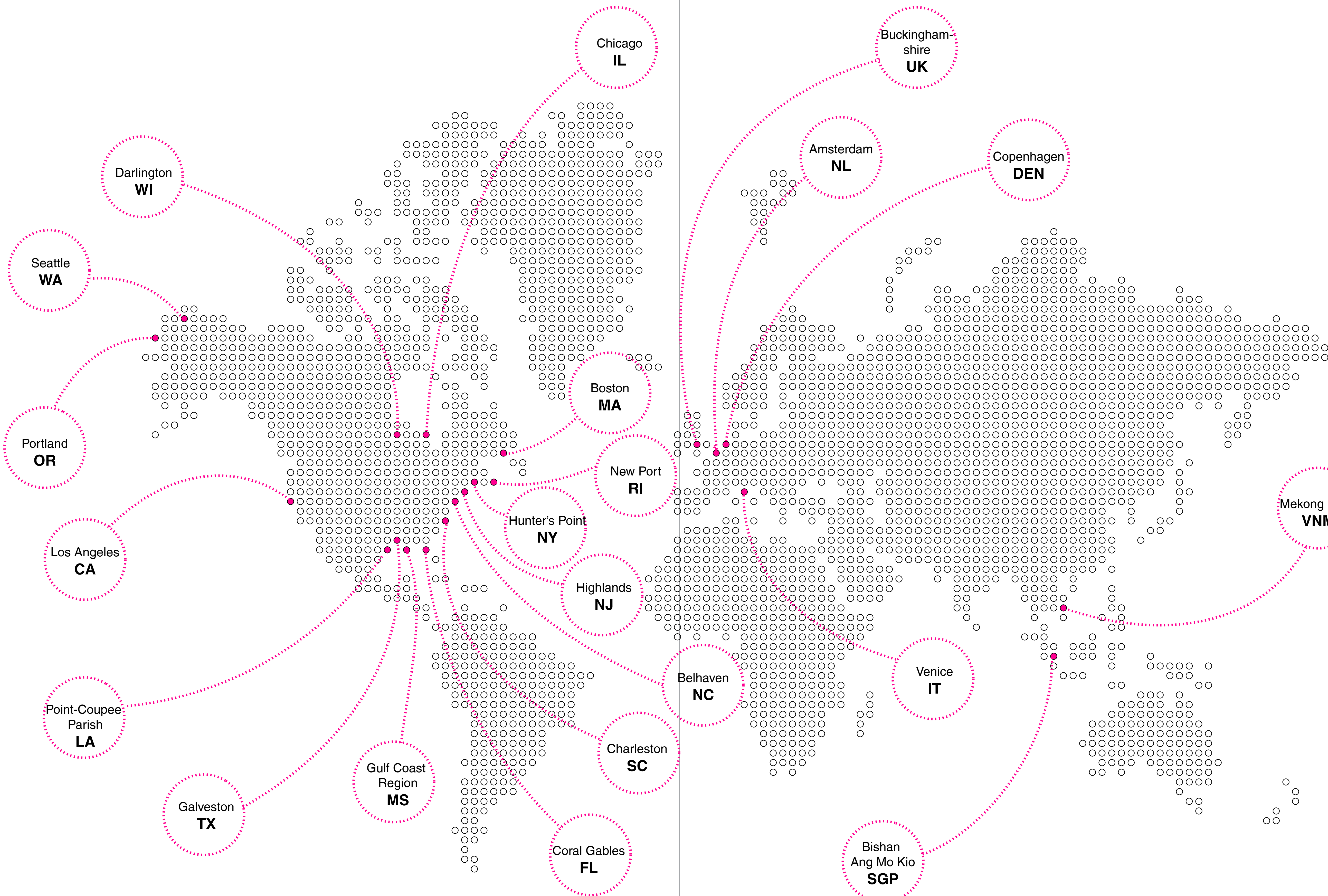
4

Best Practices

“ An important cultural value of the historic city rests precisely upon its ability to be in a constant evolution, where forms, space and uses are always adapting to replace obsolescence with functionality. This gives rises to the paradox – or perhaps the oxymoron – of the concept of preserving the ability to change.”

Gustavo F. Araoz, Preserving Heritage Places Under a New Paradigm

Collins Waterfront Study Area | Collins Avenue with 38th street looking North



Chicago IL
Buckinghamshire UK
Darlington WI
Amsterdam NL
Copenhagen DEN
Seattle WA
Portland OR
Boston MA
New Port RI
Hunter's Point NY
Los Angeles CA
Mekong Delta VNM
Highlands NJ
Belhaven NC
Venice IT
Point-Coupee Parish LA
Charleston SC
Gulf Coast Region MS
Galveston TX
Coral Gables FL
Bishan Ang Mo Kio SGP

