



MEKONG DELTA RICE FARMERS IN THE DRY SEASON

AMPHIBIOUS HOMES FOR THE VULNERABLE

RETROFITTING EXISTING HOMES IN THE MEKONG DELTA FOR FLOOD RESILIENCE AND CLIMATE ADAPTATION

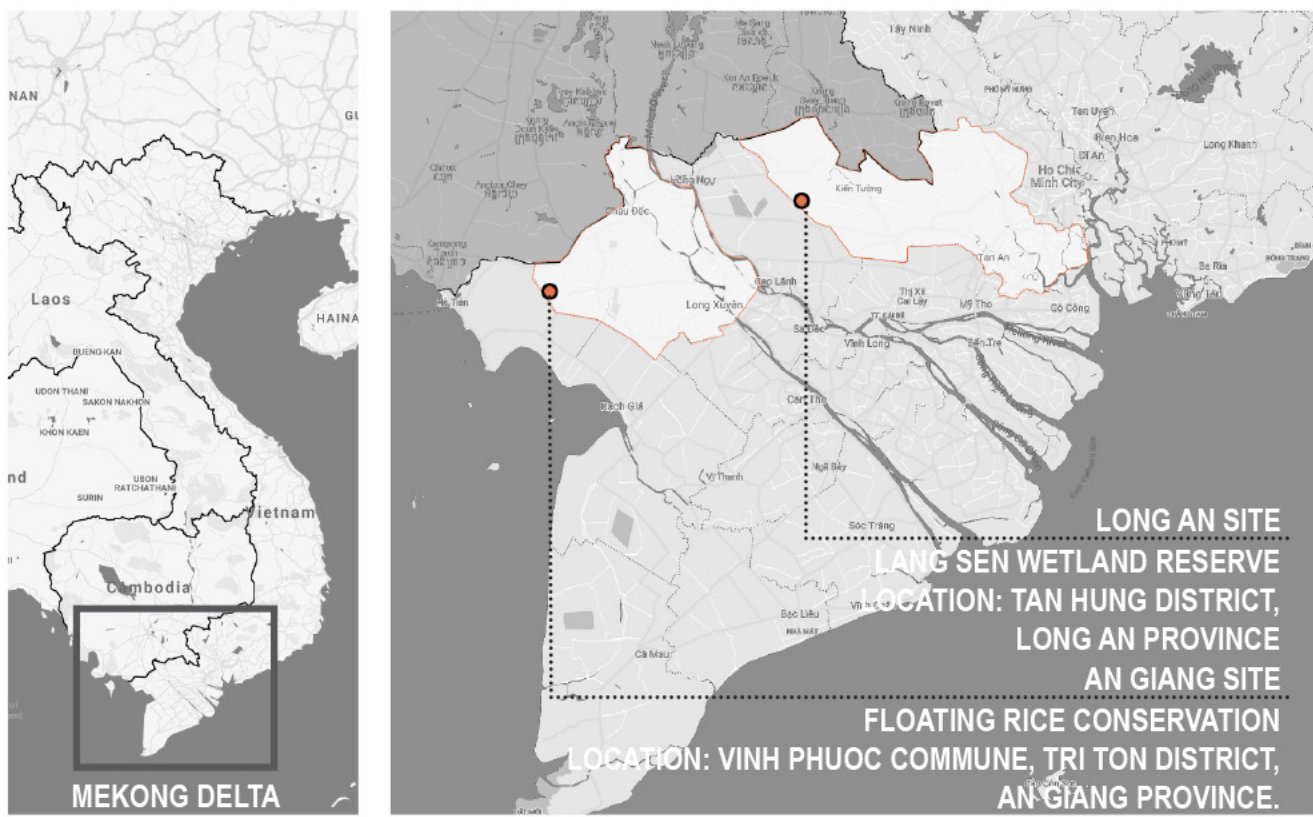


TYPICAL MEKONG DELTA HOUSING ALONG A FLOODED RICE FIELD



FLOATING RICE FIELD IN FLOOD SEASON

CONTEXT



VILLAGE IN LONG AN PROVINCE WITH TYPICAL MEKONG DELTA HOUSING TYPOLOGIES



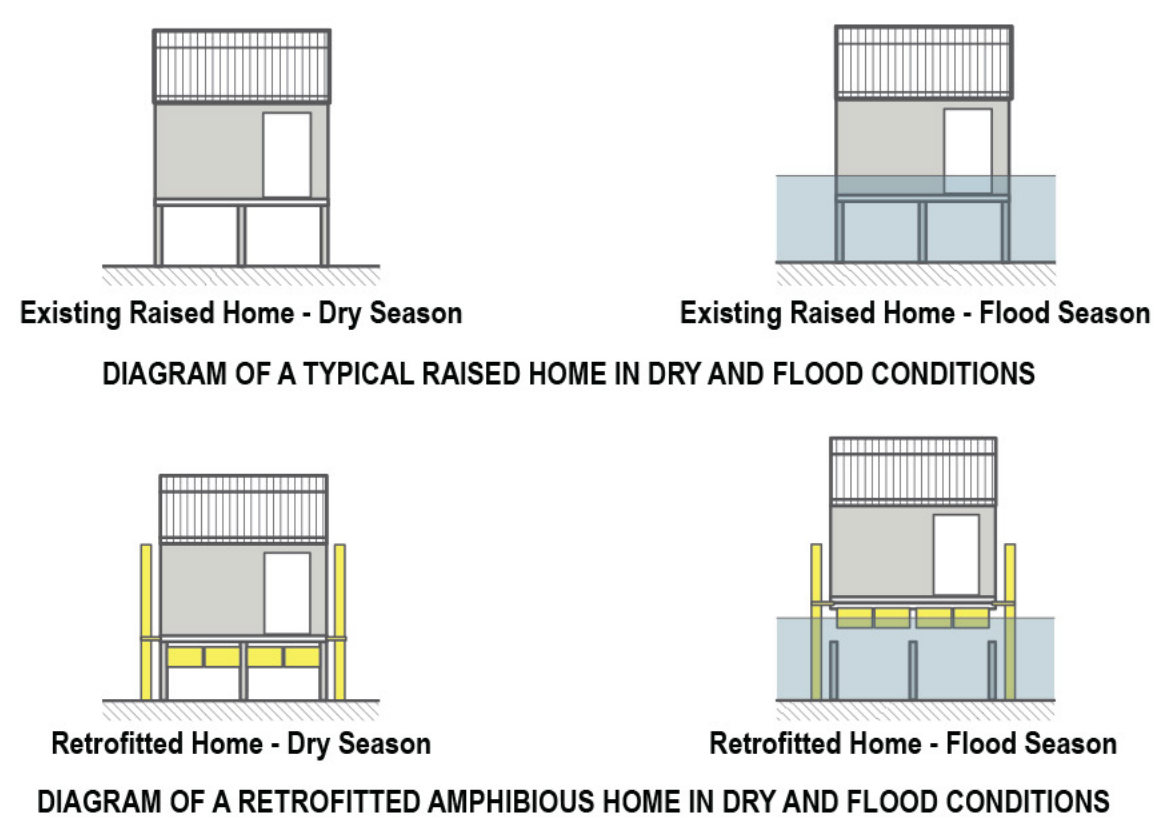
MEKONG DELTA HOMES ALONG A RIVER

THE MEKONG DELTA, VIETNAM

Vietnam's Mekong Delta is home to 17 million people (22% of the national population), most of whom are agricultural and aquacultural farmers. The Delta is comprised largely of wetlands, which contribute 52% of the national rice production and 60% of the national fisheries and aquaculture production. Food produced in this region is also exported to other areas of Southeast Asia.

Traditionally, houses in the region are raised above ground to mitigate property damage during flood events. However, as the area anticipates increasingly severe floods, the current level of static elevation of these houses may no longer be adequate to protect residents and their property. Rebuilding or repairing homes after a flood event is costly and can require a lengthy period of time. During these repairs, residents are often displaced from their homes, increasing their economic burden and vulnerability.

APPROACH



REAR ELEVATION OF NGUYEN VAN NAO'S HOME IN DRY CONDITIONS

COMMUNITY RESILIENCE

In order to preserve residents' connection to their land and livelihoods, a passive climate change adaptation and flood mitigation technique can be implemented, allowing the land in the Delta to benefit from the seasonal flooding. Low-cost amphibious retrofits to existing houses can provide a solution to these vulnerable populations, allowing residents to remain on their farmland during flood events with little or no danger to their families or damage to their homes and belongings. Amphibious construction works in synchrony with a flood-prone region's natural cycles of flooding, rather than attempting to control them.

