. Thereby addressing the third research question concerning material and technological adaptation. For instance, while hydraulic elevation systems from high-tech settings offer robust responses to flooding, they may lack the cost feasibility for widespread adoption in Sylhet's pre-urban areas. In contrast, buoyant, low-tech designs, which have been integrated into vernacular practices across Southeast Asia, provide a more scalable solution for Sylhet's flood-prone communities. It is allowing buildings to respond passively to water levels without complex mechanical systems (Hemmati et al., 2021). This comparative assessment thus highlights adaptable strategies that align with Sylhet's specific flood characteristics and resource limitations, ensuring that the recommended designs are economically viable and culturally relevant.

Semi-Structured Interviews with Locals

To complement these theoretical and case-based analyses, semi-structured interviews with local residents are conducted to capture empirical insights into community needs, perceptions, and the practicality of adopting kinetic and amphibious designs. These interviews address the fourth research question, which centers on fostering resilience and self-reliance through architectural adaptation. Interview questions are designed to explore local experiences with existing flood management practices, preferences for building materials, and openness to adopting new architectural solutions. By engaging directly with residents, the research incorporates local knowledge and preferences, which are vital to aligning the proposed solutions with community expectations. This phase provides a nuanced understanding of local attitudes toward adaptive architecture, helping to identify potential socio-cultural barriers and facilitators in implementing these designs. Consequently, the interview findings will not only inform the feasibility of proposed adaptations but also strengthen the research's community-centered approach, emphasizing the importance of participatory planning in enhancing resilience.

Together, these methods form a cohesive framework that integrates theoretical perspectives with practical solutions, enabling a comprehensive approach to developing adaptive design principles for Sylhet. The literature review anchors the study within established theories and global innovations, while the case study and comparative analyses distill these innovations into context-sensitive applications. The empirical insights from local interviews ground the research in community needs and preferences, ensuring that the recommendations align with both the socio-economic realities and cultural values of Sylhet's pre-urban areas. This methodology, therefore, not only provides a pathway for developing adaptive architectural solutions but also fosters a model of resilience that is sustainable, locally appropriate, and scalable to other flood-prone regions facing similar challenges.

RESEARCH SCHEME
METHODS AND WORKPLAN

Why?

Bangladesh faces recurring and increasingly severe flooding, exacerbated by climate change and rapid urbanization, particularly impacting the Sylhet region. In peak flood years, up to 90% of Sylhet is affected, leading to significant socio-economic consequences. The 2022 floods alone affected over 6 million people nationwide, highlighting the urgent need for adaptive, sustainable solutions. Rapid urban expansion in Sylhet further increases vulnerability by reducing natural drainage, resulting in intensified overspill flooding. Therefore, we need to explore kinetic and amphibious architectural solutions that enhance resilience and self-reliance within flood-prone communities.

What?

RESEARCH AIM

The aim of your research is to develop adaptive design principles for kinetic and amphibious architectural solutions tailored to mitigate the impacts of overspill flooding in Sylhet's pre-urban areas, enhancing resilience and self-reliance within local communities.

SUB AIM	SUB AIM	SUB AIM
Investigate the specific flood-related issues in Sylhet's pre-urban areas, including the socio-economic impacts on local communities and the limitations of current infrastructure.	Analyze global case studies of kinetic and amphibious architecture for flood resilience to identify effective strategies that could be adapted to Sylhet's unique environmental and cultural landscape.	Formulate adaptive architectural principles that incorporate kinetic and amphibious elements tailored to Sylhet, aiming to enhance local resilience and promote self-reliance within flood-prone communities.

What?

RESEARCH QUESTION

"How can kinetic and amphibious architectural solutions be designed to mitigate the impacts of overspill flooding in the pre-urban areas of Sylhet, while enhancing resilience and self-reliance for local communities?"