4.1 // ADAPTATION OF HISTORIC BUILDINGS & DISTRICTS

VENICE, ITALY

RECONCILING PRESERVATION WITH RESILIENCE

For centuries, Venetians have adapted to living with water by continuously elevating the city above flood level. They have done so “simply by building on top of other buildings, turning Venice into a kind of architectural layer cake.”[1] Today, through the accelerating impacts of sea level rise, the city has become vulnerable to deterioration and damage. While the Italian government has gone to great lengths to create a mobile dam system, the Modulo Sperimentale Elettromeccanico (MOSE) barrier,[2] the populace has stringently protested such innovative large-scale solutions. In Venice, more impactful strategies have often proven to be small-scale actions on the part of home and business owners. As of 2015, it was estimated that 42% of residential buildings and 36% of commercial buildings in the historic city center have taken measures to protect themselves from water.[3] These measures include the use of flood and saltwater resistant materials (like impermeable limestone), dry/wet floodproofing of the ground floor, use of temporary barriers, and installation of pumps.[4] These solutions work well in the short-term, as they have gentle impact on Venice’s historic buildings and can be implemented quickly. However, employing them in the absence of a larger plan can also be perceived as a retreat from modernity. Venice struggles with the contradictory activities of preserving rich heritage with effective resiliency planning.

Potential applications in Miami Beach:

- Change of use of the ground floor
- Wet/dry floodproofing
- Flood panels / barriers
- Waterproof / flood resistant materials
- Installation of small-scale pumps

Figure 1. Temporary Catwalk, Piazza San Marco | Photo Stefano Mazzola/Awakening/Getty from Taylor, Alan, “Acqua Alta, or Venice Underwater” theatlantic.com, 10/30/18

DARLINGTON, WISCONSIN, USA

RAISING INTERIOR FLOORS

Flooding from the Pecatonica River is a near-constant problem in Darlington, Wisconsin. After a devastating flood in 1993, the town decided to act in order to save its Main Street Historic District. The primary challenge was mitigating future flooding while retaining the historic character of the district. To preserve the historic storefronts, commercial property owners took advantage of high ceiling heights and raised interior first floors to the Base Flood Elevation.[FN] The newly-raised first floors were dry floodproofed to BFE +2, basements were filled in, and utilities were raised. In some buildings, wet floodproofed vestibules were created behind existing façades to provide space for stairs to the newly-elevated floor, and preserve the storefronts’ historic entrances and relationship with the street. During a flood event (when a flood shield is inserted at the top of the stairs) the vestibule acts as a sealed flood wall.[FN] In the District, historic buildings were brought up to code and innovative solutions were implemented, such as ADA ramps behind the buildings that could also act as floodwalls.[FN] For this work, the City of Darlington won a Preservation Achievement Award from the State Historical Society of Wisconsin in 1998.[FN] Yet, despite widespread recognition for its comprehensive flood hazard mitigation plan, as of October 2019 the city has seen 7 moderate flood events (defined as 15’ or higher) since 2017, more floods than the previous 25 years combined.[FN]

Potential applications in Miami Beach:

- Preservation of district character, streetscape, and relationship with the ground
- Wet floodproofing of areas below BFE
- Dry floodproofing of usable floor area above BFE
- Water / floodproof materials
- ADA compliant ramps as floodwalls
- Infill basements
- Raised utilities

Installing a vestibule | NFIP *Floodplain Management Bulletin* Historic Structures, FEMA P-467-2, May 2008, p. 17

First floor is elevated behind storefront. | Langrehr, James. “ ‘It’s becoming a bit discouraging:” Darlington dealing with 7th flood in two years’,” 3 October 2019

74 BRIDGE STREET, NEWPORT, RHODE ISLAND, USA

SHORT-TERM PROTECTION

Located in the flood-prone area of the historic Point Neighborhood of Newport, Rhode Island, 74 Bridge Street, or The Christopher Townsend House, dates back in part to the 1720s. The finished ground floor is only four feet above sea level and requires the use of a constantly running sump pump to drain a basement floor that is below groundwater level. Mechanical equipment including the building's water heater and furnace have been moved up to the first floor to prevent damage from rain and floodwaters. Sandbags and door barriers are temporarily deployed during flood events. The Newport Restoration Foundation (NRF) currently owns the property. Coordinated by the NRF, a two-day design charrette in January 2016 was held with design professionals, academics, city planners, and members of the community members. The building's development as case study for resiliency has been a collaboration among the NRF, Building Conservation Associates New England, Union Studio, and Mohamad Farzan, RIBA, AIA. [FN]

Potential Applications in Miami Beach:

- Short-term solution to protect against infrequent flooding
- Elevation of key utilities
- Temporary barriers for floodproofing
- Pumps to drain interior spaces and protected areas

