

# LIVING WITH THE FLOOD

## Bamboo-Hybrid Amphibious Housing for the Hue Citadel, Vietnam

### FROM BUILDING POROSITY TO URBAN PERMEABILITY

An amphibious housing model for the Hue Citadel – homes rooted in heritage ground that rise with the flood. Drawing on the Hue garden house and the Perfume River boat, the design adapts at the scale of the house and helps restore the city's historic water system. A way for Hue to live with water, not against it.



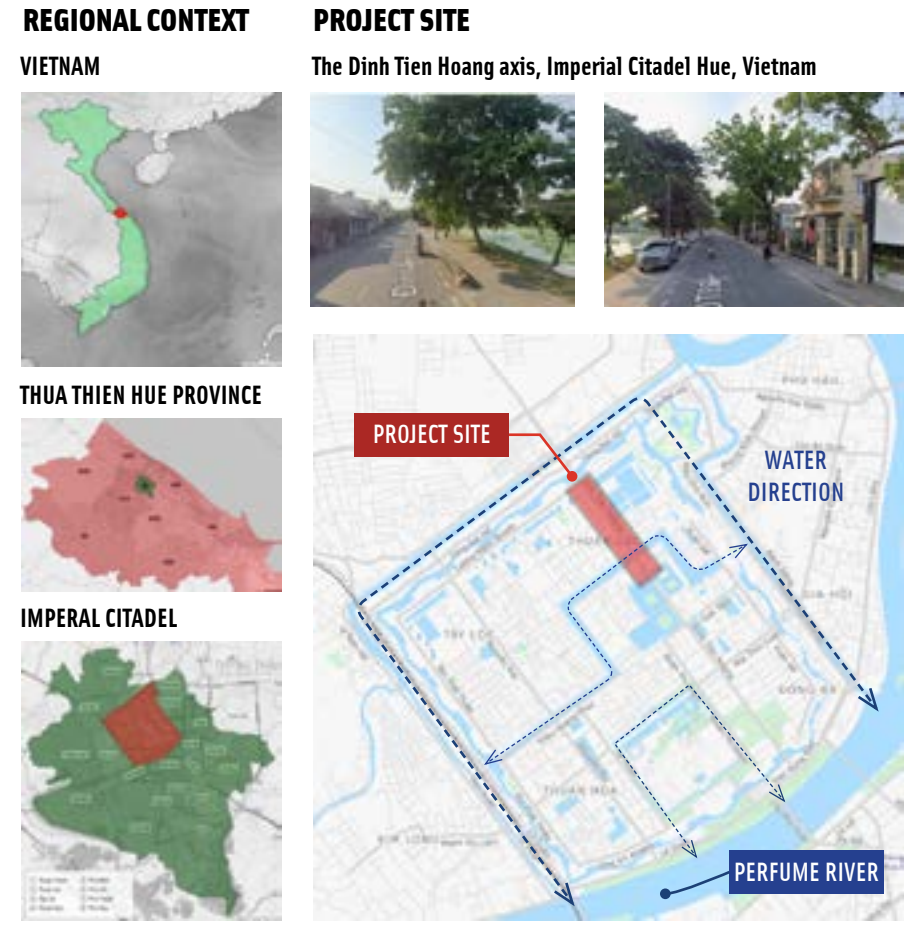
# 01 FLOODING CHALLENGES IN HUE CITY (VIETNAM)

## WHY CONVENTIONAL HOUSES STRUGGLE DURING FLOODS

### FLOODS ARE RISING WITH CLIMATE CHANGE — CONVENTIONAL HOUSES ARE NOT

#### A. HUE CITY - A WATER-BASE SETTLEMENT

A heritage city built to live with water — and a site at the heart of its lost drainage system.



**HISTORICAL WATER SYSTEM**  
The Imperial Citadel was planned around a network of moats, canals, and ponds connected to the Ngu Ha canal (1805–1826).

**CURRENT CONDITION**  
Much of this drainage network has been altered or partially infilled, contributing to recurring seasonal flooding.

**DESIGN OPPURTUNITY**  
The project site lies on the Dinh Tien Hoang axis, where building-scale adaptation can support the restoration of the Citadel's historic water function.

The Nguyen emperors adapted the Citadel to water through urban-scale drainage. This project continues that wisdom at the building scale — homes that live with the flood, helping restore the water function the Citadel has lost.

#### C. LIMITATIONS OF CONVENTIONAL HOUSES

- 1 FIXED ELEVATION**  
With floods reaching 5.81m and lasting 3–5 days, a house fixed to the ground has no way to escape rising water.
- 2 LOSS OF ACCESS**  
In the Nov 2023 flood, 80% of Hue's streets were submerged 0.4–1.5m — fixed homes become unreachable islands.
- 3 SERVICE DISRUPTION**  
Floods routinely cut power and clean water across the city; conventional homes have no independent backup.
- 4 DEPENDENCE ON EXTERNAL RESCUE**  
During prolonged 3–5 day floods, households wait for rescue boats — help that is slow, costly, and not guaranteed.

House is fixed on the ground.

