


This presentation is developed as part of the original research titled Climate-Resilient Coastal Housing: An Adaptive Architectural Framework for Flood-Responsive Design, authored by Khuloud Ali, Ph.D. (ORCID: 0009-0001-7978-4172), Ghayth Tintawi (ORCID: 0009-0009-9891-9528), and Mohamad Khaled Bassma (ORCID: 0009-0002-1849-3651). The study was published in the International Conference on Responsive Architecture and Design (ICRAD-25), Abu Dhabi, UAE, 30th December 2025.
Article DOI: [10.5281/zenodo.18073260](https://doi.org/10.5281/zenodo.18073260), **Presentation DOI: 10.5281/zenodo.18091101**

Presentation

CLIMATE-RESILIENT COASTAL HOUSING: AN ADAPTIVE ARCHITECTURAL FRAMEWORK FOR FLOOD-RESPONSIVE DESIGN

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EFSTM

International Conference on Responsive Architecture and Design (ICRAD-25)
Abu Dhabi, UAE. 30th December 2025. The EurAsia Foundation of Science, Technology and Management

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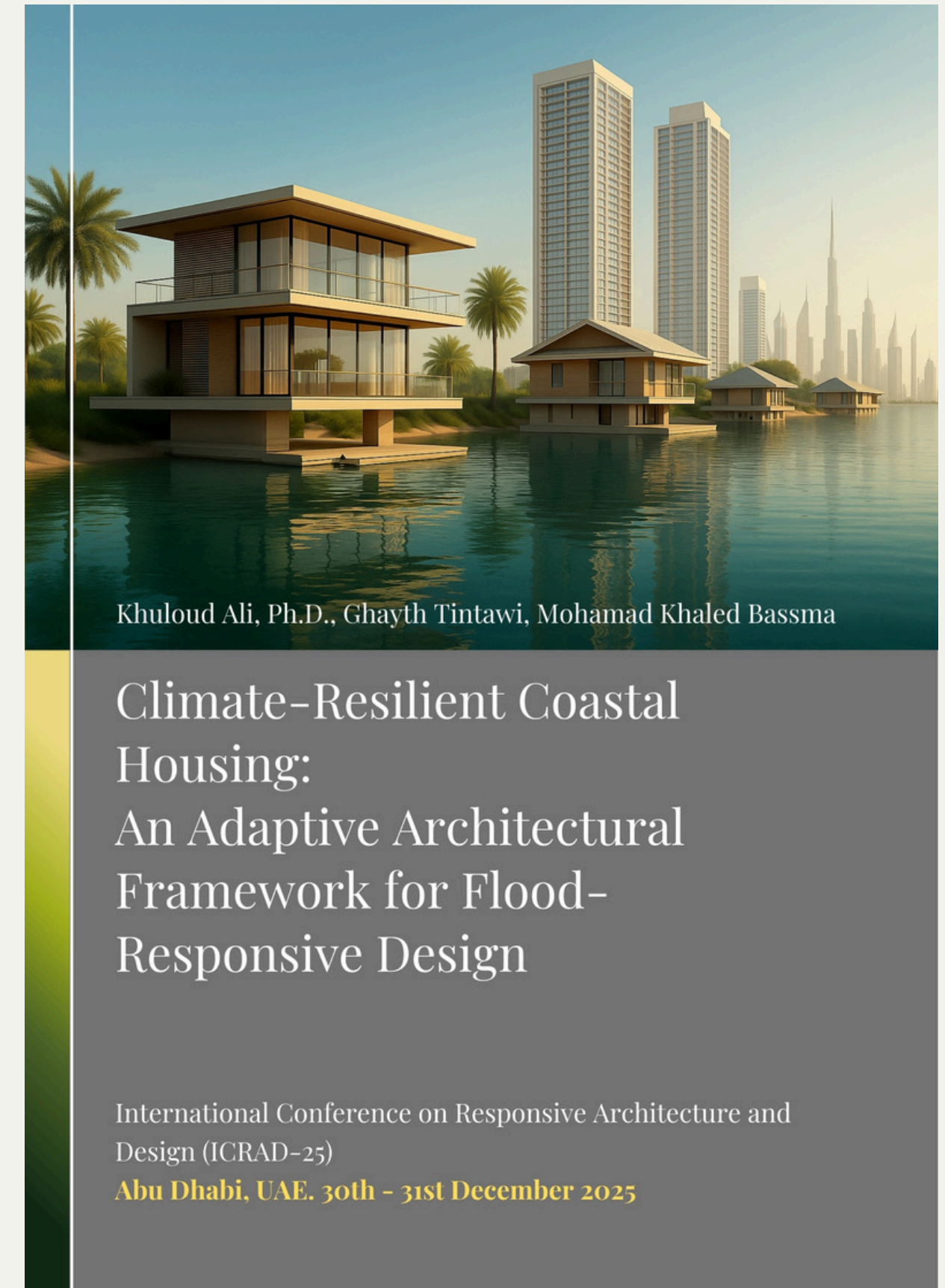
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ABSTRACT

- Addresses accelerating climate pressures on coastal housing: sea-level rise, storm surge, and compound flood events.
- Responds to the persistent gap between climate-risk evidence and architectural decision-making.
- Provides a structured method for translating complex hazard analysis into operational design logic for coastal housing.
- Presents the Adaptive Architectural Framework for Flood-Responsive Design (AAF-Flood).