Image courtesy Frank Amaral, NRF

BOSTON, MASSACHUSETTS, USA

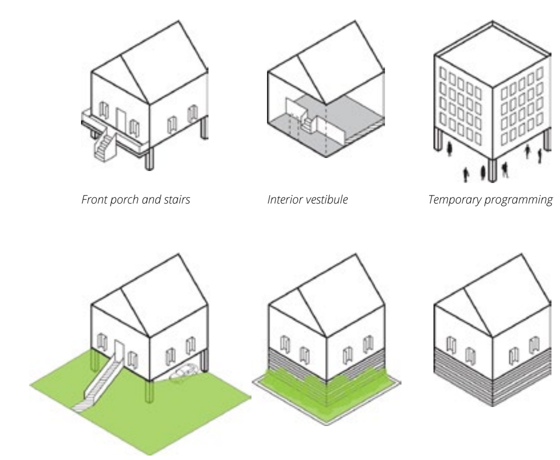
TYPOLOGICAL APPROACH

In the US, Boston has been a leader in establishing a roadmap for a city to retrofit its historic districts. Boston employed several retrofitting strategies for existing historic and contemporary buildings, by typology, along the Boston waterfront. Each strategy meets FEMA and NFIP requirements for retrofitting existing buildings and offers design scenarios that help mitigate the unintended impacts of individual retrofits on a neighborhood's urban cohesion. Retrofitting of structures in the century-old floodplain often conflicted with the City's existing zoning codes: with its 2017 Retrofitting Plan, Boston posited that openness to regulatory change, and coordinated incentivization, are crucial to support effective resiliency planning. The result of a collaboration between the Boston Planning & Development Agency and the City of Boston, a draft of the Coastal Flood Resilience Design Guidelines was published in September 2019.

Potential Applications in Miami Beach:

- Typological approach to retrofitting
- Incentivization of retrofitting strategies

Photo by David L. Ryan/Boston Globe via Getty Images. Usage permission pending



Boston typologies. From Retrofitting Boston Buildings for Flooding - Potential Strategies Report, 2019

LOS ANGELES, CALIFORNIA, USA

ACCRETIVE ADDITIONS

The City of Los Angeles developed and implemented an innovative adaptive reuse program in the city's downtown, originally approved in 1999. In 2003, the ordinance was approved for additional neighborhoods. The Adaptive Reuse Ordinance has become one of the most significant incentives related to historic preservation in Los Angeles, facilitating the conversion of dozens of historic and underutilized structures into new housing units. It provides an expedited approval process and ensures that older and historic buildings are not subjected to the same zoning and code requirements that apply to new construction. The result has been the creation of several thousand new housing units, with thousands more in the development pipeline, demonstrating that historic preservation can serve as a powerful engine for economic revitalization and the creation of new housing supply.

Potential Applications in Miami Beach:

- Regulatory change to support resilience planning
- Adapt-in-Place/accretive strategy

A third floor was added on the two-story rear portion of a building. Photo: Chadd Gossmann, Aurora Photography, LLC.

The compatible addition is set back and does not compete with the historic building. Photo: Chadd Gossmann, Aurora Photography, LLC.

SEATTLE, WASHINGTON, USA

ACCRETIVE ADDITIONS

Seattle's Landmarks Preservation Board has approved the adaptive use of, and accretive additions to, historic properties throughout the city. One such example is the treatment of the 1950 Federal Reserve Bank, placed on the National Register of Historic places in 2013. In 2015, a local developer purchased the property and proposed an addition on top of the existing building. Ultimately, the Board's Architectural Review Committee approved seven stories of office space and felt like even with the addition the historic value of the existing building would be preserved.

Another Seattle national landmark, the Maritime Building, is a good example of the integration of old and new in a single building. The Maritime Building is a 1911 waterfront commercial building located in downtown Seattle, with unobstructed views of Elliot Bay. Shortly after listing the building on the National Register a proposal was approved to add three floors of new office on top of the building. A $25 million renovation and rooftop addition was recently completed in 2018 and the software company Big Fish Games moved in to make the building its new headquarters.

Potential Applications in Miami Beach:

- Regulatory change to support resilience planning
- Adapt-in-Place/accretive strategy

The renovation of the century-old Maritime Building on the Seattle waterfront preserved the structure's historic while opening up the interior for modern use. Photo Turner ENRNorthwest

4.2 // LIVING WITH WATER

WATERBUURT, AMSTERDAM

FLOATING CITY

Like Rotterdam, Amsterdam is a global leader in water management. UNESCO recognizes the city's system of canals and locks in its Canal Ring and Defense Line on the World Heritage List. Dutch expertise in hydraulics, engineering, and urban planning is borne out in these still-intact systems. Many of the adjacent houses constructed in the 17th and 18th centuries are still standing.

Floating architecture, a contemporary approach to living with water, is becoming prevalent throughout the Netherlands, and there are several compelling examples in Amsterdam. Currently, this approach is being tested on a small scale, with floating houses (below, by architect Marlies Rohmer), multifamily apartments, offices and parks. A particularly innovative subset of academics and professionals are now discussing entire floating cities. The biggest challenge to the idea of floating architecture may be environmental regulations and barriers of zoning and building codes. In Amsterdam, however, local architects have discovered ways to include underwater infrastructure that restores natural habitat functions.

Potential Applications in Miami Beach:

- Innovative approach to living with water

Floating Houses, Ijburg, 2011

MEKONG DELTA, VIETNAM

AMPHIBIOUS HOMES FOR VULNERABLE POPULATIONS

This pilot project led by Dr. Elizabeth English, (associate professor at the University of Waterloo) involved the retrofit of four houses in the Mekong Delta of Vietnam. It was funded by a partnership between the Global Resilience Partnership (GRP) and Z Zurich Foundation of Zurich Insurance. This region in Vietnam is prone to flooding from annual monsoons, and in response, residents have typically chosen to elevate their homes on stilts to withstand the water. However, often times these buildings aren't raised high enough if these homes are raised too high, they can become unstable and unable to withstand the fast-moving currents of the monsoon floods. This project was able to retrofit amphibious foundations to buildings that already exist. The retrofitted structure consists of three parts: 1) buoyant blocks under the home that allow it to float; 2) guideposts that anchor the house and create a track for vertical movement; 3) a structural frame that attaches the house to the guideposts. At $2400 per home, the project was executed at a relatively low cost, and the new foundations were quick to implement, each taking 2-3 weeks to complete.

