CANAMPHIBIA

TEAM 86

After Hurricane Sandy, many communities have seen their Base Flood Elevations revised upwards overnight, sometimes by 10 feet or more. These areas are required by law, and compelled by the threat of sea level rise and future storms, to rebuild at much higher elevations. Currently, the only option for many homeowners and small businesses is permanent static elevation, such as building on stilts. This can be problematic in a number of ways: it alters the character of the house and neighborhood, restricts accessibility (especially for occupants with physical limitations), increases vulnerability to wind damage, may violate municipal height restrictions and undermines historic preservation. And in extreme flood events, the increased elevation height may not be sufficient and the building may still be flooded.

Amphibious foundations are a cost-effective, resident-friendly alternative to permanent static elevation in areas where flood waters are not accompanied by large waves or high velocity currents. Amphibious systems are distinct from floating houses in that they retain a home's relationship to the ground by resting close to the earth most of the time, but floating as high as necessary whenever flooding occurs. An amphibious system consists of buoyancy elements to provide flotation, a vertical guidance system to limit lateral movement, some accommodation for utility connections and a provision to keep water-borne debris from settling under the house. As such, it provides temporary elevation as needed, when needed, and does so by working in synchrony with floodwater rather than resisting it.

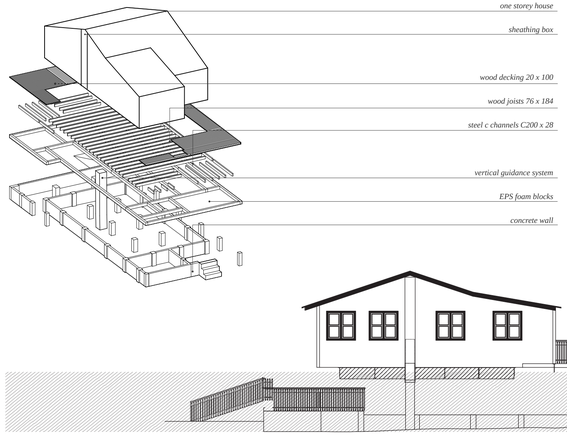
These basic components of an amphibious house form a system that can be adapted to respond to the unique challenges of diverse locations. The nature and duration of the flooding, local housing types, neighbourhood fabric, local climate and economics, and whether for retrofit or new construction are all factors that influence the design of an amphibious system. While clearly there is no universal design solution, the regional variations of amphibious architecture ensure that communities around the world are able to meet the challenges brought on by future storms and impending climate change.

Homeowners in the Lower Ninth Ward of New Orleans have resisted elevating their homes because doing so is expensive, inconvenient and disruptive to their "front-porch" community lifestyle. Many homes are being rebuilt as they were, leaving them highly vulnerable in the event of another major flood. The cost of an amphibious retrofit to these simple shotgun houses is estimated to be about 40%-50% of the expense of permanent static elevation. Amphibious retrofits can provide superior flood protection without destroying the unique character of these neighbourhoods.

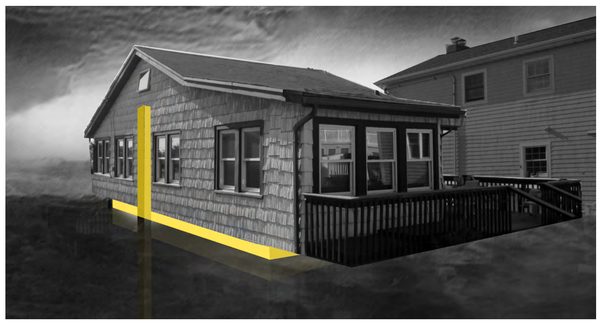
NEW ORLEANS, LOUISIANA

BREEZY POINT, NY

3 Utica Walk is a traditional single-storey home with a 785 sq. ft. floor area. The bungalow is a retrofit project commissioned by two sisters whose father was living in the house before Hurricane Sandy. Located in Breezy Point, New York, is surrounded by water on three sides, making it vulnerable to floods. This neighborhood was one of the hardest hit during Hurricane Sandy, with more than 2,000 residences damaged. After Hurricane Sandy in 2012, FEMA listed Breezy Point as a Zone A flood zone, ***which is considered as a coastal high hazard area. The base flood elevations in the area are being raised by 3 to 6 feet to aformpt to fight the flood should another hurricane strike again, bringing the total required permanent elevatiovn of the house to 13 feet.*** *The sisters do not want their father to have to climb 13 feet of stairs, and looking into an amphibious retrofit as an alternative solution.*