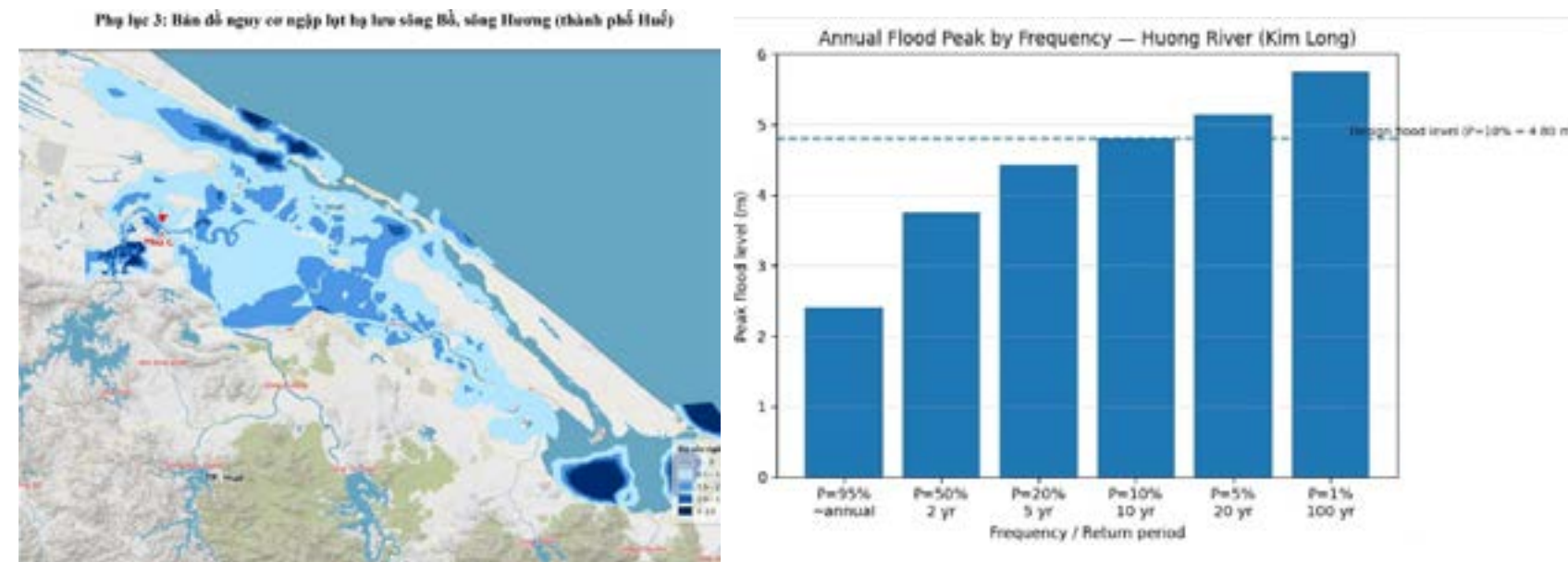
Access is lost. Communities are isolated.

No power, no clean water, no safe sanitation

Rescue is reactive, not sustainable.

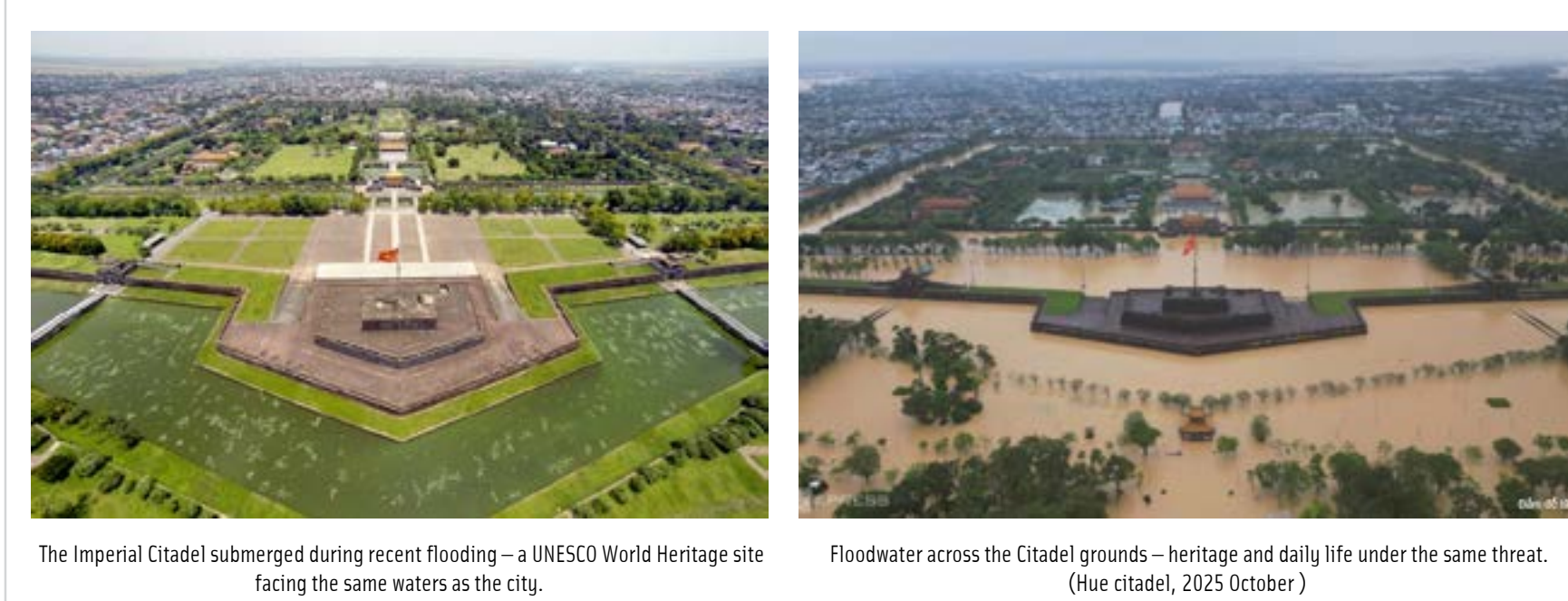
#### B. FLOOD RISK IN HUE (VIETNAM)

Hue faces 2–3 river floods yearly, with extreme rainfall and a long history of flood damage to its heritage.



Flood Risk Map — Lower Huong & Bo River Basin, Hue City (2025 October 14th)  
Source: National Center for Hydro-Meteorological Forecasting (Vietnam) Inundation depth (m): 0 / 0.1–1.5 / 1.5–2.5 / 2.5–3.5 / >3.5

#### D. HERITAGE UNDER THREAT — A GROWING, UNPREDICTABLE RISK



Flooding in Hue is growing increasingly unpredictable. Since the 1999 record flood, major floods have struck repeatedly (2017, 2020–2023, 2025), threatening not only lives and livelihoods but the Imperial Citadel itself — submerged many times throughout its history. Resisting water by raising ground or building walls is no longer enough. The chart shows the 10-year moving average rainfall, revealing a clear upward trend after 1999.