TECHNICAL SUMMARY



Research Problem

- Increasing flood risk in coastal housing.
- Fragmented flood-resilience design approaches.
- Weak link between climate data and architecture.



Objective

- Bridge climate risk and housing design.
- Test adaptive strategies across scenarios.
- Guide resilient coastal housing decisions.

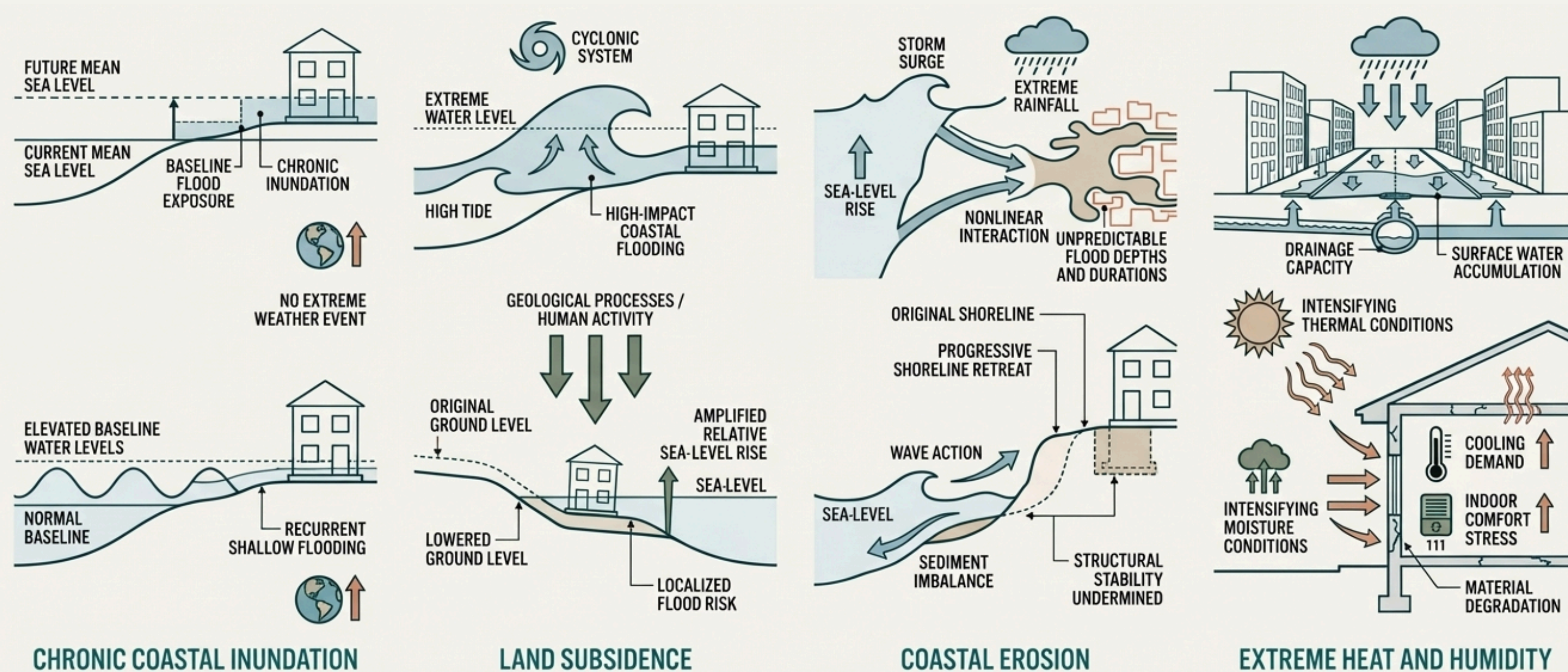


Methodology

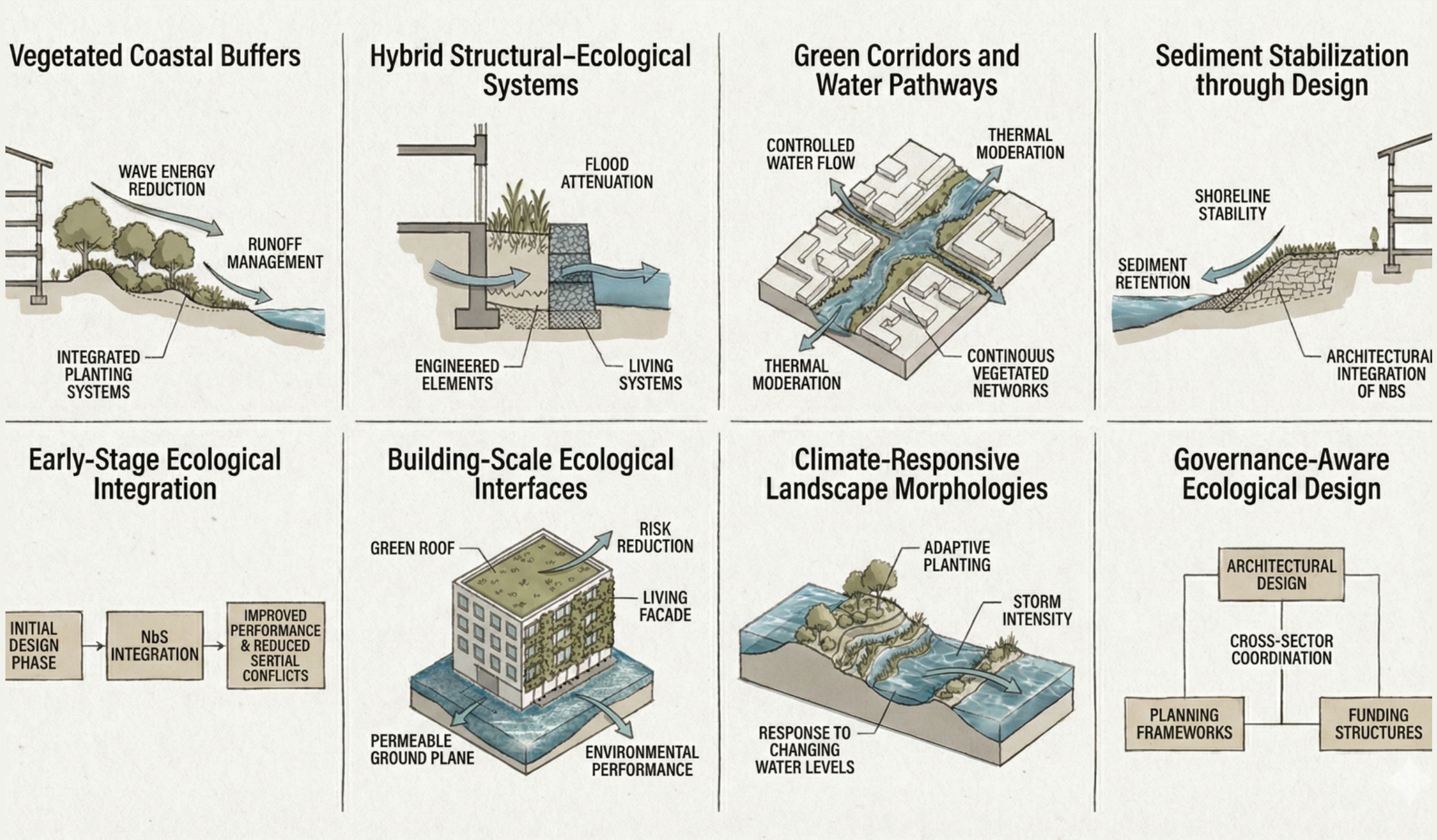
- Secondary climate and flood data review.