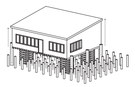


amphious house during flood conditions

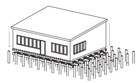


FIRE ISLAND, NY

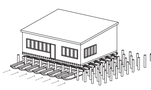
For the community of Ocean Beach, Fire Island, storm surges are a frequent and often devastating occurrence. With its new Base Flood Elevation established at 16 feet, the community of mostly summer homes faces serious challenges to its ability to rebuild after Hurricane Sandy. Amphibious architecture allows the community to become resilient to future storm surges, while at the same time protecting the unique character of the island community. ***Homes can be easily retrofit using the existing foundations, creating an alternative to permanent static elevation*** *that allows the homes to maintain their current appearance and accessibility.*



existing decking is removed and the house is raised above wood foundations. Guidance sleeves are installed

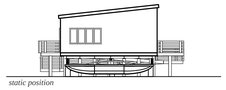


fibreglass reinforced plastic FRP truss is installed and the house is lowered back down onto foundation. Guidance posts are inserted into the sleeves attached to the truss

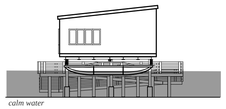


pontoons are attached to the FRP truss

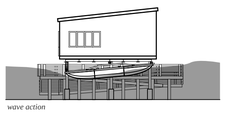
decking is replaced and new ADA compliant ramp is installed



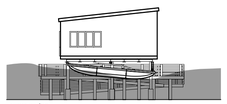
static position



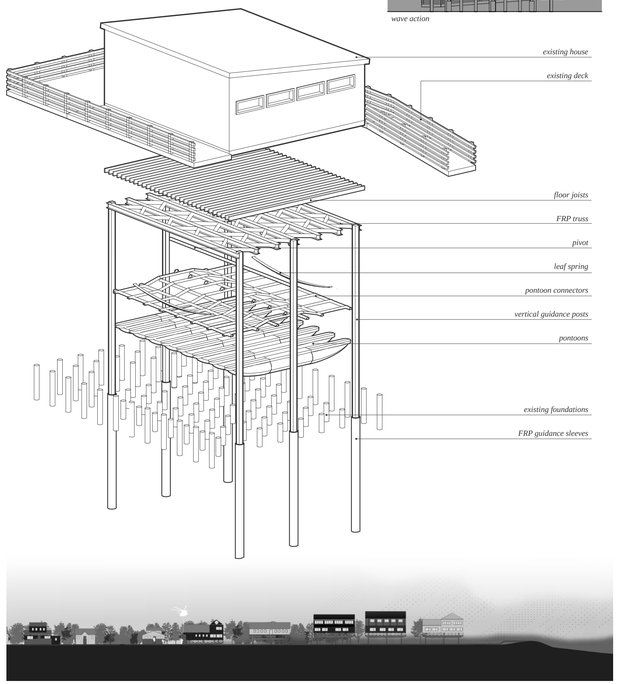
calm water



wave action



wave action

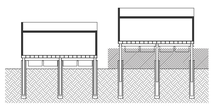


PERTH-ANDOVER, NB, CANADA

Not only does an amphibious retrofit completely, and safely, mitigate the effects of ice jam flooding in Perth-Andover, it also sets a benchmark for the rest of the buildings along the river and preserves the culture and architecture of the downtown core. Now small local businesses can be protected against flooding, and new construction can continue in the flood plain as the town continues to develop. ***As the neighbouring buildings convert to amphibious over time, the entire waterfront will be raised one building at a time revitalizing the culture. Chicago in the mid 1800's serves as an example.*** *Amphibious architecture also reduces the need for the construction of new water infrastructures (such as dams), which harm the natural ecology of the environment.*

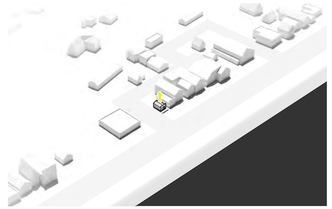
North Side of Lake Street between Clark and LaSalle 1857, Chicago. "The sidewalks of Chicago are...remarkable. With almost every block of buildings there is a change of grade."