Potential Applications in Miami Beach:

- Retrofit existing buildings with amphibious foundations
- Flexible strategy that allows for changing levels of water and sea level rise
- Would need exception from FEMA, which requires that structure in flood-prone areas beadequately anchored to prevent flotation, collapse, or lateral movement

Photo University of Waterloo. Buoyant-foundation homes in Vietnam.

Elevated structurein Vietnam

POINTE COUPEE PARISH, LOUSIANA, USA

INCENTIVIZATION BUYOUT/ABANDONMENT

While the effectiveness of amphibious housing has also been explored in places like Great Britain, Bangladesh, and Taiwan, it has been slow to catch on in the United States. That is partially due to FEMA, which favors permanently elevated homes in flood zones. FEMA mandates that technology that relies on mechanical processes to provide flood protection is not equivalent to the same level of safe protection provided by permanent elevation. In Louisiana, a large-scale effort to incentivize building elevation was called the Restore Louisiana Buyout and Resilient Housing Incentive Program. Federal regulations prohibit Restore Louisiana – which is funded by the U.S. Dept. of Housing and Urban Development (HUD) – from repairing or reconstructing homes located inside a federally designated floodway. However, federal funds can be used for the voluntary buyout of eligible properties located in a floodway.

Potential Applications in Miami Beach:

- City providing incentives for building elevation
- Flexible strategy that allows for changing levels of water and sea level rise
- Would need exception from FEMA, which requires that structure in flood-prone areas be adequately anchored to prevent flotation, collapse, or lateral movement

Courtesy KPF

AMPHIBIOUS HOUSE, UNITED KINGDOM

FLOATING FOUNDATION

Located along the Thames in Buckinghamshire, this is the first constructed amphibious house in the United Kingdom.[FN] Like other amphibious architecture projects, this house is designed to float on guiding posts when water floods the site — up to 2.5 meters (well above the future flood levels for the area [FN]. However, unlike other comparable projects, where the building either permanently sits on the water or is raised a few feet on buoyancy blocks, this house provides an elegant solution by submerging the basement (and thus the buoyancy device) underground. This helps retain the house's relationship with the ground / street and doesn't create accessibility issues other elevated homes experience. The garden is designed in a series of terraces that progressively flood and utilities are strung through flexible pipes that keep the building from becoming 'unplugged' as it floats.[FN]

Potential Applications in Miami Beach:

- Flexible strategy
- Retain connection wtih the ground/street
- Create tethered, flexible utilities
- Utilize green infrastructure
- Retain accessibility in non-flood events

Buoyant House by Baca Architects (2016) Images courtesy Baca Architects

TASINGE SQUARE, COPENHAGEN

CLIMATE-ADAPTED PARK

Copenhagen has been experimenting with the concept of “climate resilient neighborhoods” and has also invested quite heavily in public infrastructure to manage excess water. In considering their public infrastructure, the city proposed a couple of options:
Grey system option. Expand the city’s existing subterranean sewer and drainage system. This would have meant doubling down on the 20th-century philosophy that a city can handle higher volumes of rainwater as it falls by burying more and larger pipes to handle the runoff.
Green-Blue system option. As an alternative to funneling all stormwater at once through underground pipes, this option re-thinks the management of water at the street level through a network of parks, cloudburst boulevards and retention zones.

Ultimately, Copenhagen opted for a Climate Adaptation Plan that relies almost exclusively on Green-Blue (technical solutions above-ground) options as they address challenges when there is water — but also provides value for the community when it is dry.

The city’s first climate-adapted park, Tåsinge Plads, is at the center of a neighborhood (Saint Kjelds) that is considered to be Copenhagen’s first climate resilient neighborhood. The site was previously paved with asphalt and primarily used as a parking lot. Today it has hidden water management features that form a large part of the basis of the city’s climate change plan.

Potential Applications in Miami Beach:

- Flexible strategy that allows for changing levels of water and sea level rise
- Would need exception from FEMA, which requires that structure in flood-prone areas be adequately anchored to prevent flotation, collapse, or lateral movement

Tasinge Square, St. Kjeld before. Photo Tredje Natur

Tasinge Square, St. Kjeld after. Photo Tredje Natur

4.3 // RAISING HISTORIC BUILDINGS & DISTRICTS

CHICAGO, ILLINOIS, USA

ELEVATION OF A DISTRICT

In the 19th century, the city of Chicago was not higher than the shores of Lake Michigan. When the lake flooded, natural drainage of water was not possible. Poor living conditions followed, with contamination and water-logging frequently a source of diseases, dysentery among them. A cholera outbreak in 1854 led to the death of about 6 percent of the city’s total population. This catastrophe prompted the city’s engineers and city council members to seriously consider the drainage problem and its mitigation. In 1856 engineer Ellis S. Chesbrough proposed an extensive sewer system, a proposal that the city later adopted. This massive infrastructure project entailed the laying of drains, regrading and refinishing of roads and sidewalks, and raising a huge proportion of the city’s buildings with hydraulic jacks.