- Case-study-based comparative analysis.
- Four-stage adaptive synthesis.

COASTAL RISK AND ARCHITECTURAL RESILIENCE

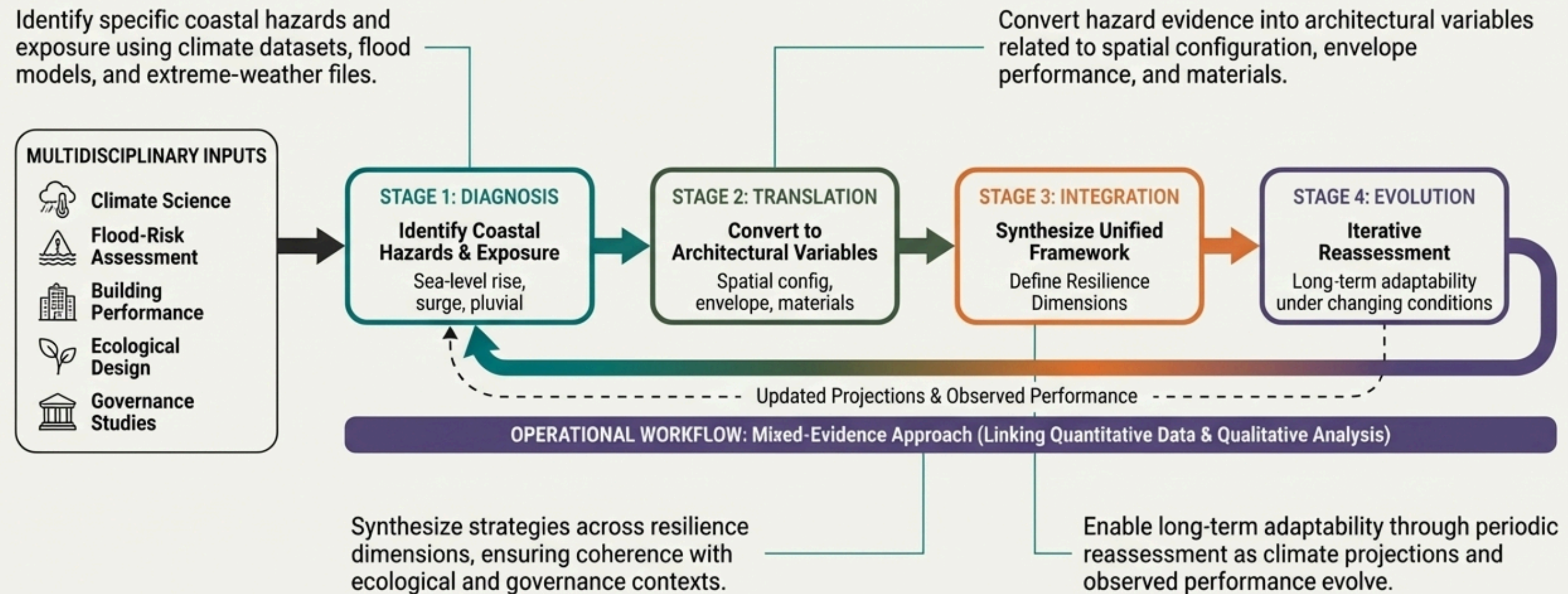
- Intensifying flood and climate hazards are reshaping exposure patterns, while adaptation policies and resources remain insufficient.
- Despite advances in risk assessment and construction methods, architectural translation into integrated, building-scale resilience remains limited.