SUB QUESTION	SUB QUESTION	SUB QUESTION	SUB QUESTION
What are the specific flood-related challenges in Sylhet's pre-urban areas, and how do they affect local communities?	What are the most effective kinetic and amphibious architectural strategies identified in global case studies for flood resilience, and how can they be adapted to the unique environmental challenges of Sylhet?	How do the characteristics of overspill flooding in Sylhet's pre-urban areas influence the selection of materials and technologies for kinetic and amphibious architectural solutions?	In what ways can these architectural solutions promote resilience and self-reliance among Sylhet's pre-urban local communities?

How?

Sub question 1	Sub question 2	Sub question 3	Sub question 4
Literature review		Literature review	
	Case Study Analysis		Case Study Analysis
	Comparative Analysis	Comparative Analysis	
Interviews with Locals			Interviews with Locals

Figure 4: Research Scheme (own work)

Q1 10 weeks

Pre Reearch
Problemstatement
Define Research Question
Creating Research Plan (Who, Why, What and How?)
Begin to literatuur revies
Start on the Theoretical Framework
Begin to write the methodology, goal and relevance
Finalize Research Plan

Submit:
Research Plan (Final)

P1

Q2 10 weeks

Setting up Fieldtrip (Bangladesh)
Attend Fieldtrip (03-12 t/m 20-12) Bangladesh
Organize Fieldtrip findings
Selecting Case Studies
Start Theoretical Research (sub question 1 & 2)
Start development concepts
Begin of the comparitive reearch

Submit:
Graduation Plan (Final)

P2

Q3 10 weeks

Continue on the Research and Design Proposal
Begin writing Graduation Thesis

Design in Progress
Graduation Thesis in Progress

Submit:
Refelction (Draftl)

P3

Q4 10 weeks

Finalizing Design

Submit:
Refelection (Final)
Graduation Thesis (Final)

P4

Final Presentation

P5

Figure 5: Workplan (own work)

RELEVANCE
GLOBAL STRATEGIES

Flooding poses a severe and growing challenge worldwide, affecting millions of people annually by disrupting livelihoods, damaging infrastructure, and straining local economies. Amphibious and kinetic architectural solutions have emerged as viable, adaptive strategies to mitigate flood risk, providing buildings that can either move or rise with water levels, thereby minimizing flood damage and enhancing resilience. As these approaches gain traction globally, regions prone to flooding, such as Bangladesh, offer a valuable context for exploring the efficacy of such designs. Bangladesh, particularly its Sylhet region, is frequently impacted by extreme weather events that result in overspill flooding, leading to widespread displacement and socioeconomic disruption.

This research aims to explore how kinetic and amphibious architectural solutions can specifically benefit pre-urban communities in Sylhet, enhancing their resilience and self-reliance in the face of recurrent floods. By examining globally implemented strategies and adapting them to Sylhet's unique environmental and cultural landscape, this study addresses critical flood challenges and presents sustainable, community-centric design models that support continuous habitation and recovery post-flooding. This research holds potential not only for Sylhet but also as a blueprint for other vulnerable regions in the global south, fostering adaptive architectural solutions as essential tools in the broader spectrum of disaster risk reduction.

DEFINITIONS
KEYWORDS

Kinetic Architecture:
Architectural design incorporating movable, adaptable elements—such as shifting walls or elevating foundations—that respond to environmental forces like flooding, providing dynamic protection and functionality (Megahed 2017).

Amphibious Design:
Buildings designed with buoyant or flexible foundations, allowing structures to float or elevate with rising water levels, minimizing flood damage and sustaining habitability during inundation (Ameh et al. 2024).

Flood Resilience:
The structural and community capacity to withstand, adapt to, and quickly recover from flood impacts, reducing long-term disruption and dependency on external aid (Proverbs & Lamond 2017).

Community Self-Reliance:
Local populations' ability to independently prepare, manage, and recover from environmental challenges like flooding, fostering sustainable resilience without heavy reliance on external resources (Hemmati et al. 2021).

Biomimetic Adaptation:
Design approach inspired by nature's adaptive strategies, using sustainable, low-tech solutions like buoyant materials and flexible structures to enhance flood resilience in resource-constrained regions (Benyus 1997; Ameh et al. 2024).

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Figure 4: Own work

Figure 5: Own work