Potential Applications in Miami Beach:

- Collective Raise

Raising a block of buildings on Lake Street.

GALVESTON, TEXAS

ELEVATION OF A DISTRICT

Flood mitigation and retrofitting/adaptation is at the heart of the history of Galveston. Over a century ago, building elevation and building relocation was deployed en mass following the Great Storm of 1900. The City built a 3-mile-long seawall, raised the ground elevation of the whole city by 8 feet (17 feet at the seawall) and 2,000+ buildings were raised as high as 17 feet above their original foundation height. More than 16 million cubic yards of sand were dredged to raise the ground elevation to the underside of the raised buildings. Consistent efforts to preserve Galveston's built environment (including 1000+ residential and commercial historic buildings, 4 National Register Historic Districts and 2 National Historic Landmark Districts), in spite of periodic natural disasters, makes it one of the best examples of well preserved, historic cities in the country.

The local preservation organization, the Galveston Historical Foundation, has taken it upon themselves to be experts in historic building resilience and climate adaptation. One of the things they do is host annual symposiums and workshops related to mitigating flood damage for historic buildings and districts. Recently, they hosted a hands on workshop to test different building strategies to minimize flood vulnerability: reinforcement, flood-proofing, structural elevation, and amphibious architecture.

Potential Applications in Miami Beach:

- Collective raise

Before and After: This house was elevated ten feet, and the owners constructed a new porch and fence. Source | Galveston County Museum, Galveston, Texas.

BELHAVEN, NORTH CAROLINA

METICULOUS PLANNING

The Town of Belhaven, North Carolina, along the Pungo River, is subject to repeated flooding. In its last flood event, over 60 percent of the town's buildings were damaged, including most of the buildings in the National Register-listed Belhaven Historic District. In an effort to retain the town's historic and economic link to the waterfront, the decision was made to elevate the 379 buildings in place rather than relocate them to higher ground or demolish and rebuild them. With assistance from the North Carolina State Historic Preservation Officer, plans were developed for an elevation project that would best preserve the historic character of the district. In the plan, frame buildings were raised onto concrete block foundations faced with brick veneer. Brick buildings were elevated onto continuous concrete block foundations, which were also faced with brick veneer. A projecting brick course was used to demarcate where the original house ended and the new foundation began. Additional guidance was drafted for preserving porches, railings, balusters, and steps, and for replacing old materials with appropriate new materials where necessary. To prepare for the elevation project, large-format archival photographs were taken of each building that would be included in the project. These photographs provided a permanent record of the historic appearance of the district. Due to all these extra planning efforts for preserving its historic properties, the Belhaven Historic District was able to maintain its National Register status.

Potential Applications in Miami Beach:

- Retaining National Register District designation
- Building elevation on new legible base
- Preservation of accessory historic elements, like porches, railings and stoops
- Documentation of historic structures before resilience strategies are implemented
- Possible funding through FEMA's Hazard Mitigation Grant Program

Belhaven waterfront

Frame Building elevated on concrete block foundation faced with brick veneer.

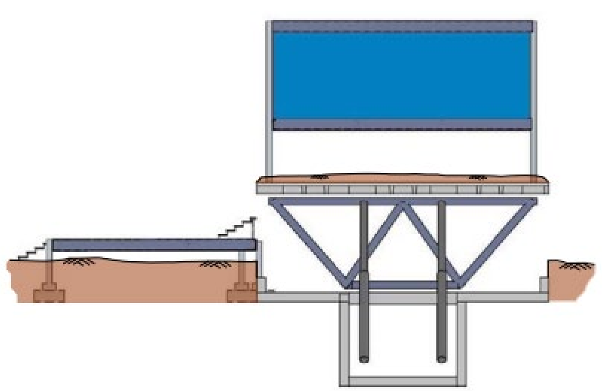
THE FARNSWORTH HOUSE, ILLINOIS

TECHNOLOGICAL SOLUTIONS

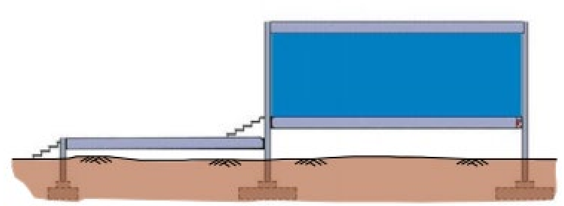
The early modernist Farnsworth House in Plano, Illinois designed by Mies Van Der Rohe was built in 1951 adjacent to the Fox River. The property and home have seen intense river flooding, leading the National Trust for Historic Preservation to explore flood-protection options for the site, including relocating the house off-site to higher ground. Instead, a hydraulic lift designed by Silman Engineers is currently being implemented. It will allow the home to be temporarily raised in place only as needed during a flood event. [FN]

Potential Applications in Miami Beach:

- Flexible building raise



Elevation showing main level raised while lower terrace remains and is allowed to flood (RSA, 2014)



Schematic elevation of existing structure (RSA, 2014)

GULF COAST REGION, MISSISSIPPI

BUILDING RAISE GUIDELINES

The Elevation Design Guidelines for Historic Homes in the Mississippi Gulf Coast Region specifically mentions an important intention of providing elevation guidelines: “to limit the total height of elevation for historic buildings so they maintain their historic character in relation to other historic buildings within each local historic district, thus protecting the architectural qualities of each historic district as a whole.”