**Learning to live with the flood — letting homes adapt rather than resist — has become urgent.**

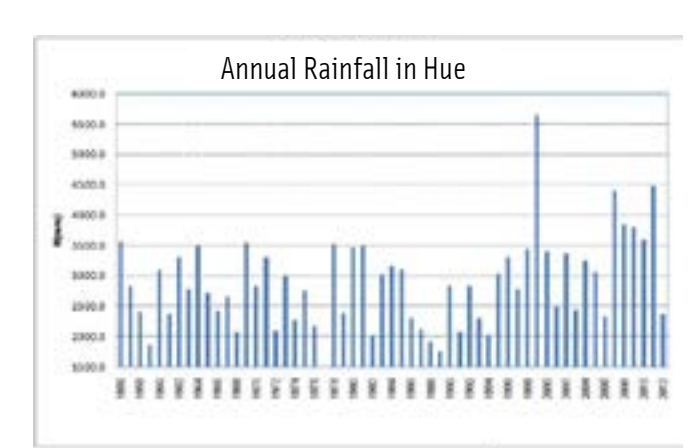


Figure 17.1. Annual rainfall in Hue

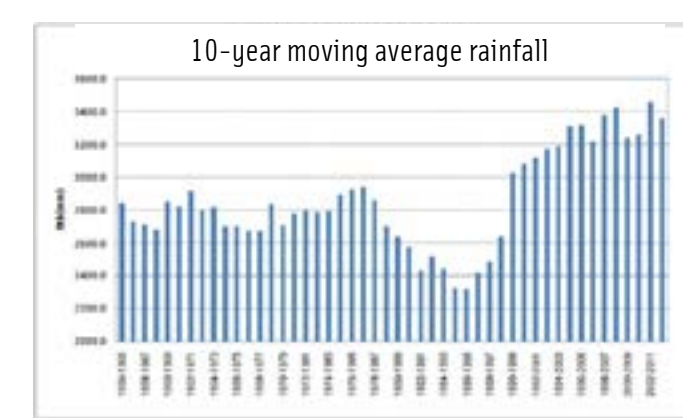


Figure 17.2. 10-year moving average rainfall in Hue

- RIVERINE FLOODING**  
Annual floods from Huong River overflow — 2–3 per year above alert level, peaks up to 5.81m.
- INTENSE RAINFALL**  
With floods reaching 5.81m and lasting 3–5 days, a house fixed to the ground has no way to escape rising water.
- CLIMATE CHANGE**  
+25% rainfall since 1999" (2726mm □ 3426mm)
- LOW-LYING SETTLEMENTS**  
In the Nov 2023 flood, 80% of streets across 36 wards were submerged 0.4–1.5m.

Sources: Du địa chi TP Huế (hue.gov.vn); University of Hue Journal.

# 02 ADAPTING LIVING STRATEGY

## EXISTING APPROACH and THE GAP

### HOW CURRENT HOUSING RESPONDS TO FLOODS — AND WHAT IS STILL MISSING

#### A. CURRENT FLOOD-HOUSING APPROACHES

##### 1 RAISED FOUNDATION

Raises the entire house above an expected flood level.



Location: Thai Hoa commune, Nghe An province, Vietnam – flood level up to 1.5m

**Pro:** Simple, affordable • Main-tains daily life in seasonal floods  
**Con:** Fixed elevation • Extreme floods above design level still enter

##### 2 HIGH STILTS

Lifts living spaces on permanent columns above floodwater.



Location: Mekong Delta / urban canals, Vietnam

**Pro:** Lives with water year-round • Keeps living areas dry, water passes below  
**Con:** Fixed height • Ground floor unusable, vulnerable to extreme floods

##### 3 FLOATING REFUGE (“Nhà Chống Lũ”)

Low-cost, proven, rooted in the bamboo-raft tradition • Families live normally through floods – cooking, sleeping, even solar power and clean water



Location: Nhà Chống Lũ / Sóng Foundation – Tân Hóa, Quảng Bình province, Vietnam

**Pro:** Low-cost flood refuge • Widely used,  
**Con:** Single rural household • No heritage character or urban-hydrology role

-> the warning-triggered mode: consolidate when floods are forecast, then live normally through the flood.

##### 4 AMPHIBIOUS HOUSING (Nguyen & Vukorep, 2017)

A prefabricated modular amphibious house – light steel frame with bamboo panel enclosures, floating on sealed drums. The whole dwelling rises with floodwater; residents stay in place.



**Pro:** Proven bamboo-steel modular system  
 • Whole home floats – no relocating to a separate structure

**Con:** Proven bamboo-steel modular system  
 • Whole home floats – no relocating to a separate structure

Location: Nguyen & Vukorep (2017), Amphibious Housing for Flood Adaptation in Vietnam

-> the modular bamboo-drum system – but we resolve its unsolved weaknesses (rocking, unit failure).

##### 5 FLOATING BAMBOO HOUSE – H&P Architects (2022)

Compartmentalised bamboo house on reused drums + steel tubes, with septic/fil-ter/storage tanks, solar and rainwater roof. Inspired by the Rông communal house; built to form floating communities.



Location: “Nhà tre nổi” – H&P Architects (2022), Mekong Delta, Vietnam

**Pro:** Highly resolved, self-sufficient, community-oriented  
 • Built and proven (2022)  
**Con:** Permanently floating – for river-based rural life, abandoning land • Rooted in Rông (Central Highlands), not Hue • No urban or historic-water role

-> self-sufficient living and community grouping – but amphibious, staying on heritage land.

**Building on a proven Vietnamese lineage – the warning-triggered floating of Nhà Chống Lũ, the modular bamboo-drum system of Nguyen & Vukorep, and the self-sufficient community of H&P – this project extends it to what none reached: amphibious, rooted in Hue’s heritage, restoring the Citadel’s water.**

#### B. COMPARISON — WHAT EACH APPROACH ACHIEVES

CRITERION	RAISED FOUNDATION	HIGH STILTS	FLOATING REFUGE (“Nhà Chống Lũ”)	AMPHIBIOUS HOUSING	FLOATING BAMBOO HOUSE (“Nhà tre nổi”)	Proposed
Adapts to changing flood levels	●	●	●	●	●	●
Maintains daily life	●	●	●	●	●	●
Quantified structural validation	●	●	●	●	●	●
Amphibious – stays on land, floats only in flood	●	●	●	●	●	●
Rooted in Hue heritage identity	●	●	●	●	●	●
Community-scale	●	●	●	●	●	●
Restores urban hydrology	●	●	●	●	●	●

● Achieves ● Partially achieves ● Does not achieves

#### C. THE GAP



Flood Ad-aptation + Heritage Preservation + Hydrological Restoration

The floating principle is proven – Nhà Chống Lũ, Nguyen & Vukorep, and H&P’s Floating Bamboo House all show bamboo, drums, and community living can work.

