Advances in amphibious retrofit construction for flood risk reduction for vulnerable populations

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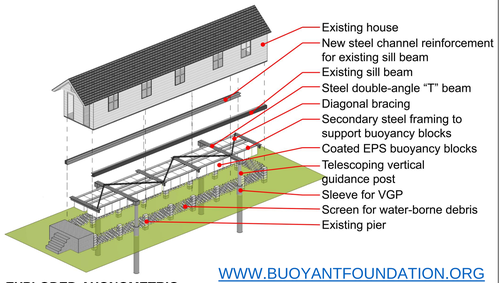
Amphibious construction presents intriguing possibilities in the quest for sustainable, low impact responses to the global climate change crisis. Forward-looking strategies are needed that are capable of providing adaptability to future flood levels difficult to quantify in advance. An amphibious foundation system allows a house to remain on the ground under ordinary circumstances, but to rise with floodwater and float on the surface until it returns to its original position as the flood recedes. This retrofit strategy has great potential to benefit vulnerable populations that currently face difficult choices between leaving their communities or living in fear of the devastation and trauma that severe floods impose.

Amphibious retrofits to existing structures function in synchrony with natural cycles of flooding, allowing water to flow where it will rather than attempting to control it. Since amphibious structures rise to exactly the height necessary to stay above the water, they can accommodate both changing sea levels and land subsidence. Amphibious retrofitting is particularly appropriate for communities with strong connection to place and respect for natural ecosystems. This poster features case studies of inexpensive prototypes implemented in Louisiana, Bangladesh and Vietnam, and visionary projects designed for other flood-vulnerable locations around the world. For more information, please visit www.buoyantfoundation.org.

RENDER OF AN AMPHIBIATED NEW ORLEANS SHOTGUN HOUSE

THE BUOYANT FOUNDATION PROJECT (BFP)



EXPLODED AXONOMETRIC

WWW.BUOYANTFOUNDATION.ORG

FLOOD RISK CONF PAPER 2016

BUOYANT FOUNDATION RETROFIT SCHEMATIC DESIGN

UNDER CONSTRUCTION

MOVING SANDBAGS TO TILT THE HOUSE

1st AMPHIBIOUS PROTOTYPE

BATON ROUGE, LOUISIANA
Constructed 2007

In 2007 a team of LSU Hurricane Center faculty and students successfully constructed and tested a full-scale prototype buoyant foundation system installed on a platform structure representing the full width (13ft) and 40% (24ft) of the full length of a typical Louisiana shotgun house. Dead load was simulated using water-filled barrels, and live load by sandbags. The stability of the prototype was experimentally verified in a series of tests.

LSU PROTOTYPE PROJECT

BFP ASSEMBLY ANIMATION

TEDX TALK 2019

BUOYANT SUBSTRUCTURE

PAVILION AS INSTALLED ON THE UW CAMPUS IN OCTOBER 2018

PAVILION IN WINTER

2ND PROTOTYPE NRC PAVILION

WATERLOO, ONTARIO
Constructed 2018

With support from the National Research Council of Canada, the Buoyant Foundation Project constructed an amphibious pavilion prototype for testing the behaviour of buoyancy materials in sub-zero weather conditions. The goals of the project are to provide cost-effective retrofits for vulnerable Indigenous communities facing increased flooding due to climate change and to develop guidelines for amphibious construction in Canada.

NRC PAVILION PROJECT

OTTAWA CITIZEN ARTICLE 2019

EMPTY PLASTIC BOTTLES BUNDLED INTO BUOYANCY ELEMENTS

UNDER CONSTRUCTION

COMPLETED PROTOTYPE

LIFT HOUSE

DHAKA, BANGLEDASH
Constructed 2010

Designed and built by Prithula Prosun while a Master of Architecture student at the University of Waterloo, the LIFT House has self-sustaining infrastructure that is independent of the city's service system. It is constructed of bamboo and brick and the project has two different systems for buoyancy: on the left a ferrocement open caisson and on the right a bamboo frame filled with bundles of recapped, recycled water bottles.

