Designing for Flood Risk focuses on preparing buildings to withstand the threat of coastal flooding, while ensuring that they support everyday livability and quality of life. The devastation wrought in waterfront communities from recent Hurricanes and storm surge has brought a new level of urgency to this work. Flood tolerance is the capacity to remain undamaged and functional when flooded, which requires adapting the built environment to floods.

For a diagram of the Sea Level Rise impact to your community see maps below prepared by Union of Concerned Scientists: (all of maps referenced here are continuously being updated as new data comes in)

https://ucsusa.maps.arcgis.com/apps/MapSeries/index.html?appid=cf07ebe0a4c9439ab2e7e346656cb239

The USA National Oceanic and Atmospheric Administration:

https://coast.noaa.gov/slr/

or climatecentral.org:


How can we ensure that buildings meet higher flood protection standards while preserving the vitality of our neighborhoods?

BASE FLOOD ELEVATION (BFE) the computed elevation in feet to which floodwater is anticipated to rise during the base flood, is the regulatory requirement for the elevation or floodproofing of structures. A building’s flood insurance premium is determined by the relationship between the BFE and a structure’s elevation.

"In the coastal velocity zone ("V zone"), where hurricane storm surge is the risk and wave action is the driving force, you need an open foundation on pilings, which allows
waves to pass below the home’s occupied space. Waves pack an enormous punch—because water is so much more massive than air, a 2-foot or 3-foot wave is far more destructive than the hurricane winds that are pushing it. That’s why a 30-foot surge with high battering waves, like Hurricane Katrina brought in 2005, is able to scrape shorelines clean of buildings" Ted Cushman, Building mag.

We need to develop a flood-tolerant lifestyle based on flood adaptation at the property level:
Parday House near Wargrave: a completed home is raised up on a steel frame, above ground level

- allows the site to flood, protecting from potential damage
- flood water flows freely underneath the building- development does not adversely impact the flood plain as a whole and excess water isn't pushed elsewhere
Beach House Landscape by Dirtwork NJ
Learning lessons from Hurricane Sandy in 2012,

- critical wet-flood proofing measures were incorporated in the design to mitigate heavy flooding, property damage and disruption of vital services
- The flood resilient landscape is built outside the sea wall to prevent soil erosion and to stabilize the natural shoreline
- Native plants, establishing a dense network of root systems, surround the site to help the fragile dunes and create a sustainable, flexible approach to long-term maintenance
- Bioswales are strategically planted to help prevent overwash from flowing directly back to the sea
- They also trap stormwater runoff until it can be safely drained into the soil. Wood decking can temporarily capture runoff and maximize groundwater recharge, a defense against coastal subsidence
- Rising 14 feet above sea level, the residence is accessed through a flood vent that allows for the equalization of pressure from unexpected and rapid surges and flooding.
RIBA competition entry above: flood solution

Permeable paving use in mitigating flash flooding caused by heavy rainfall:
- permeable paving can drain into swales and retention ponds
- reduces the risk of flash flooding by slowing down the flow of rainwater to help to discharge it back to the ground at a reduced flow rate

**Drainage swales to prevent and ease flash flooding from heavy rainfall:**

**Swales** can be part of an area’s natural landscaping, or they can be created to help ensure proper drainage, minimize runoff or capture storm water. In simple terms, they are generally shallow ditches that have gently sloping sides.

- swales are a cost effective and more natural solution to traditional drainage construction
- provide an opportunity to introduce more native species to a site
- the swales can be seeded with a mix containing species suitable for seasonally wet soils

**Green corridors/temporary holding ponds for flood waters:**

**Water Boulevards**, a concept developed in England, creates a network of green corridors to manage and passively reduce flooding, integrating Green Infrastructure and Water Sensitive Urban Design into City streets. It can be applied as a **network of green**
corridors to any city at risk of flooding. Water Boulevards is a project by Baharash Architecture.

[vimeo 120477342 w=640 h=360]

Water Boulevards from Baharash on Vimeo.

Parks as water holding areas:

Parks can be designed to double as a water holding area during a flood event. Parks, designed like this one in Copenhagen, allow recreational areas like skate parks to become temporary holding ponds for flood waters:
Mechanical and electrical equipment protection during flood events:
Mechanical and electrical equipment such as HVAC, boilers, and water heaters should also be relocated above BFE whenever possible. It is important not only to protect the equipment from flood damage, but also to prevent gas and oil from mixing with flood water contributing to other environmental risks.

In flood prone areas the main lines should be run through the ceiling or upper wall then down to switches and outlets set at mid-wall height. Any wiring installed below the BFE must be water-resistant.