But they float permanently, for rural, river-based life. None keeps people rooted to heritage land, in a historic city, while restoring its water system.

#### D. DESIGN DIRECTION



##### 1 ADAPT, DON’T RESIST (inherit)

Float with the flood on the proven drum principle – but stay on land in the dry season (amphibious, not permanently floating), and resolve known drum weaknesses with a flat-bottom hull and removable cassettes.



##### 2 ROOT IN HERITAGE (develop)

Derive form from Hue’s own heritage – the garden house and the river boat – not a generic or Rông-inspired shelter.



##### 3 SCALE FROM HOUSE TO CITY (develop)

Extend to community clusters and urban water function – restoring the Citadel’s historic Ngu Ha drainage.

**A proven floating principle exists — but it abandons land for permanent water-dwelling. This project keeps people rooted to heritage ground, rising only when the flood comes, and develops what is missing: Hue’s identity, its community, and its water.**

# 03 AMPHIBIOUS MODULAR LIVING ORGANIZATION FROM THE HUE RỪNG HOUSE

## SEPARATED FUNCTIONS REINTERPRETED AS INDEPENDENT FLOATING MODULES

### A. SOURCE 1 — THE HUE GARDEN HOUSE

Spatial organization — separated functions distributed across independent modules.



**The source:** The traditional Hue garden house distributes domestic life across several separate buildings in a garden compound — main house, kitchen, service — not one block.

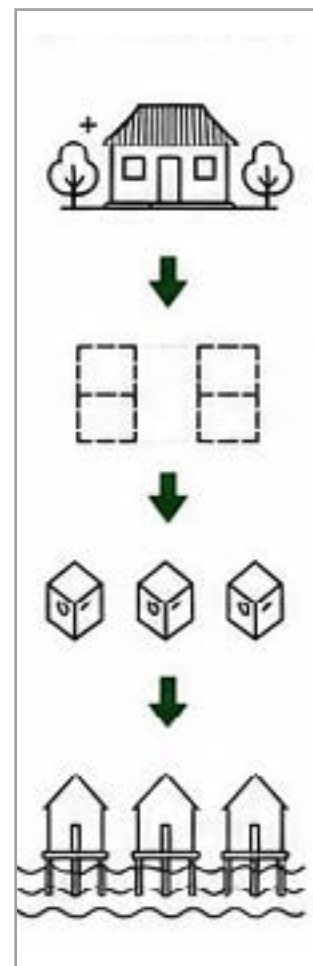
**What we take:** the principle of separated functions — each domestic role in its own building.



**How it applies:** three independent modules (main / kitchen / sanitation), each a self-contained floating unit — the garden compound's separation becomes the basis for amphibious modularity.

- 1 MAIN HOUSE**  
Living, sleeping, ancestral worship, family activities
- 2 KITCHEN**  
Food preparation, cooking, food storage
- 3 SANITATION**

### B. TRANSLATION STRATEGY



**Traditional Hue garden house**  
The traditional Hue garden house already distributes domestic life across separate buildings within a garden compound.

**Distributed Living Logic**  
(Separation of Function)  
This inherited logic of separation is abstracted into distinct functional units, each serving one domestic role.

**Independent Modules**  
(Adaptable and Flexible)  
Each function becomes a self-contained module that can be built, maintained, and arranged independently.

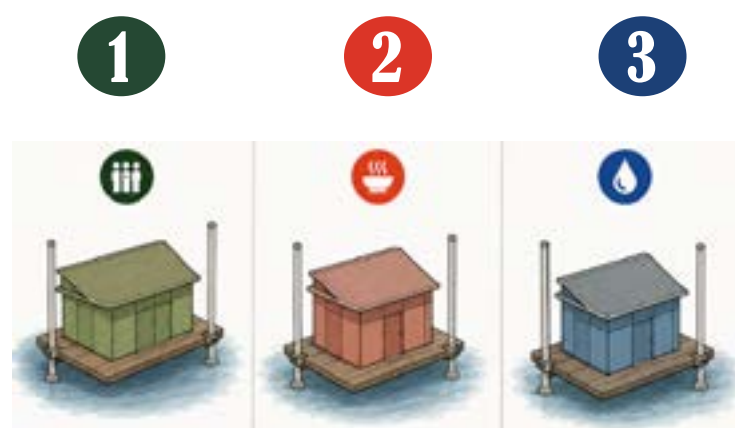
**Amphibious Adaptation**  
(Live with Seasonal Flood)  
Living with the flood, not against it.

### C. WHY SEPERATE MODULES?

Rooted in the Hue garden house, the kitchen and service areas traditionally sat in a separate auxiliary building — keeping smoke, heat and odours away from the main living and ancestral-worship space.

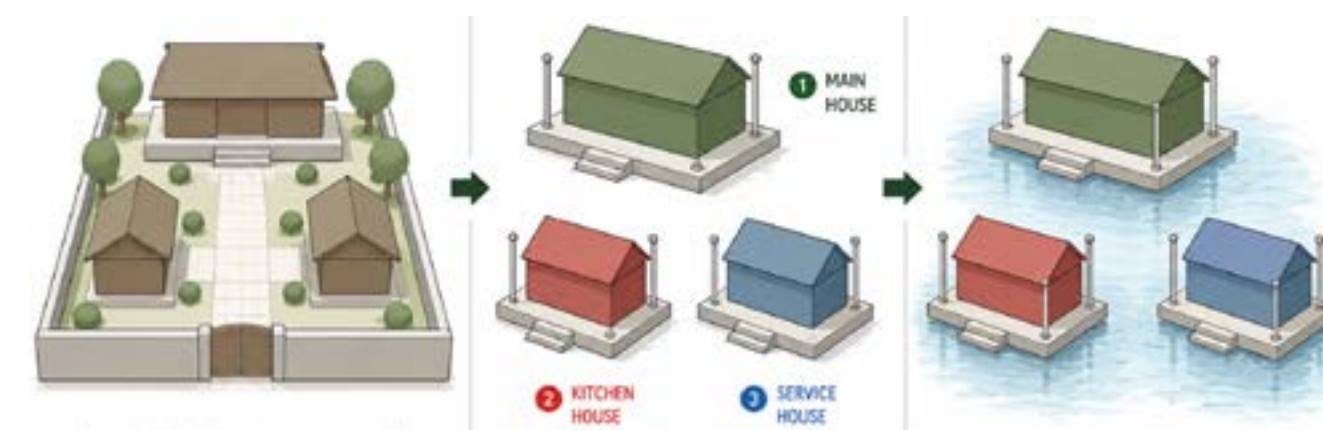
Three independent modules carry this logic forward, allowing phased operation during floods so each function works without disrupting the others.

