Adaptive Architecture for Coastal Resilience: A Design Framework for Flood-Responsive Housing

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Abstract:

Coastal and urban floods are becoming significant hazards to Gulf communities, necessitating a transition from defensive infrastructure to adaptive architectural systems. This paper introduces the Adaptive Coastal Resilience Framework (ACRF), a qualitative, design-oriented approach that tackles flood-responsive housing in coastal, fluvial, and pluvial environments. The ACRF combines environmental flexibility, material resilience, and community-driven governance into a cohesive approach designed for arid and swiftly urbanizing areas.

The ACRF defines five essential dimensions: hydro-adaptability, morphological flexibility, material resilience, ecological integration, and community & institutional adaptation. And executed through a four-stage cycle: Diagnosis, Translation, Integration, and Evolution. This structure provides a pragmatic roadmap for transforming flood-risk zones into adaptive, livable environments.

The framework is substantiated by international examples, including Maasbommel (Netherlands), FLOAT House (USA), Makoko School (Nigeria), and Nhà Bè Housing (Vietnam), as well as developing Gulf models in Abu Dhabi, Doha, and Muscat. Findings demonstrate that adaptive design provides quantifiable advantages in resilience, sustainability, and social continuity.

This study emphasizes the role of architecture as a driver of climate resilience across the Gulf region by positioning the ACRF as both a design guide and policy instrument, in alignment with the UAE Vision 2050 and the Qatar National Building Code 2024.