Potential Applications in Miami Beach:

- Retaining National Register District designation
- Building elevation on new legible base
- Preservation of accessory historic elements, like porches, railings and stoops
- Documentation of historic structures before resilience strategies are implemented
- Possible funding through FEMA’s Hazard Mitigation Grant Program

Severe flooding in New Orleans

HIGHLANDS, NEW JERSEY

COLLECTIVE RAISE

Just outside of New York City, Highlands, New Jersey is another area to factor in the importance of relative elevation of historic homes. The town experienced over 80 percent of its homes damaged or destroyed during Superstorm Sandy in 2012. City government decided to raise in tandem. Coastal cities and towns are not unfamiliar with this approach. The question of where and how to rebuild various areas of New Jersey after Hurricane Sandy was a complex one, involving urban density, property values, lifestyles, employment opportunities and significant tourism revenues, weighed against the risk and costs of similar severe weather events in the future. In addition, local development is governed by a dense network of plans and regulations: municipal zoning and master plans; the state's environmental regulations, including those dedicated to water resources and to guiding coastal development; and the ways in which we've directed investments in water, transportation and power infrastructure.

Potential Applications in Miami Beach:

- Coastal location
- Coastal Resilience Plan

A view of Barbarie Avenue in Highlands

Highlands flooding during hurricane Sandy

CHARLESTON, SOUTH CAROLINA

TECHNOLOGICAL SOLUTIONS

The City of Charleston has been exploring options to raise and adapt their historic structures most at-risk of sea level rise and storm surge during hurricane season and king tides. The Board of Architectural Review (BAR) has taken on the task of leading the effort to develop building elevation guidelines for Charleston's historic districts and buildings. One of the options that the guidelines consider and allow for is elevating internal floors within a building, particularly feasible and recommended in historic commercial structures with tall ceilings.

Potential Applications in Miami Beach:

- Coastal location
- Coastal Resilience Plan

House at 42 Ruteledge being raised, Charleston

Raising historic homes, Charleston

4.4 // LANDSCAPE & GREEN INFRASTRUCTURE

HUNTER'S POINT SOUTH WATERFRONT PARK, NEW YORK, USA

GREEN INFRASTRUCTURE

As part of a larger redevelopment of the Hunter's Point area in Long Island City, New York, an 11-acre riverfront park was created in two phases. Providing playgrounds, basketball courts, river overlooks, playing fields, beaches, and passive public spaces, the park was designed to account for future flood patterns of the adjacent East River. The park incorporates green infrastructure and natural landscape materials to provide for more sustainable and resilient local ecology in a former industrial site. Adjacent to the park site is a development of residential buildings that have also incorporated resiliency into their design: elevating mechanical systems and back-up generators, designing exterior ground level doors to receive flood gates, and utilizing a concrete base along the building wall that extends up to flood elevations.

Potential Applications in Miami Beach:

- Elevating the majority of the waterfront park above flood levels
- Elevating new adjacent streets and buildings above flood levels
- Selecting durable materials such as stone walls, stone pavers, and water-resistant wood decking
- Utilizing native coastal plantings in bioswales and stormwater planters
- Porous pavement sidewalks
- Valves and backflow preventers installed on separate storm and sanitary sewers
- Construction of new wetlands for natural stormwater management

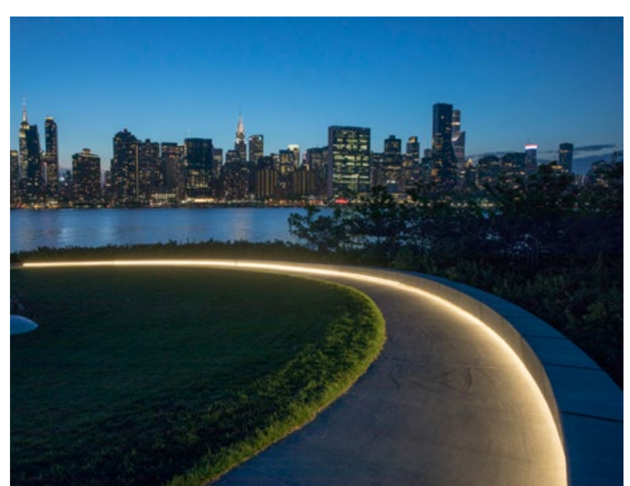


Photo Credit: ARUP

BISHAN ANG MO KIO PARK, SINGAPORE

EMBRACING WATER

Singapore's Active Beautiful Clean Waters Program was developed in 2006 in order to create new community and recreation spaces in association with the country's water system. Resulting from this initiative, the re-imagined Bishan Ang Mo Kio Park provides a model for an ecological park designed to function also as a water management system. [X] The park design renovated the previously channelized Kallang River into a naturalize river system.