Beyond heritage, separation also serves flotation: smaller independent hulls float more stably and let each module's draft be balanced individually.



### D. HERITAGE TO ADAPTATION

SEPARATION, ONCE A RESPONSE TO SMOKE AND HEAT, NOW ALSO SERVES FLOTATION  
Smaller independent hulls float more stably than one large mass — heritage logic and structural logic coincide



**Traditional Hue garden house**  
Domestic life distributed across several separate buildings (nếp); kitchen and service kept apart from the main house

**Distributed Living Logic**  
The traditional separation of functions is abstracted into discrete, self-contained modules

**Amphibious Living System**  
The same three modules sit on buoyant hulls with guide-posts, rising and resettling with floodwater



### E. RESIDENTS ARRANGE THEIR OWN HOME

Because the three functions are already separate — as in the traditional Hue garden house — residents arrange them freely, as a single fixed house never could.

**1 LINEAR**

**Pro:** compact, private, short walkways; suits narrow river-side plots.  
**Con:** no shared yard; aligned with current may block local flow

**2 COURTYARD**

**Pro:** shared central yard for gathering; closest to the Hue garden house.  
**Con:** largest footprint; water may stagnate in the yard during floods

**3 L-SHAPE**

**Pro:** wraps a corner, opens one side to the view. **Con:** arms heave out of phase; corner walkway takes torsion.  
**Con:** arms heave out of phase; corner walkway takes torsion

**4 FREE**

**Pro:** positioned to current, sun, wind — best flow-through  
**Con:** long multi-joint walkways, most complex and costly

The technical framework is fixed — three modules, guide-posts, flexible walkways. The arrangement is not.  
As each family once placed its buildings differently within the Hue garden compound, every household here shapes its own home.

## KEY MESSAGE

The three-module system is not an arbitrary choice, but a contemporary reinterpretation of the traditional Hue garden house — turning cultural heritage into resilient, flood-adaptive architecture.

# 04 AMPHIBIOUS STRUCTURAL SYSTEM

## FORM FROM THE PERFUME RIVER VAULTED BOAT

### A FLAT-BOTTOM, FREE-DRAINING BOAT-FORM PLATFORM

The amphibious platform combines a guide-post system, HDPE drum-cassette buoyancy, and a flat-bottom, free-draining boat-form hull — delivering flood resilience while maintaining natural water flow and carrying the form of the Perfume River boat.

#### A. SOURCE II — THE PERFUME RIVER BOAT

Roof and hull form: vaulted canopy / amphibious roof / boat body / buoyant platform



The source: The vaulted river boat (ghe mui vom) of the Perfume River — a low, continuous, single-curvature canopy — is a long-standing cultural emblem of Hue.

What we take: the vaulted single-curvature form and the boat hull's relationship with water.

How it applies: the canopy becomes the amphibious roof; the boat hull becomes the buoyant platform — transposing a vessel of travel into a dwelling that floats with the flood.

#### C. LOCALLY SOURCED, LOCALLY BUILT

Every part sourced and built within Hue — keeping traditional crafts alive, by local hands.

Component	Local material	Local craft (verified)
Hull & frame	Hue-region timber	Boat-building (active in Hue) + rường carpentry
Roof (vaulted)	Cót tre + dầu rái	Boat-building (timber bending) + bamboo weaving
Walls	Phên tre	Bamboo weaving