URBAN FLOOD CONF PAPER 2009

LIFT HOUSE M ARCH THESIS 2011

RETROFITTED HOMES IN THE MEKONG DELTA, VIETNAM

COMMUNITY RESILIENCE

MEKONG DELTA, VIETNAM
Constructed 2018

Rice farmers in the Mekong Delta in Vietnam experience flooding every year, and this seasonal flooding is essential for crop production. But with climate change the floods are increasing in severity. The project is a cost effective alternative to relocation and aims to develop an inexpensive, easily reproducible system that the local people will be able to implement on their own using local resources.

VULNERABLE IN VIETNAM VIDEO

DISPLACEMENT & TRAUMA 2019

FISHING CAMPS

OLD RIVER LANDING, LOUISIANA
Since 1970s (not by BFP)

The water level at Old River Landing (ORL) rises and falls with the seasonal flooding of the Mississippi River. In this remote location, local residents devised an ingenious amphibious foundation system that has helped keep their homes dry for several decades. The BFP and ORL amphibiation systems are based on similar principles. Old River is famous for its fishing, watersports and amphibious restaurant.

URBAN FLOOD CONF PAPER 2009

ECONOMIC ARGUMENT PAPER 2018

AMPHIBIOUS RESTAURANT WHEN OLD RIVER LANDING IS FLOODED

AMPHIBIOUS HOUSE IN NORMAL CONDITIONS

AMPHIBIOUS HOUSE IN FLOOD CONDITIONS

CASA ANFIBIA

MALACATOYA, NICARAGUA
Project 2013

Communities along the Malacatoya River are under continuing threat of displacement. Amphibious construction could eradicate the economic disadvantage of repetitive rebuilding. The design uses recycled plastic barrels as buoyancy elements, based on their local availability and low-cost. Using bamboo as a renewable resource for construction of the houses also responds to the issue of deforestation.

CASA ANFIBIA PROJECT

DISPLACEMENT & TRAUMA 2019

EXISTING HOME IN MALACATOYA

SCHEMATIC RENDER OF HOUSE WITH BUOYANT FOUNDATION

RENDER OF AMPHIBIATED HOME IN FLOOD CONDITIONS

"SACRIFICIAL ZONE"

LEEVILLE, LOUISIANA
Project 2015

Leeville is located along Bayou Lafourche, outside the levee protection system. Recent reconstruction of Louisiana Highway 1 has bypassed Leeville, making the town an isolated "sacrificial zone", an area that has been written off as not worth protecting from floods. Finding a strategy to save the homes of residents who cherish living in Leeville has become an urgent priority for this community.

LOSS AVOIDANCE CONF PAPER 2015

FLOOD RISK CONF PAPER 2016

ECONOMIC ARGUMENT PAPER 2019

LOCATION OF HOUSE IN LEEVILLE

CAMP MADELYN UNDER NORMAL CONDITIONS

RENDER OF AMPHIBIATED CAMP MADELYN DURING FLOODING

HERITAGE PROTECTION

PRINCEVILLE, NORTH CAROLINA
Project 2017

The historic town of Princeville sits in the floodplain of the Tar River and has twice in the past twenty years been devastated by "100-year" hurricane-related flooding. Buoyant foundation retrofits of Princeville's important landmarks would prevent the forced relocation of this culturally vibrant and historically significant African-American community.

HERITAGE PAPER 2019

PRINCEVILLE CHURCH ANIMATION

MT. ZION PRIMITIVE BAPTIST CHURCH IN PRINCEVILLE

ABRAHAM WOOTEN MEMORIAL

RENDER OF AMPHIBIATED CHURCH DURING FLOODING

FARNSWORTH HOUSE

PLANO, ILLINOIS
Project 2014

"Floating slabs" are already a part of the Farnsworth House's tectonic vocabulary. The fully below-grade retrofit installation ensures that the outward appearance remains visually unaltered. The project offers an alternative to the costly restoration that is required after each flood, and combines appropriate, resilient technologies with a sensitivity to preserving this valuable cultural asset.

FARNSWORTH HOUSE PROJECT

FLOOD RISK CONF PAPER 2016

FARNSWORTH HOUSE ANIMATION

BEFORE & DURING FLOODING

RENDER OF BUOYANCY SYSTEM