The park is designed to flood during storm events, accommodating 40% more stormwater than the previous channel could [XX], while simultaneously creating ecological spaces and habitat, allowing recreational and educational opportunities, and creating social spaces for people to enjoy. [XXX] The design creates amenities and increases ecological benefits in addition to updating the stormwater system

Landscape Architect | Ramboll Studio Dreiseitl

Strategies & Potential Applications for Miami Beach:

- Combining a water management system and ecology with a social function
- Allowing an area to flood temporarily during a storm event

Image Credit: Lim Shaing Han[xxxx]

GOWANUS CANAL SPONGE PARK, NEW YORK, USA

GREEN INFRASTRUCTURE

Gowanus has a rich history. Originally a large, marshy wetland, the area is the site of early Dutch settlement, important Revolutionary War battles, and commercial industrial activity stretching back over 100 years. Now an EPA Superfund site, planners and real estate developers envision the area to be a locus of large residential development — a controversial proposal in light of the area's overburdened infrastructure and highly-contaminated environment. In this context, and working closely with local community organizations, government agencies, and elected officials, DLANDstudio initiated and designed a new kind of public open space called Sponge Park™. The Sponge Park™ design grants equal value to the aesthetic, programmatic, and productive importance of treating contaminated water entering the Gowanus Canal. The Gowanus receives many millions of gallons of combined sewage effluent every year. The park is designed as a working landscape that improves the health of the canal over time. This innovative plan proposes strategies to divert stormwater run-off for use in the public park along the canal, reducing the input of stormwater into the sewer system. The Sponge Park™ Pilot, completed in 2016, manages nearly 2,000,000 gallons of stormwater per annum. Landscape Architect | DLANDstudio

Potential Applications in Miami Beach:

- The Sponge Park Pilot Project's modular system design creates replicable results, leading to cost benefits by significantly reducing the testing and approval process.
- The Sponge Park modular cells are precast concrete and can function at low elevations or within a water body, allowing for tidal fluctuations or salt water to be present.
- The challenge for Miami Beach to use a precast modular green infrastructure planter would be the variable and dimensions of existing built-out neighborhoods.

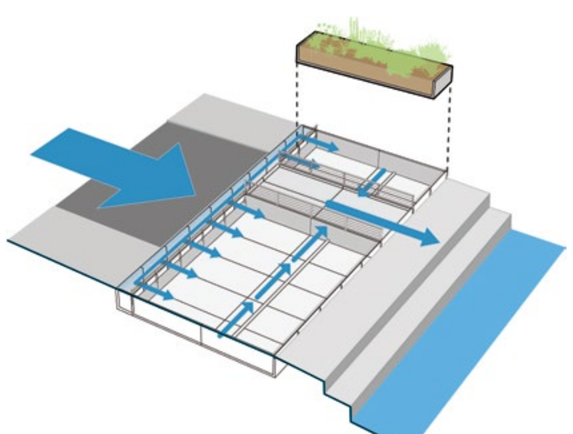


Image: DLANDstudio

Photo: DLANDstudio

PORTLAND GREEN STREETS, OREGON, USA

GREEN + GRAY INFRASTRUCTURE

In 2002, the city of Portland, Oregon was faced with the challenge of combined sewage overflows into the Willamette River violating the Clean Water Act. Portland chose to add green infrastructure to divert stormwater at a fraction of the cost of updating their drainage pipes.[X] The 2005 pilot project, the SW 12th Avenue Green Street Project, includes four green infrastructure planters which were shown to manage nearly all of the SW 12th Avenue's 180,000 gallons of runoff and to reduce the runoff intensity of the 25 year storm by 70%.[XX] As a result of this successful pilot project, Portland's City Council passed a Green Streets Policy in 2007 mandating the removal of 60 million gallons of stormwater annually from the combined sewer system through green infrastructure.[XXX] In 2011 Portland also constructed new grey infrastructure to almost eliminate sewer overflow into the river.[XXXX] In addition to cost saving, street beautification and improved water quality, the green infrastructure slows the storm event peak flow rate, and the decrease in system pressure leads to less basement sewer backups when storm events are larger than the 25 year storm for which the grey infrastructure is designed.[FN]

Potential Applications in Miami Beach:

- Use of stormwater planters to reduce sewage overflow
- Use of gray infrastructure to reduce sewer overflow

City of Portland, OR

4.5 // STORMWATER MANAGMENT

MEXICO BEACH, FLORIDA

FINANCIAL MITIGATION STRATEGIES

The City of Mexico Beach was impacted by Hurricane Michael on October 10, 2018, a Category 5 storm considered to have a return period frequency of 1 in 500 years.[x] The storm surge exceeded +15.5 feet along the coast, with wave crest elevations inland exceeding +20 feet.[xx] A large area of the City has been mapped by FEMA to be an X-Zone, or an area of minimal flood hazard, outside of the 0.2% annual-chance flood (or the 1 in 500 year storm). Yet over 50% of the buildings within the X-Zone were completely destroyed.[xx] Since buildings within an X-Zone are not required to purchase flood insurance, many of those property owners will bear the cost of rebuilding. The City's antiquated building codes, lack of understanding of its vulnerability, gap in available insurance coverage, reliance on the FEMA flood zone mapping, and unavailability of immediate funds profoundly impacts their recovery. Coastal Systems presented recommendations to ensure that the City is structurally and financially prepared, should another disaster strike. And developed Mitigation solutions to limit future damage impacts.