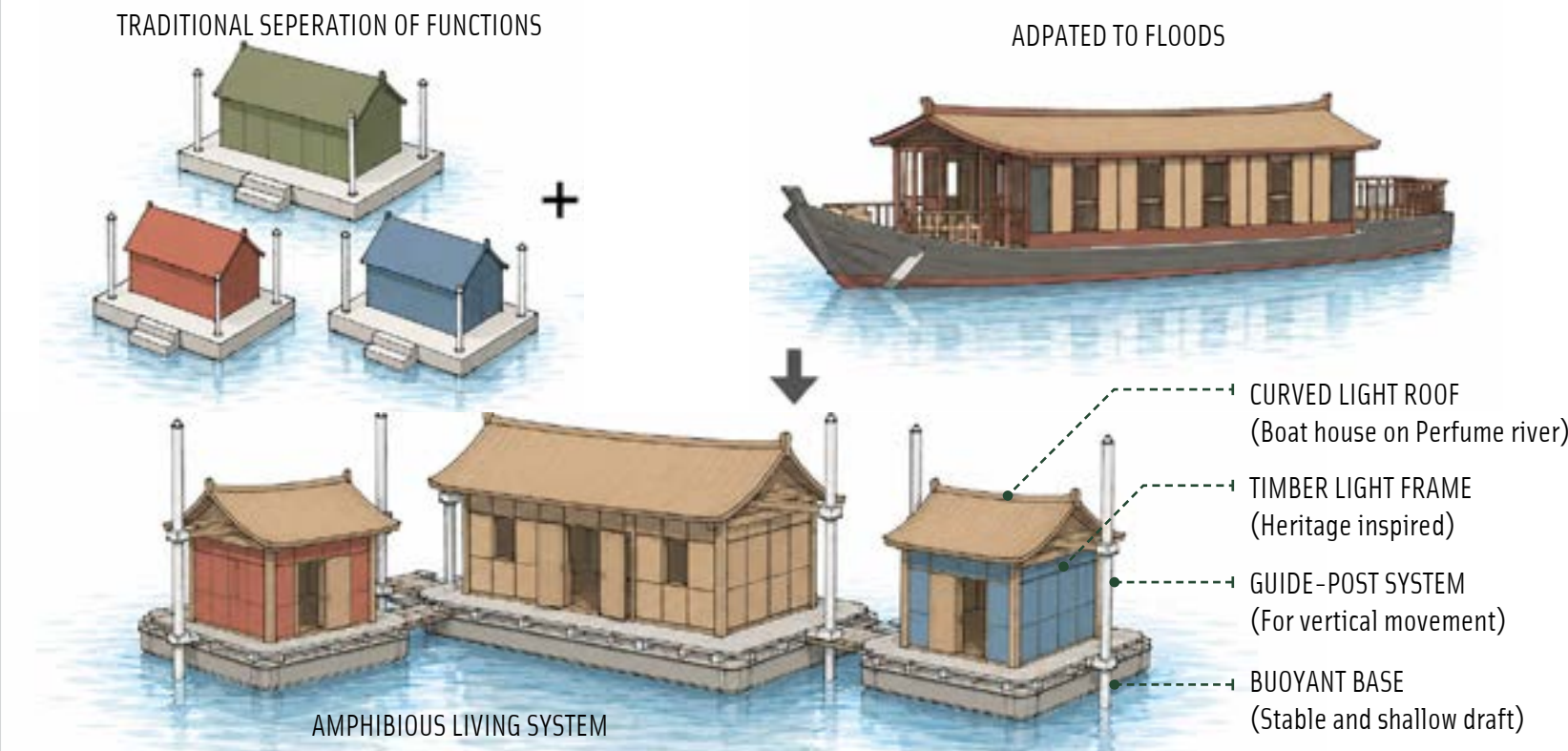
#### THREE LIVING CRAFTS OF HUE

Boat-building — Hue's active boat-builders shape and bend timber for hulls; the same skill forms the boat-form hull and vaulted roof (Source: Huế ngày nay, 2015)

Rường-house carpentry — traditional mortise-tenon joinery of the Hue garden house  
Bamboo weaving — cót and phên tre for roof and walls

Built from local timber and bamboo, by Hue's own boat-building, carpentry, and weaving crafts — keeping heritage skills alive.

#### B. FROM TRADITION TO ADAPTATION



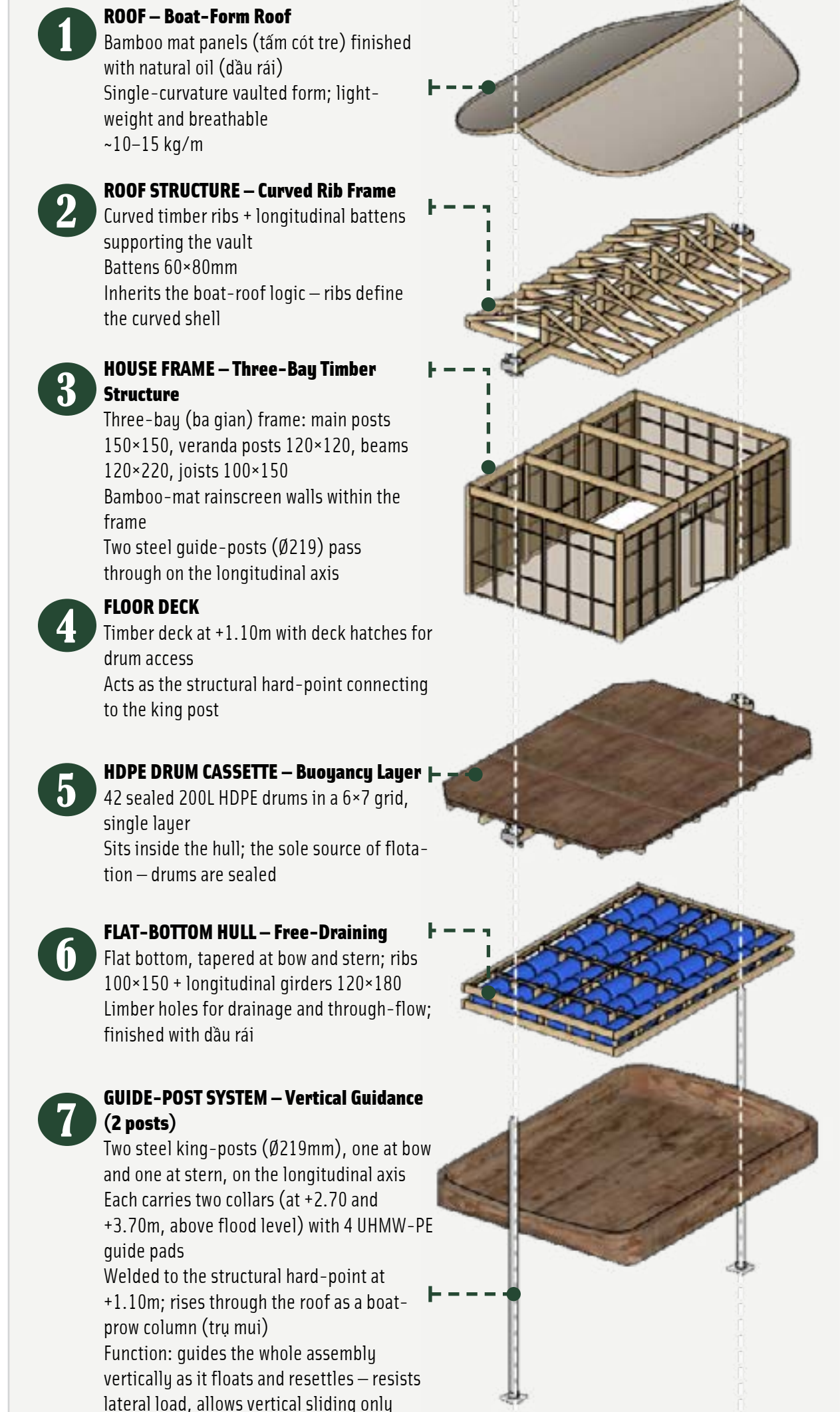
#### D. SECTION THROUGH PLATFORM



#### E. STRUCTURAL PERFORMANCE



#### F. EXPLODE AXONOMETRIC



# 05 COMMUNITY RESOURCE NETWORK

## SPECIALIZED HOUSEHOLD FOR COLLECTIVE FLOOD RESILIENCE

COOPERATION TURNS INDIVIDUAL HOUSES INTO A STRONG AND ADAPTIVE COMMUNITY

### A. WHY CONCENTRATE? - FEWER POINTS, LESS ENERGY, FASTER HELP

Three households as a model. Alone, each would need all three functions — nine houses in all. During flood peaks they pool into one cluster of three shared houses.