NATURE-BASED SOLUTIONS (NBS) & ECOLOGICAL ARCHITECTURAL IMPLICATIONS



BRIDGING THE GAP: THE AAF-FLOOD OPERATIONAL WORKFLOW

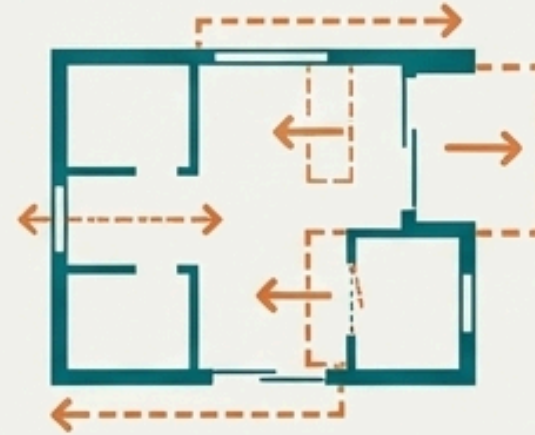


THE FIVE DIMENSIONS OF ARCHITECTURAL RESILIENCE



Hydro-Adaptability

The capacity to engage with floodwater through resistance, accommodation, or controlled inundation. **Designing with water, not against it.**



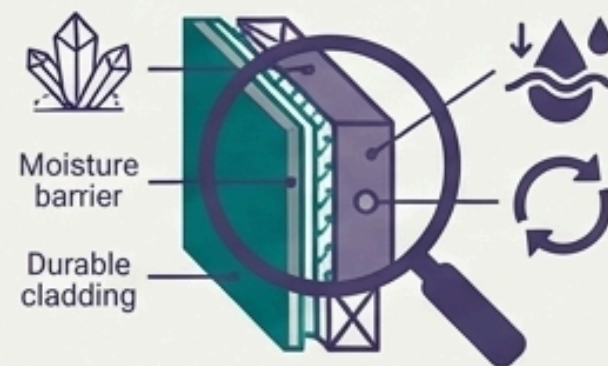
Morphological Flexibility

The ability of spatial and structural configurations to adapt over time in response to changing exposure and needs.



Ecological Integration

The incorporation of nature-based systems (wetlands, buffers) to reduce risk at the building and site scale.



Material Resilience

The long-term durability of building systems under coastal stressors like salinity, humidity, and wetting-drying cycles.



Community-Institutional Alignment

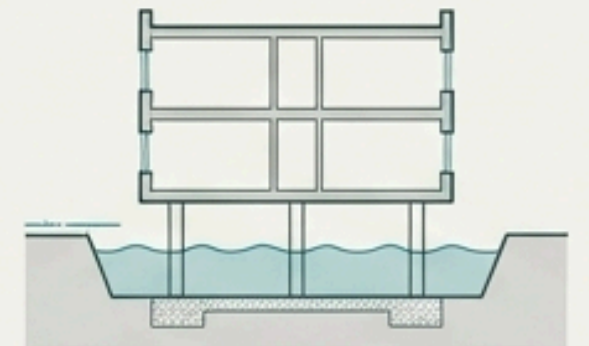
The support provided by governance structures, regulatory frameworks, and long-term management responsibilities.

A MULTIDIMENSIONAL APPROACH TO RESILIENCE

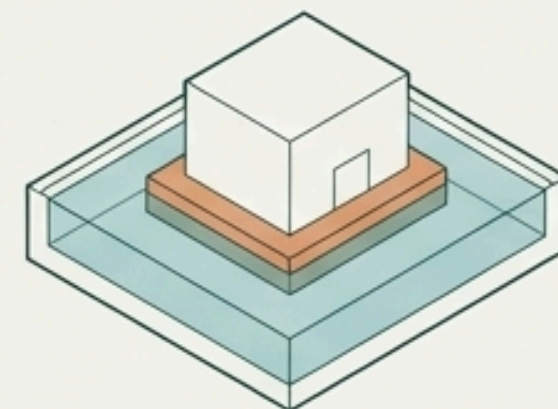
Hydro-Adaptability

Shift from absolute water exclusion to controlled management. This approach is more robust under the uncertainty of compound flood events.

- Elevating structures or habitable floors above projected flood levels.
- Amphibious or buoyant foundation systems.
- Designing 'sacrificial' or floodable ground floors with hydro-tolerant materials.
- Vertical relocation of critical infrastructure (mechanical, electrical).