Potential Applications in Miami Beach:

- Compile a database with property values, floor elevations, and flood damage coefficients
- Conduct detailed Coastal and Stormwater flood modeling to understand vulnerability
- Quantify probable damage costs associated with various storm events, now and in the future
- Conduct a benefit-cost analysis of mitigation solutions that will reduce future damage
- Revise building codes to ensure a clear strategy for rebuilding and recovery after a storm event
- Establish policies to ensure a 100% level of insurance coverage
- Understand which amenities, features, and areas the municipality may be willing to give up to protect the community.

Photo Credit: Coastal Systems

CORAL GABLES, FLORIDA

DRAINAGE MANAGEMENT SYSTEM

The City of Coral Gables aimed to improve the public realm in the downtown area of Miracle Mile and Giralda Avenue. With the creation of a civic promenade that would else protect commercial and retail spaces from flooding events. A drainage management system was developed that includes roof and Right-of-Way drainage systems that harvest rainwater for the purpose of irrigation to large planting areas. The system was designed to contain the full amount of water produced by storm events, and treat rainwater on-site within the same space. The roof drainage system is located underneath the sidewalk and parking spaces. The Right-of-Way drainage system is a parallel system; the surface run-off is collected through a continuous 4-inch trench drain over a large-diameter slotted drainage pipe. The implemented drainage management system provided a total amount of rainwater storage that meets Miami-Dade County Department of Environmental Resources Management (DERM) and Florida Department of Transportation (FDOT) requirements for 25-year (3-day) and 100-year (1-day) storm events, respectively.

Potential Applications in Miami Beach:

- Design roof and Right-of-Way drainage management system to retain and store rainfall, and discharge overflow subsequent to flooding events.
- Harvest rainwater for irrigation purposes

Photo Credit: ??

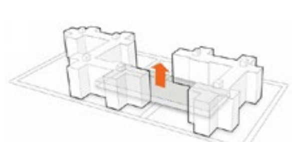
NYCHA RED HOOK HOUSES, NEW YORK

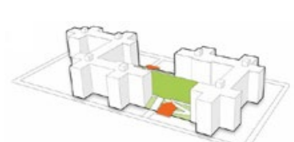
RESILIENCY AND RENEWAL STUDY

Hurricane Sandy permanently damaged the majority of the electrical and heating systems while also causing extensive roof and basement flood damage throughout the 28-building campus of the New York City Housing Authority (NYCHA) Red Hook Houses in Brooklyn, NY. In restoring and redesigning the site, an enhanced sitewide hot water distribution network was developed utilizing a central plant complete with back-up electric generators in case of future power outages. Other MEP and utility equipment upgrades were relocated to new smaller utility buildings constructed above design flood elevations calculated for future storm surges incorporating expected sea level rise. New building roofs and other impervious area directs runoff to underground infiltration tanks that can provide temporary rainfall storage during storm events and then also allow for natural infiltration into the ground. Through a combination of sloped earth, retaining walls, stairs, and ramps, the area between residential buildings was elevated to serve as "lilypads"— a park-like gathering space that will be free from floodwaters and able serve as an active programming area for additional playgrounds, landscaping, and seating.

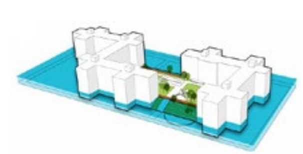
Potential Applications for Miami Beach:

- Increased drainage capacity through new catch basins and renovated drainage system
- Backflow preventers installed on storm and sewer outlets
- Pervious paving used for site pathways, basketball courts, and seating areas
- Key utilities elevated in new raised utility buildings and remaining utilities within basements to be flood protected
- Retention tanks installed for stormwater management and floodwater storage
- Plaza space elevated between buildings
- Passive flood barriers installed for areas that cannot be raised above design flood elevations
- Coordination between buildings and property owners required for a districwide utility system such as shared hot water or electric generation


1. Earth is lifted to median FFE height


2. <5% slopes provide barrier-free access


3. Surface programmed for residents


4. Passive barriers deployed in flood

LESSONS FROM HURRICANE SANDY, NY

LANDSCAPE RECOVERY

In 2012, coastal regions of New York and New Jersey were devastated by Hurricane Sandy. Along the New York City waterfront, parks and surrounding streets were submerged in brackish and salt water. Important case studies at waterfront parks, such as Brooklyn Bridge Park, highlight the major horticultural concern of flushing soils that were exposed to storm surge and salt spray, because salt damages soil structure, ultimately resulting in the loss of water and air availability necessary for healthy soil biology. Salt-damaged soil is also more prone to erosion and causes root loss[1]. After the storm event at Brooklyn Bridge Park while the electricity was still down, water trucks were brought in to spray foliage and flush soils in low-lying lawns and beds. Various salinity-reducing soil additives were also tested although data on these methods is still limited. Using the unfortunate event of a super-storm to test remediation strategies for future hurricanes can turn a potentially devastating event into a teaching opportunity.

Potential Applications in Miami Beach:

- High wind-resistant trees, with low centers of gravity and deep penetrating roots.
- Preventative pruning
- Immediately following a storm, flush soils of plant-toxic salts with fresh water

Image Credit: Allison Joyce/Getty Images


Image Credit: GrowNYC