Two approaches to floodproofing buildings: Wet and Dry:

Wet floodproofing:
- allows buildings in the flood zone to be designed to allow floodwaters to enter and leave the structure without the use of any mechanical equipment.
- Spaces that are below grade on all sides are prohibited, and the lowest occupiable floor is required to be elevated above the BFE.
- To prevent the collapse of building walls, a wet-floodproofed building allows for the equalization of hydrostatic forces on both sides of the wall during a flood event. This is achieved with openings at the ground level called flood vents see Orla Studios Guide to Flood Vents.
- All emergency exit stairwells and corridors shall be wet floodproofed and designed with hydrostatic openings (flood vents) to maintain the operation of the exit door. Emergency exits must open at grade. Evacuation points from elevated floors are not acceptable as emergency exits.
Dry floodproofing:

- Dry floodproofing makes a structure watertight up to at least the level of the BFE through the implementation of sealants, flood shields, aquarium glass and strengthening structural components to resist hydrostatic forces from floodwaters, and protecting utilities from flood damage.
- Unlike wet floodproofing, the first floor of a dry-floodproofed structure can be at an elevation below grade or below the base flood elevation.
● Through dry floodproofing, building access can be maintained at grade with no apparent differences from a non-floodproofed condition.
● Any of these conditions will generally entail higher construction costs. **Dry floodproofing can present safety hazards during a flood event by blocking egress**, so it is not allowed in entirely residential buildings.
As a fairly common practice in New York City, new mixed-use buildings in A zones have **combined wet and dry floodproofed areas** at the ground floor. With this solution, portions of the building are sealed at the ground floor to keep floodwaters out, **while lobbies and entryways are designed to accommodate flooding**.
New York City and Sea Level Rise

1-in-100 Yr Flood Zones for New York City
with Rapid Ice Melt Sea Level Rise Projections

- Major Roads and Highways
- FEMA Current 1-in-100 Year Flood Zone
- 2020s 1-in-100 Year Flood Zone (9” Sea Level Rise)
- 2050s 1-in-100 Year Flood Zone (27” Sea Level Rise)
- 2080s 1-in-100 Year Flood Zone (53” Sea Level Rise)

Flood and Hurricane proof skyscraper in NYC:
"In American Copper Apartments, (above) developers decided to fortify the two towers with features that would mitigate the effects of a hurricane, including a flood resilient basement and lobby and a park that doubles as a bioswale.

Mechanical equipment that would typically be found in the basement — such as generators, electrical switchgear, and pumps — is on the second floor, above the flood line" writes Lauren Young of Science Friday,
Nearly 2 million people were left without power during the Sandy storm in NYC, and some were living in buildings for no power for a week, the developer of these apartments elected to put things like water pumps, elevators, lights, electrical charging outlets and people’s refrigerators on emergency power generators.

Full article about American Copper: [https://www.sciencefriday.com/articles/building-flood-proof-skyscraper-resilient-climate-change/](https://www.sciencefriday.com/articles/building-flood-proof-skyscraper-resilient-climate-change/)

Helping neighborhood vibrancy when first floors need to be elevated above base flood plain:

- A **planting buffer with shrubs or trees**, combined with other façade treatments such as vertical articulation, can mitigate limited ground-floor activity
- Architectural elements like turns in an entry stair, **porches or decks for one and two family buildings** can mitigate the distance between grade and the first occupied floor of a building, introduce an additional horizontal visual feature
that gives the façade more of a pedestrian scale, and bring “eyes on the street” with a semi-private space closer to the sidewalk.
• Access elements such as stairs and ramps can be integrated into the landscaping to make a more seamless transition from sidewalk to building. Grading should be designed that does not create drainage problems for adjacent properties.

Coastal community planning and development codes need to be updated immediately:

• Planning and zoning could be modified allowing for additional flexibility to raise yards and building heights to resolve the difference between existing grade and BFE, making it possible to resolve the height differential between them.

RESOURCES:

San Francisco has a Model for Grant Assistance for Flood Preparation:
The San Francisco Public Utilities Commission (SFPUC)’s Floodwater Grant Program (“Grant Program”) helps property owners in San Francisco minimize the risk of property damage due to flooding. They encourage Residents to take advantage of the Grant Program which reimburses flood victims who want to install improvements like doorway seals, flood gates or plumbing upgrades to lessen or prevent future flood damage. More info here:


New Jersey Excellent Guide to Resilient Building Design:


For Cities trying to protect Utilities and Wastewater plants, excellent guide from US Environmental Protection Agency:


New York Cities Video about their flood resilience strategies:

[youtube https://www.youtube.com/watch?v=6QJYgm0fRHk]

[youtube https://www.youtube.com/watch?v=cFEJJFsDpvI&w=560&h=315]

Orla Huq

#flood #floodplanning #floodvent #resilientarchitecture #greendesign #sustainable #resilientbuildings #flooddesign #retentionponds #flooding #wetproofing #dryproofing