FLOODABLE GROUND LEVEL MADE
FLOOD-TOLERANT MATERIALS

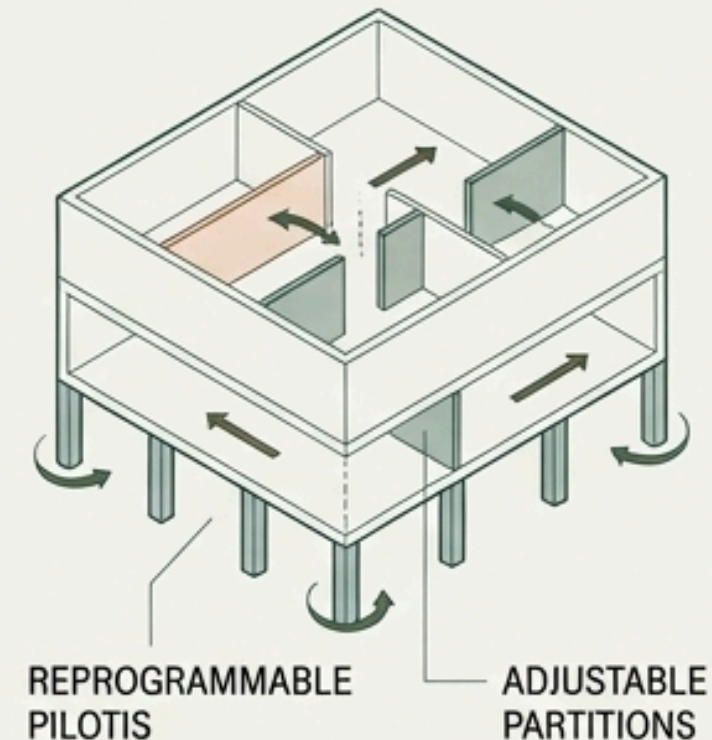


AMPHIBIOUS & BUOYANT SYSTEM

Morphological Flexibility

Acknowledge that climate and social conditions are not static. Design buildings that can be reconfigured.

- Open or reprogrammable ground levels (e.g., pilotis).
- Adjustable partitions and lightweight interior modules for rapid post-flood recovery.
- Decoupling vulnerable components from primary structural systems.



REPROGRAMMABLE
PILOTIS

ADJUSTABLE
PARTITIONS

A MULTIDIMENSIONAL APPROACH TO RESILIENCE

Material Resilience

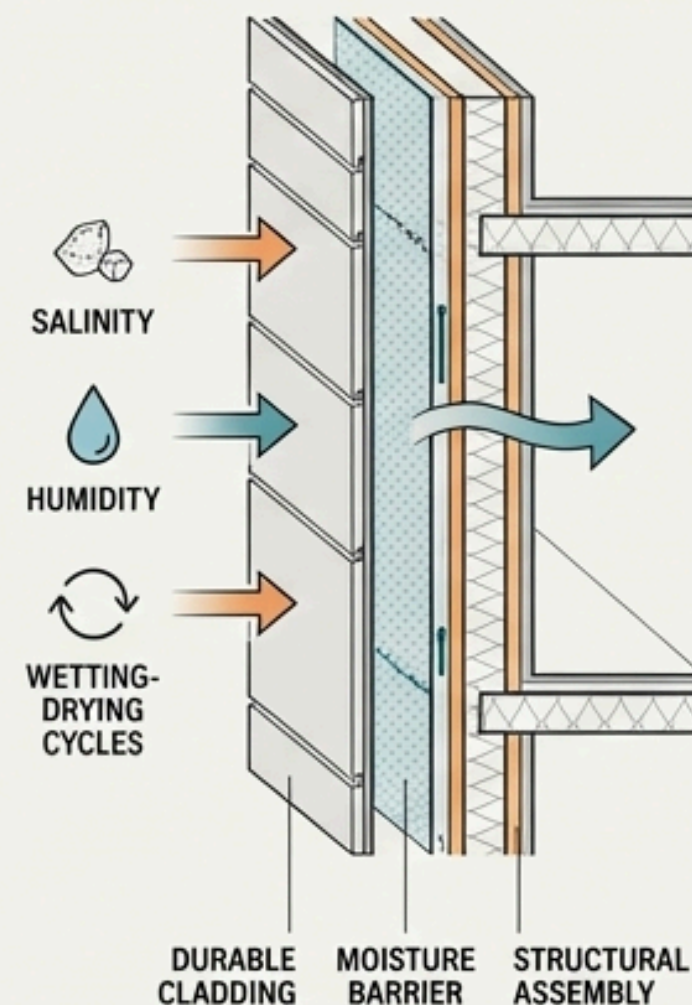
Principle: Architectural form alone does not ensure performance. Material systems must be specified for the harsh coastal environment.

Key Stressors

- High salinity
- persistent humidity
- accelerated corrosion
- wetting-drying cycles.

Key Strategies

- Corrosion-resistant fixings and protected steel components.
- Moisture-tolerant assemblies and treated concrete.
- Durable cladding and sealed envelope interfaces.