#### 1 RESCUE AND SUPPLY ACCESS



**SCATTERED**  
If each household kept all its own functions, three families would spread across nine houses — nine separate points that rescue and supply boats must reach.



**SHARED ROLES**  
Pooled into one cluster, the families share a single landing point — supplies and rescue reach everyone through one access.

**Effect:** Fewer access points: faster, safer emergency response.

#### 2 ENERGY EFFICIENCY



**SCATTERED**  
Running every house separately spreads power thin across many small batteries — each drains fast during prolonged floods.



**SHARED ROLES**  
The cluster pools energy through the main house — concentrated for pumping, lighting and communication; spare modules float as protected reserve.

**Effect:** Limited flood energy lasts longer where it matters most.

#### 3 TIME & COORDINATION



**SCATTERED**  
Scattered households need more time and effort to prepare and defend — costly when flood warnings give only hours.



**SHARED ROLES**  
One connected cluster is faster to prepare, easier to coordinate, and simpler to protect together.

**Effect:** Faster preparation, simpler emergency management.

### B. COMMUNITY CLUSTER

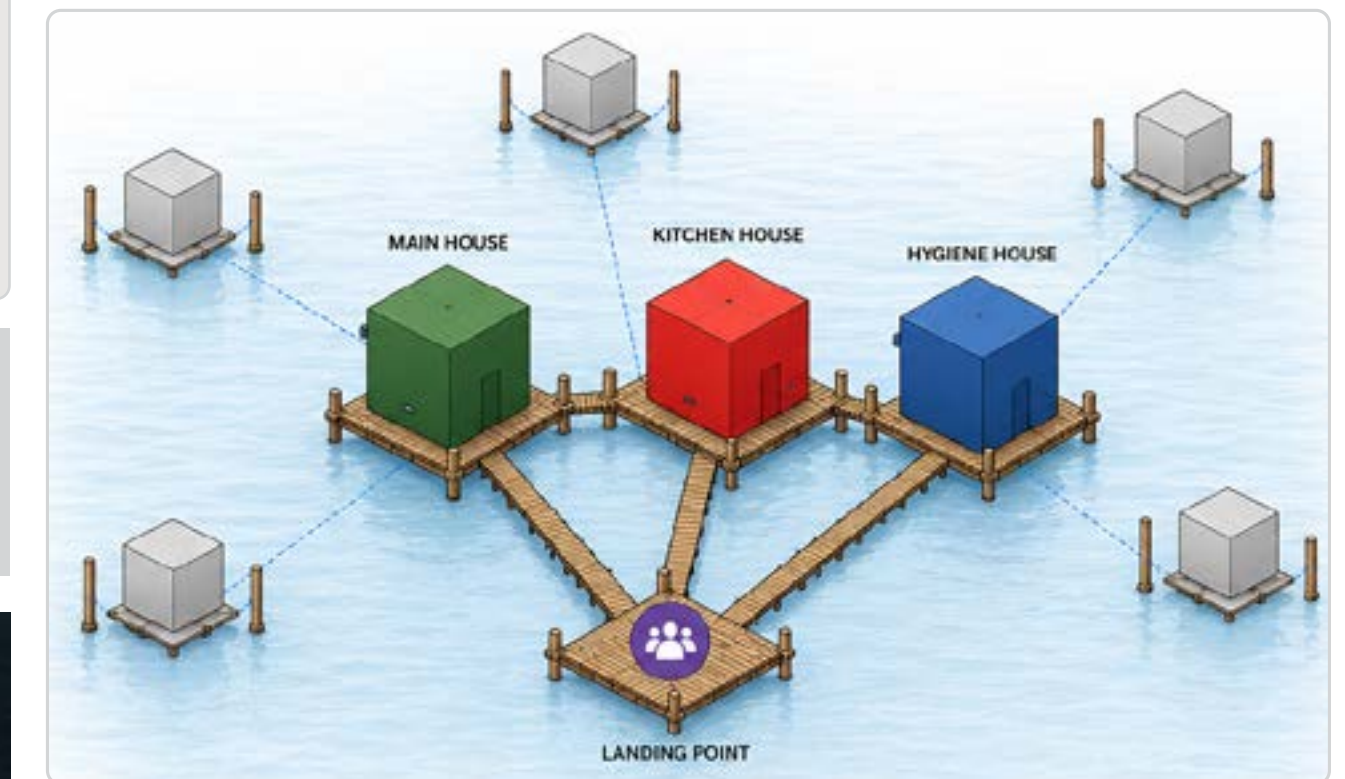
During flood peaks, three households pool their specialized houses into one shared cluster — each contributes one, all three use all three.

#### THREE ROLES - ONE CLUSTER



Each household maintains one specialized house — a main house, a kitchen, or a hygiene house. On their own, three households would need nine houses to cover every function. Instead they pool: three specialized houses serve all three families. Each gives one, each gains three.