Clark Street 1857, Chicago. "...it was a continual succession of ups and downs."

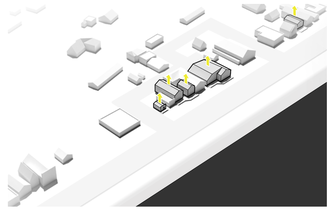


commercial building in normal conditions

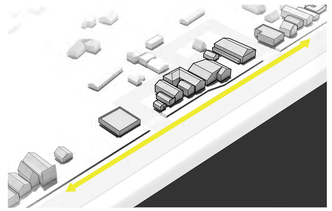
commercial building during flood conditions



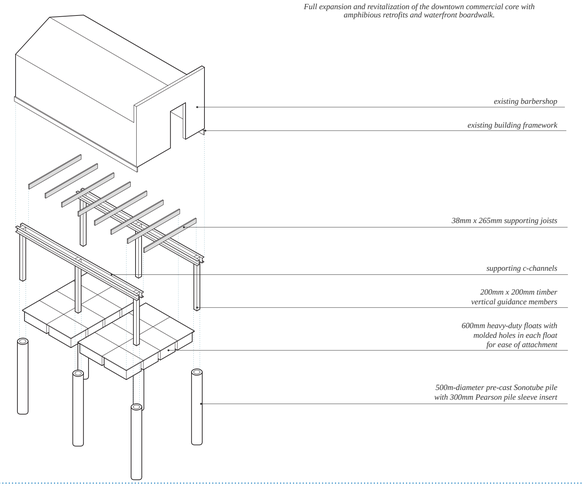
First amphibious retrofit implemented to local barbershop setting the standard for flood mitigation.

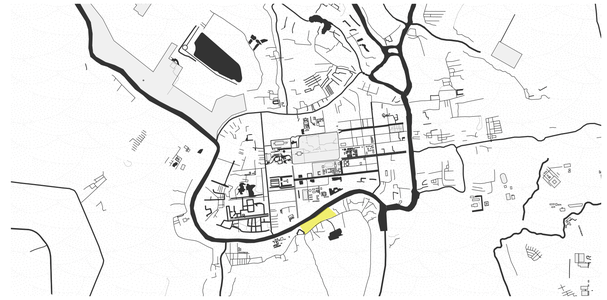


Further development of the amphibious prototype funded by the government and investors in the local economy.



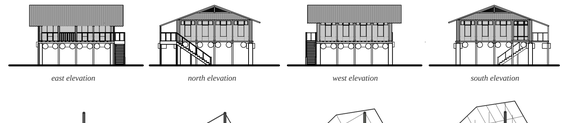
Full expansion and revitalization of the downtown commercial core with amphibious retrofits and waterfront boardwalk.





AYUTTHAYA, THAILAND

The design intent of the amphibious bamboo house for Thailand is to create a ***lightweight structure that retains traditional Thai architecture. The structure is composed primarily of bamboo which is locally abundant and can easily be treated for preservation.*** *Similar to the local housing types and traditional ways of living in Thailand, the structure is designed on stilts to be able to withstand frequent minor floods. The amphibious system supplements the static system to provide protection from infrequent major floods that damage the existing neighbouring houses. The floor requires additional reinforcement to support the uplift loads from the barrels. This determines the placement of the 78 200L steel drums that comprise the buoyancy system. The programming of the plan is deliberate to allow for balanced loads when the house begins to float.*

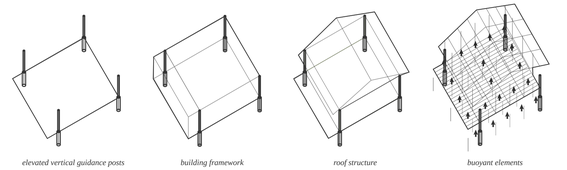


east elevation

north elevation

west elevation

south elevation



elevated vertical guidance posts

building framework

roof structure

buoyant elements