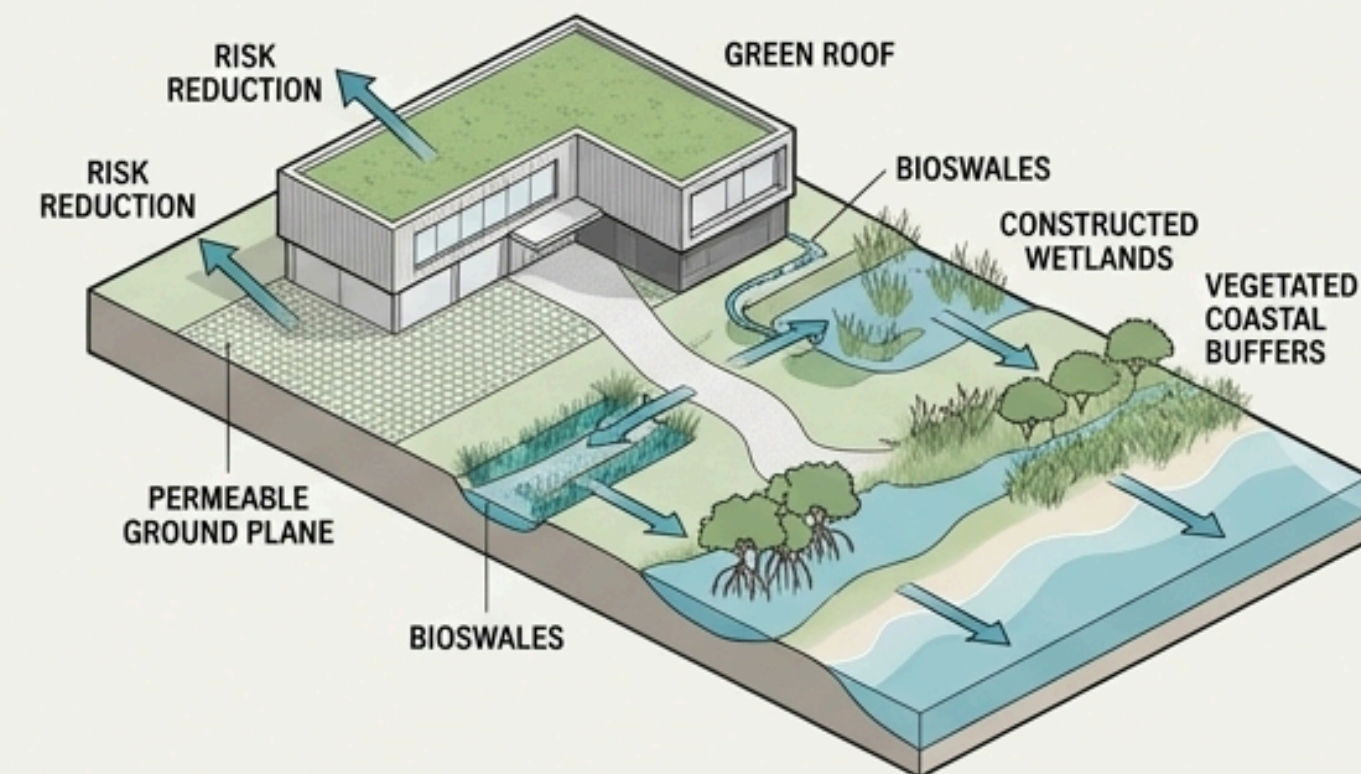


Ecological Integration

Principle: Resilience emerges from combining architectural and ecological systems, not from isolated actions.

Key Strategies (Nature-Based Solutions - NbS)

- Building/Site Scale: Green roofs, permeable ground planes, bioswales.
- Community Scale: Vegetated coastal buffers, constructed wetlands, and mangrove systems to attenuate storm surge and manage runoff.



A MULTIDIMENSIONAL APPROACH TO RESILIENCE

Governance is an Architectural Variable

Technical and ecological strategies are only as strong as the social and governance systems that support them. Fragmented governance can undermine the most robust designs.

Key Considerations

Regulatory Frameworks: Do local codes and zoning support or hinder adaptive design?

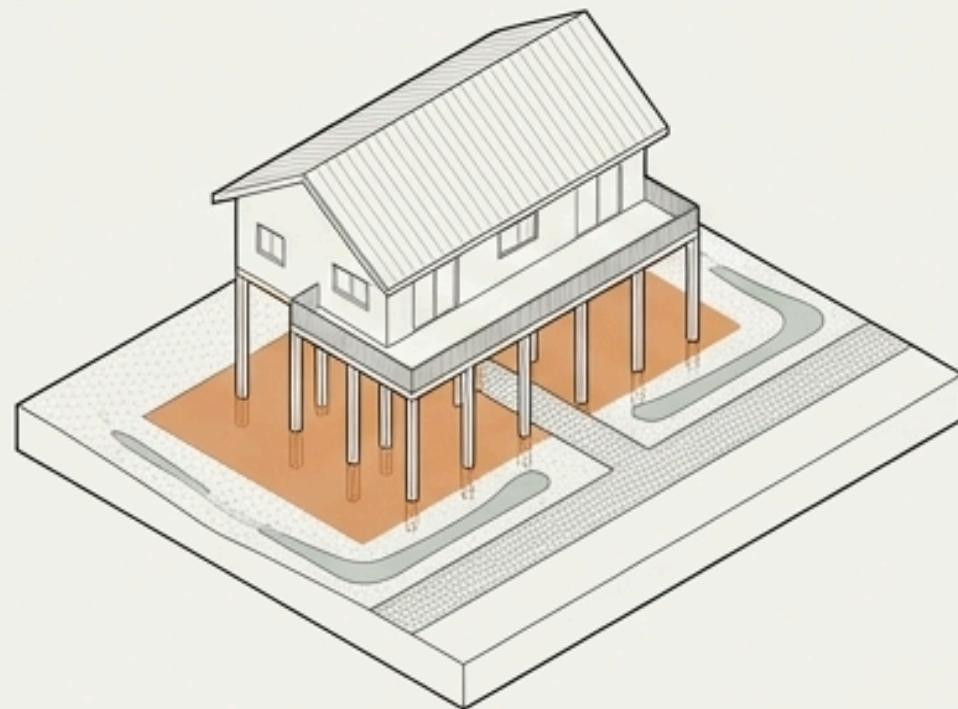
Long-Term Management: Are there clear responsibilities for maintenance, especially for shared or ecological infrastructure?

Financial Mechanisms: Do insurance, financing, and adaptation funds align with resilience goals?