ADAPTING TO FLOODS

Amphibious retrofits offer resilience to flood-prone communities, primarily by reducing the destabilization that flooding causes. At the household level, floods can disrupt livelihoods, trigger displacement and trauma, and cause financial stress that lower-income families cannot afford. These shocks may also have cascading impacts: as households incur additional expenses trying to compensate for flood damages, accumulating debt restricts their access to healthcare and education, which further contributes to increased poverty and inequality.



REAR ELEVATION OF NGUYEN VAN NAO'S HOME IN FLOOD CONDITIONS

DISPLACEMENT

Amphibious retrofits are an alternative to government plans to relocate vulnerable populations away from the flooding that may endanger them but provides their livelihoods. By allowing households to remain safely in place during flood events, amphibious retrofits act to enhance resilience, reduce flood-related expenses, and provide greater opportunity for households to pursue their daily economic activities without social and physical disruption.

KNOWLEDGE TRANSFER

If amphibious housing takes hold, new entrepreneurial opportunities will become available for those trained in amphibious construction techniques. Currently, the limiting factor for expanding this project is the number of instructors qualified to teach these concepts and skills. The Buoyant Foundation Project is the only research group in the world dedicated to developing amphibious retrofit technology for the world's most vulnerable populations; we aim to expand our scope by teaching local populations how to implement this technology themselves using affordable, locally available materials. We will have succeeded in this goal when the communities we serve can carry on independently without our help.



RETROFITTING WITH LOCAL CARPENTERS

LOCAL CARPENTERS ARE TAUGHT how to implement amphibious retrofits themselves using locally familiar carpentry skills and construction techniques. The training program developed by our team will provide local communities with a stronger knowledge base and allow them to diversify their skillsets. It can be extended throughout the Mekong Delta, supporting a community-based bottom-up approach to flood risk reduction and climate change adaptation.



MONITORING EQUIPMENT ATTACHED TO NANG'S HOUSE

PHYSICAL MONITORING EQUIPMENT has been installed to collect wind data and track the movement of the houses during the flood season. This will be used to make adjustments or improvements to our amphibious designs before scaling up.



RETROFITTING PROCESS: NGUYEN VAN NAO'S HOUSE, AN GIANG PROVINCE

1. Vertical guidance posts (VGPs) installed with poured-concrete foundations.
2. Masonry centering devices constructed at column bases to ensure precise resettlement in original position.
3. Connecting beams attached to underside of floor framing.
4. Installation of new joists to carry uplift from buoyancy jugs.
5. Buoyancy jugs tied in bundles and attached to new joists that carry uplift forces. Skirt boards protect jugs from force of flowing water.
6. Installation of VGP rope sleeves on connecting beam ends.
7. Concrete poured into VGP to 20cm above sleeve level to increase strength and damp noise.



RETROFITTING PROCESS: DANG VAN NANG'S HOUSE, LONG AN PROVINCE

1. Site preparation and replacement of existing wood columns for consistent stone post grid.
2. Connecting beams attached to underside of floor framing.
3. Installation of new joists to carry uplift from buoyancy barrels.
4. Vertical guidance posts (VGPs) installed with poured-concrete foundations.
5. Buoyancy barrels tied up beneath new joists.
6. Completion of VGP box sleeves on connecting beam ends.
7. Concrete poured into VGP to 20cm above sleeve level to increase strength and damp noise.
8. Additional bracing installed on foundation posts.
9. Wood centering devices installed just below floor framing.

SITE SELECTION



FLOATING RICE CONSERVATION AREA SITE

FLOATING RICE CONSERVATION AREA, AN GIANG, consists of floating rice fields that are home to many farmers and diverse ecologies. This site provides the location for the conservation of a traditional agricultural practice, the cultivation of floating rice.



HOMEOWNER NGUYEN VAN NAO AND HIS FLOATING RICE FIELD

ABOUT THE HOMEOWNERS:

Three generations of Nao's family live in their raised home located beside their rice field. Their current livelihood stems from growing floating rice and rotating with cassava in the dry season. Flood depth of the site can be measured by the height of the rice stalks due to their unique adaptive ability to lengthen as flood waters rise. Nao's younger brother and neighbour, Nguyen Van Lac, was also selected to have his home retrofitted.