#### NETWORK DIAGRAM DURING FLOOD

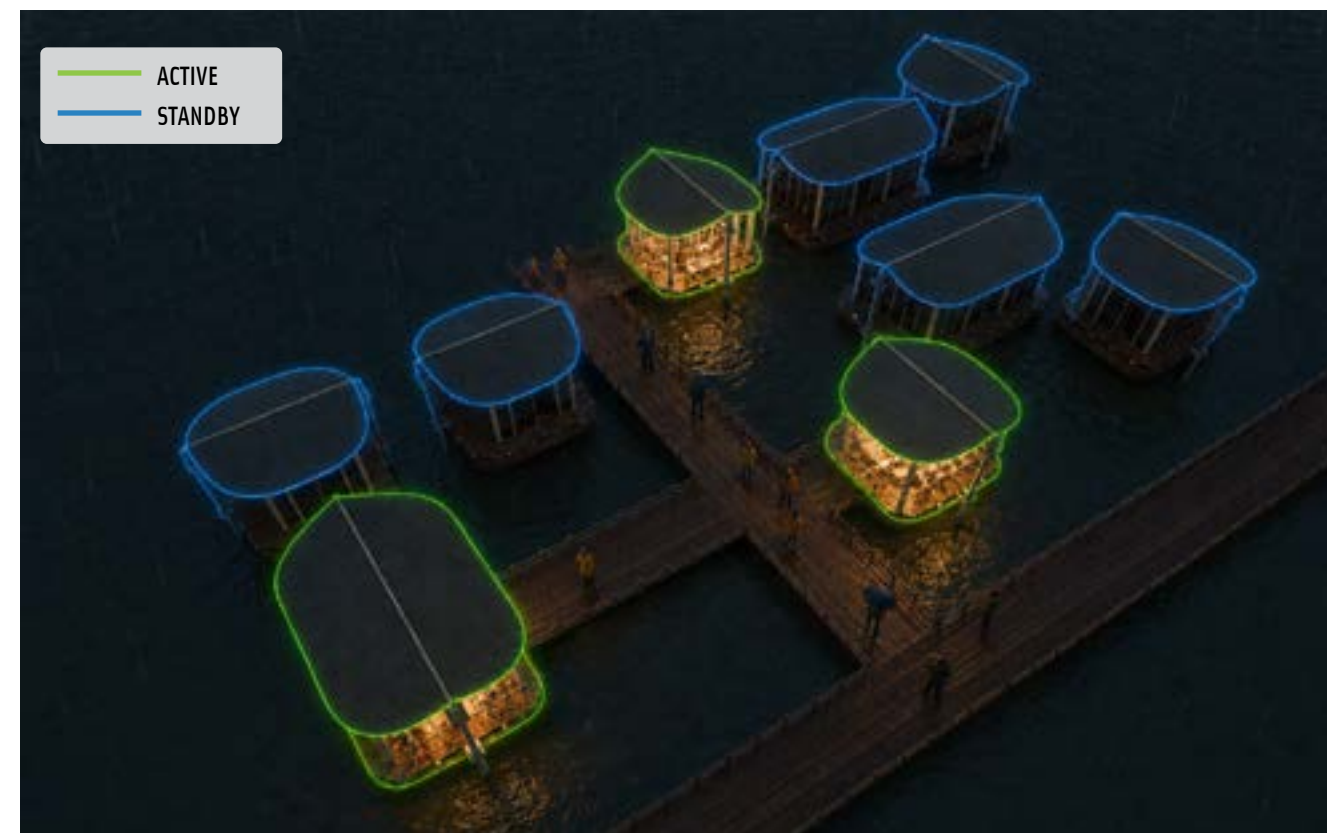


- ACTIVE** (Blue circle)  
Main + Kitchen + Hygiene in use, serving all three households  
Connected by temporary walkpaths  
Concentrate services and energy  
Primary rescue and supply access
- STANDBY** (Grey circle)  
Floating safely  
Unconnected  
Protected storage and reserve capacity
- LANDING POINT** (Purple circle)  
Shared dock for rescue and supply

When floods peak, three households link their specialized houses into one cluster. Each gives one — main, kitchen, or hygiene — and all three share the full set through temporary walkways. After the flood, the cluster disperses and families return home.

### CONCENTRATION IS A FLOOD-PEAK STRATEGY, NOT A SACRIFICE — EVERY MODULE STAYS AFLOAT AND PROTECTED.

For the dangerous days, families pool their houses so scarce resources carry everyone through.



- SHARED RESOURCES
- REDUCED COST
- GREATER RESILIENCE
- STRONGER COMMUNITY

# 06 TOWARD A WATER-ADAPTIVE HUE

## LIVING WITH WATER, THRIVING TOGETHER

### ONE ARCHITECTURE, ADAPTIVE TO EVERY WATER FUTURE



As Hue restores its historic water system, the same amphibious house adapts wherever it stands — on land, or on restored water. One architecture, a recognizable identity for Hue.

#### A. ONE HOUSE, TWO CONDITIONS

Same house, same identity — adapting to any water level



**1 ON LAND: RESTS ON THE GROUND, RISES ONLY IN FLOODS**  
 RESTS ON THE GROUND  
 FUNCTIONS AS A NORMAL DWELLING  
 RISES ONLY IN FLOODS

**2 ON RESTORED WATER: SITS ON CONTROLLED WATER (NGU HA CORRIDOR)**  
 SITS ON CONTROLLED WATER  
 INTEGRATED WITH THE RESTORED WATER SYSTEM  
 ADAPTS TO ANY WATER LEVEL

#### B. A RECOGNIZABLE IDENTITY



1. A shared architectural language (boat-vault roof + rường framing)
2. Clusters of the same form -> a distinct identity for Hue
3. Like Hội An's old houses — recognition through a unified architecture



#### C. RESTORING THE CITY'S WATER



Each house lets water pass beneath it



Across the city -> building porosity becomes urban permeability



Aligned with Hue's restoration of the Ngu Ha waterway

#### D. FROM BUILDING POROSITY TO URBAN PERMEABILITY

A scalable architectural strategy that reconnects heritage, water, and flood adaptation across the Hue Citadel.



ONE AMPHIBIOUS HOUSING TYPOLOGY ADAPTS TO BOTH LAND AND WATER, TRANSFORMING FLOOD RISK INTO PRODUCTIVE AND INHABITABLE LANDSCAPES.



WATER CANAL NETWORK  
 Canals connect to the Perfume River, helping water circulation and drainage.

#### FROM BUILDING POROSITY TO URBAN PERMEABILITY

ARCHITECTURE AS INFRASTRUCTURE FOR WATER RETENTION, CIRCULATION, AND FLOOD ADAPTATION.