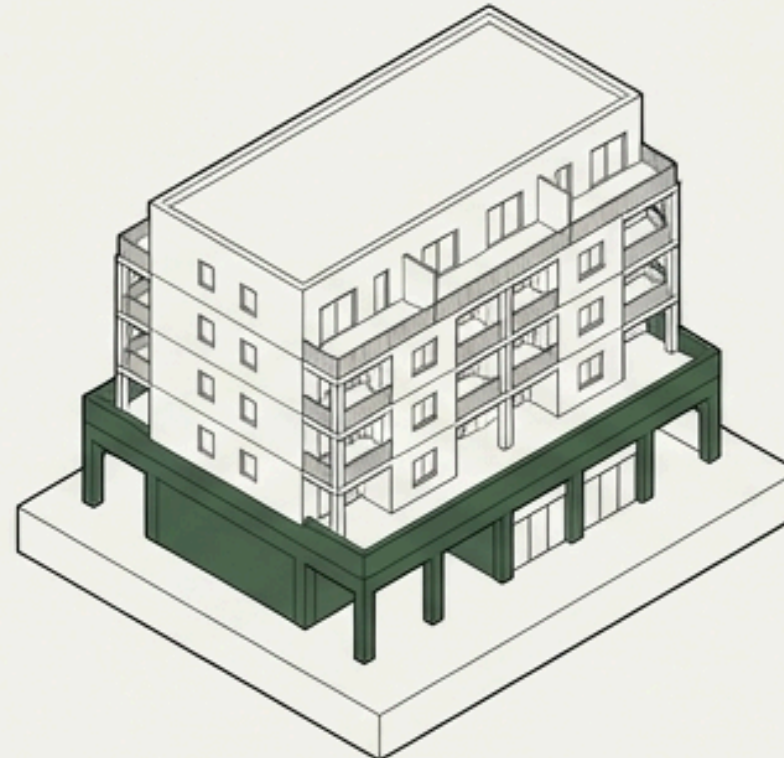
APPLYING THE FRAMEWORK ACROSS COASTAL HOUSING TYPOLOGIES

**Typology 1: Low-Rise Housing
(Detached/Semi-Detached)**



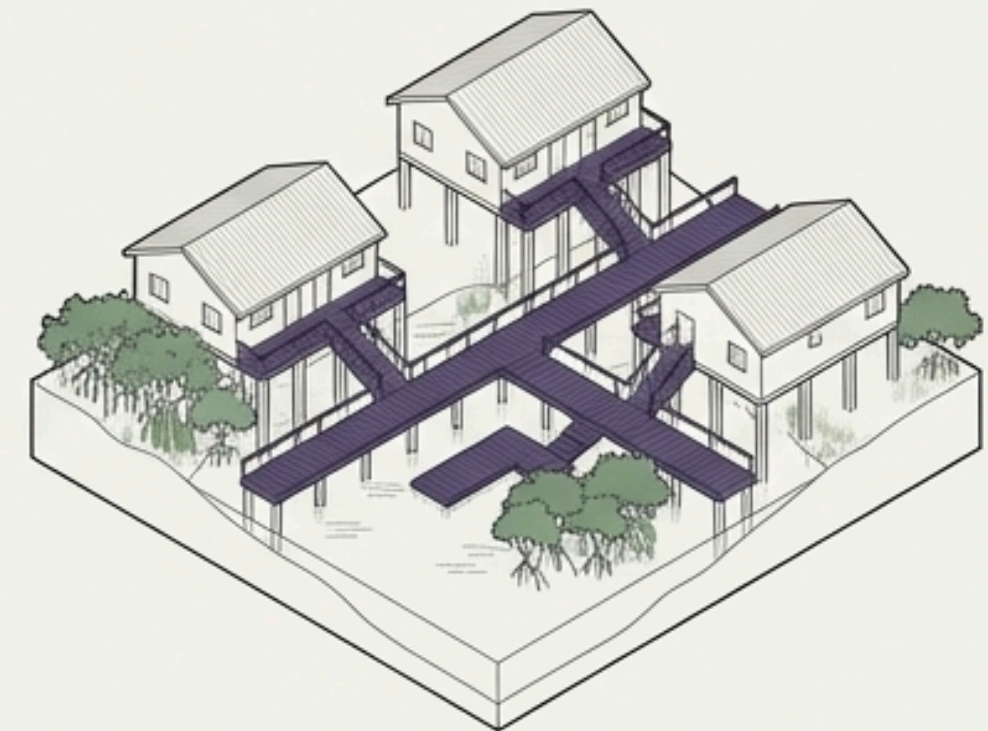
Focus: Ground-level exposure.
Strategies: Elevation, amphibious foundations, sacrificial floodable zones, parcel-scale NbS (swales, permeable surfaces).

**Typology 2: Mid-Rise Housing
(Multi-Family)**



Focus: Ground-floor systems and building envelope.
Strategies: Raised plinths, flood-resilient ground-floor uses (parking, lobbies), relocating critical systems, corrosion-resistant façades.

**Typology 3: Clustered & Hybrid Housing
(Stilt Villages, Courtyard Communities)**



Focus: Shared risk and collective infrastructure.
Strategies: Elevated walkways, modular floating decks, large-scale integrated NbS (wetlands, mangrove belts), collective management frameworks.

CASE STUDIES



Case I: IJburg Floating Housing (Amsterdam, Netherlands)



Case III: BIG U Housing–Adjacent Interfaces (New York City, USA)



Case II: Waterbuurt West (Amsterdam, Netherlands)



Case IV: Kampung Improvement Program (Jakarta, Indonesia)

A TOOL FOR DESIGN AND POLICY ASSESSMENT

Purpose:

To translate the five resilience dimensions into actionable guidance for design development, policy review, and community consultation. It structures expert judgment where purely quantitative metrics are insufficient.