LANG SEN WETLAND RESERVE SITE

LANG SEN WETLAND RESERVE, LONG AN, covers five thousand hectares of land and consists of three zones: a core zone, an economic forest zone and a biodiversity zone. The reserve is home to diverse flora and fauna that are still being discovered today. But due to increasing agricultural activities around the wetland, many endemic species are becoming extinct over time.



HOMEOWNER DANG VAN NANG INDICATING HIGH FLOOD LEVELS

ABOUT THE HOMEOWNERS:

Dang Van Nang constructed his house in 2009 with materials donated by his uncle who also lives in the same village. Since construction, his home has been subjected to flooding at least twice. Nang's sister-in-law, Nguyen Thi Dung was also selected to have her home retrofitted by the team.



NON-AMPHIBIATED HOME IN A NEIGHBOURING COMMUNE

AMPHIBIOUS HOMES FOR THE VULNERABLE

RETROFITTING EXISTING HOMES IN THE MEKONG DELTA FOR FLOOD RESILIENCE AND CLIMATE ADAPTATION

8th ICBR Lisbon | Nov 2018
Building 4Humanity
 DESIGN COMPETITION

Category 1:
Best Resilient Building Project

Team Project Coordinator(s): Elizabeth English

Team Members: Pham Duy Tien, Nguyen Van Truoc, Teresa Tran, Thanh Tran.

Year of conclusion: 2018

Location: Mekong Delta, Vietnam

TEAM CODE: B4H-DC1158



MASTER CARPENTER NGUYEN VAN TRUOC EXPLAINS FUNCTION OF CONNECTING BEAM



AERIAL VIEW OF NGUYEN VAN NAO'S HOUSE FLOATING ON THE FLOOD



PROJECT TEAM, CARPENTERS AND CLIENTS

PROCESS

EXPLODED ASSEMBLY OF COMPONENTS

- Existing house
- Connecting beams cross underneath house
- Rope sleeve loops around guidance post
- New joists to carry uplift
- Recycled jugs for buoyancy
- Skirt boards to protect jugs from force of flowing water
- Vertical guidance posts to limit lateral motion
- Centering devices for exact repositioning on ground



IMPLEMENTATION



Original house



With amphibious retrofit



NGUYEN VAN NAO'S HOUSE

Amphibiated house floating on floodwater



Original house



With amphibious retrofit



NGUYEN VAN LAC'S HOUSE

Amphibiated house floating on floodwater

OUTREACH

Master carpenter Nguyen Van Truoc and trainee carpenters discussing fabrication details for the box sleeves that will connect Lac's house to the vertical guidance posts.



Team members and guests on Nao's front porch during the flood. Even with twelve people on the front porch, the house remained stable and level with little movement in response to all the human activity.



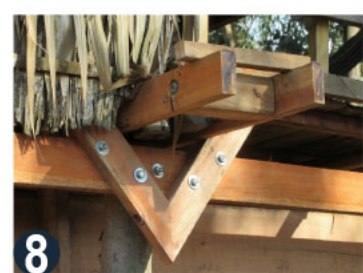
Professor Nguyen Duy Can of Can Tho University (right) interviews homeowner Nguyen Van Nao (left) to assess client satisfaction with the performance of the retrofitted house.



AN GIANG PROVINCE

LONG AN PROVINCE

- Existing house
- Connecting beam crosses underneath house
- End centering device for exact lateral repositioning
- Wood box sleeve with rope cushioning surrounds guidance post
- New joists to carry uplift
- Recycled barrels for buoyancy
- Vertical guidance posts to limit horizontal motion
- Side centering device for exact longitudinal repositioning



DANG VAN NANG'S HOUSE



Original house



With amphibious retrofit



Amphibiated house floating on floodwater

NGUYEN THI DUNG'S HOUSE



Original house



With amphibious retrofit



Amphibiated house floating on floodwater

Luu Thi Tang of Vietnam National University (right) interviews Le Thi Dao (left), village resident and aunt of homeowners Nang and Dung.



Pham Duy Tien of An Giang University (right) in conversation with trainee carpenters from Long An Province.



The entire community comes out to help lift Dung's house to test the centering devices.