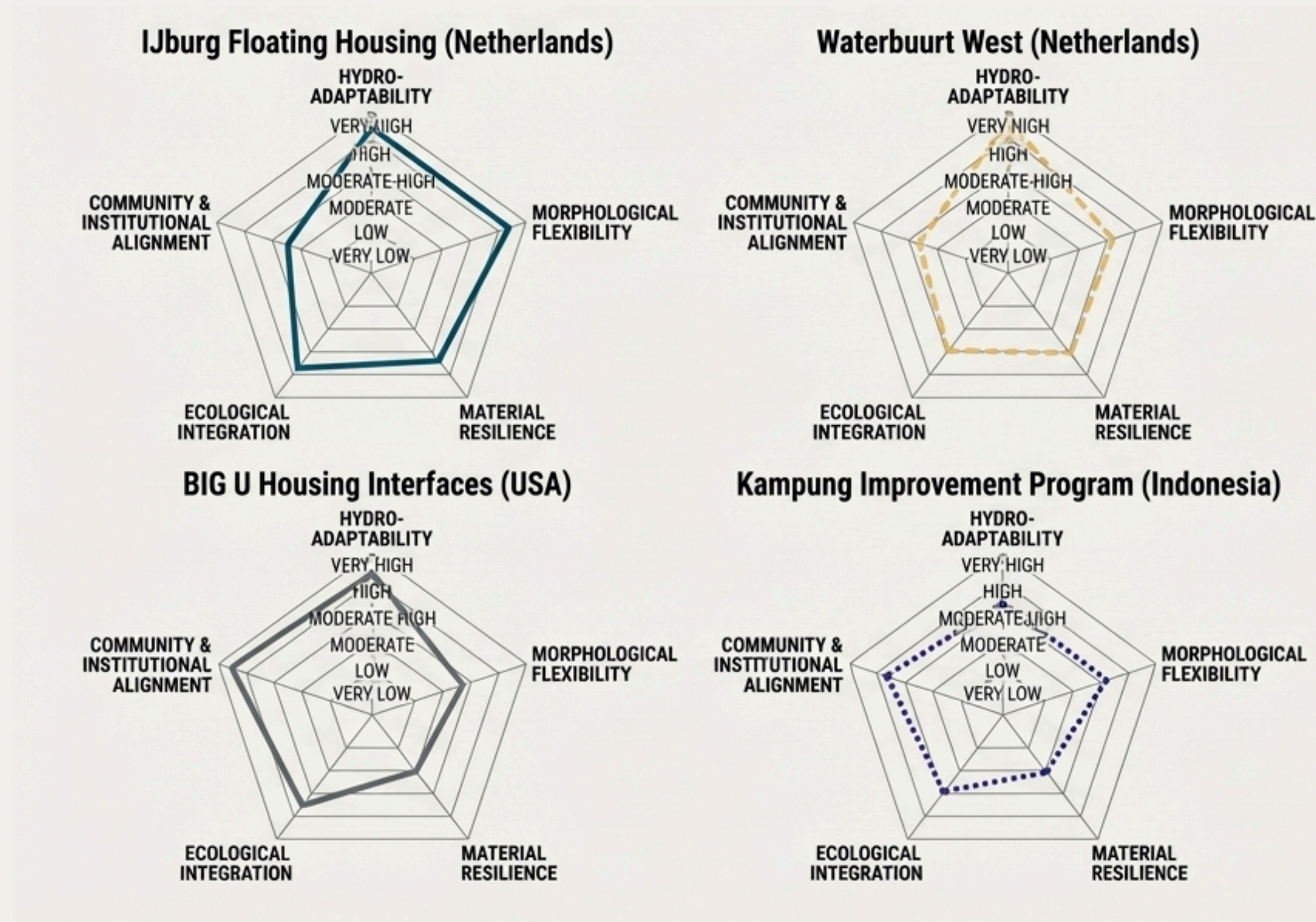
How it Works:

Each of the five dimensions is assessed against three qualitative performance categories based on observable criteria.

- **Low:**
Limited/absent adaptive features, weak governance. High vulnerability.
- **Moderate:**
Partial adaptation, but with limitations. Performance is dependent on event severity and maintenance.
- **High:**
Integrated strategies, durable materials, strong institutional support. Functional continuity is likely.

AAF-Flood Dimension	Low	Moderate	High
Hydro-Adaptability	No elevation; exposed utilities; absence of flood pathways	Partial elevation; limited flood-management features	Engineered elevation or amphibious systems; protected utilities
Morphological Flexibility	Rigid spatial layout	Limited adaptability	Modular, open, reconfigurable spaces
Material Resilience	Materials prone to moisture damage and corrosion	Mixed durability and partial protection	Marine-grade materials; sealed assemblies
Ecological Integration	Minimal or absent ecological features	Isolated or decorative NbS elements	Embedded wetlands, dunes, mangroves, or bioswales
Community Institutional Alignment	No governance or maintenance framework	Partial regulatory or community alignment	Strong institutional, financial, and community mechanisms

TESTING THE AFF-FLOOD ON IMPLEMENTED PROJECTS



DESIGN WITH UNCERTAINTY, NOT AGAINST IT

THANK YOU