

CHAPTER 3 RETROFITTING METHODOLOGY

To best understand a building's flood risk and opportunities for adaptation, one must be able to identify the building typology and specific flood risks, the construction methods best suited to protect the structure, as well as the appropriate codes and regulations that control adaptation techniques. The report proposes the following methodology to facilitate informed decision-making.

Broad Channel, Queens



STEP 1 IDENTIFY YOUR FLOOD RISK

STEP 2 IDENTIFY YOUR FLOOD ELEVATION

STEP 3 REVIEW RELEVANT REGULATIONS

STEP 4 IDENTIFY YOUR ADAPTATION STRATEGY

STEP 5 DESIGN YOUR STRATEGY

STEP 2 IDENTIFY YOUR FLOOD ELEVATION

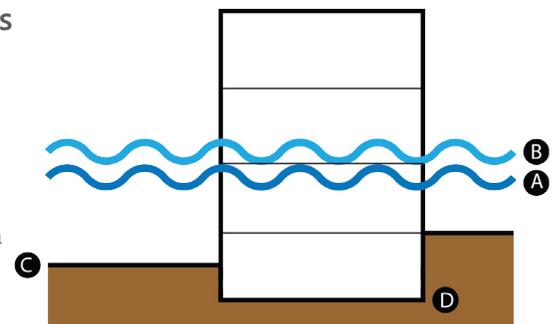
Understanding where your building is in relation to grade and the flood elevation is critical in determining what floodproofing measures must be taken. This involves (1) locating the lowest adjacent grade elevation on your property, (2) the lowest floor of your building, and (3) the Design Flood Elevation (DFE) for your building. The Design Flood Elevation is the elevation at which the lowest occupiable floor must be located or the height to which dry floodproofing must be installed.

The Design Flood Elevation is calculated by adding Freeboard to the Base Flood Elevation noted on the FEMA flood maps. In New York City, the Building Code requires that buildings apply “Freeboard” to their base flood elevation to include an additional margin of safety to protect against more severe storms and increased future flood risks from rising sea levels. Freeboard is one foot for commercial and multi-family buildings and two feet for single- and two-family buildings.

The most effective way to identify the flood level of a building is to obtain an Elevation Certificate from a professional engineer, architect or land surveyor. An Elevation Certificate officially documents the building’s elevation and its relationships to the Base Flood Elevation. It is one of the key documents to provide in order to purchase flood insurance and it provides all the basic critical information to determine the appropriate retrofit strategy.

Determine critical elevations for your building

- A** Base Flood Elevation (BFE)
- B** Design Flood Elevation (DFE)
=BFE + Freeboard
- C** Lowest Adjacent Grade Elevation
- D** Lowest Floor Elevation



STEP 3 REVIEW RELEVANT REGULATIONS

Regulatory Tools

Knowing the codes and regulations at the federal, state and local level will structure your approach to retrofitting for resiliency. Flood retrofitting design and construction is regulated by FEMA’s FIRMs, State and City building code, as well as City zoning regulations and other local laws. FEMA sets standards for floodplain management at the federal level, which is enforced through state and local regulations. FEMA also administers the NFIP. In order for homeowner and property owners in the city to receive flood insurance as part of the NFIP, the City is required to adopt these federal standards into its building code. Local standards are also required to be as stringent as state codes. At the state level, the New York State Department of Environmental Conservation (DEC) is the State Floodplain Administrator.

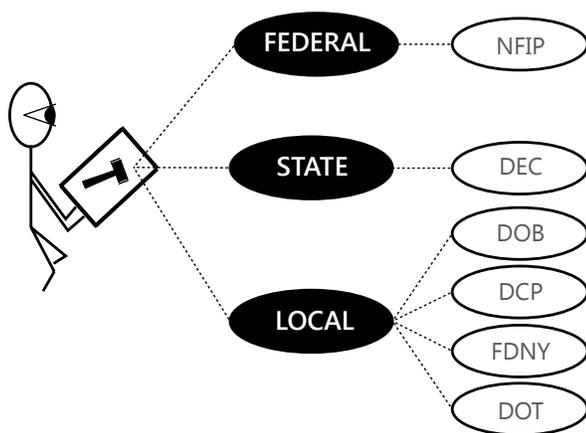
At the local level, The New York City Department of Buildings is designated as the City’s Floodplain Administrator and is tasked with enforcing Appendix G of the NYC Building Code, which prescribes standards for flood-resistant construction in accordance with federal mandates. On January 31, 2013, the New York City Building Code was updated to match New York State standards for flood protection. And in October 2013, the Department of City Planning updated its Zoning Resolution with a Flood Resilience Zoning

Text Amendment to remove regulatory barriers that hinder or prevent the reconstruction of storm-damaged properties in compliance with the NYC Building Code. The amendment enables new and existing buildings to comply with new, higher flood elevations issued by FEMA, and to new freeboard requirements in the New York City Building Code. Constructing to these new standards reduces vulnerability to future flood events, as well as helps property owners avoid higher flood insurance premiums. The zoning text amendment also introduces regulations to mitigate potential negative effects of flood-resistant construction on the streetscape and public realm.

Threshold For Compliance

One of the most important factors in identifying retrofitting strategies is to determine whether a building is Substantially Damaged or Improved. A building is considered substantially damaged when the cost to repair or restore the structure to its pre-damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred. Additionally, even if the home is not substantially damaged, if the cost of improvements to the property, including any repair, reconstruction, rehabilitation, or addition to a building equals or exceeds 50% of the market value before the improvement starts, the building is considered Substantially Improved. If the building falls within either of these definitions it must be completely brought up to current flood resistant construction standards set forth in Appendix G, as well as other requirements of the NYC Building Code. If a building is not Substantially Damaged or Improved, it has access to many more options for mitigation. But these strategies may not reduce flood insurance premiums and may not offer full protection.

Understand how Federal, State and City floodplain regulations impact your options



National Flood Insurance Program

Flood insurance costs are expected to rise for homes that do not meet the resiliency standards set forth by the National Flood Insurance Program (NFIP), which is administered by FEMA. Homeowner and property owners of buildings in the 100 year floodplain with a mortgage from a federally insured bank are mandated by law to buy flood insurance. Buildings receiving subsidies

as part of a federal housing program are also required to carry flood insurance. Recent reforms to the NFIP that reduce subsidies to homeowner and property owners will cause premiums to increase significantly. The cost of flood insurance for residential buildings is based on a number of factors, one of the most important of which is the distance between the lowest occupied floor and the Base Flood Elevation (BFE). Therefore, it is advantageous, in terms of insurance cost, to have the lowest occupied floor above the BFE. Locating critical systems above the BFE can also provide a premium reduction, but the savings are greatest only when combined with elevation. For buildings that are not substantially improved, retrofitting is at the discretion of the owner.

If a residential building is substantially damaged, or improved, it is required by the NFIP to fill sub-grade spaces to the level of the lowest adjacent grade. For building typologies with one or more shared party-walls, this will result in a challenging retrofit strategy. NFIP regulations restrict the use of residential areas located below the BFE, and the NYC Building Code restricts uses below the Design Flood Elevation (DFE), to building access, crawl space, storage, and vehicular parking for new and substantially improved structures. For residential buildings, appliances, heating and cooling equipment are not allowed below the DFE.

The Role Of The Fire Code

The New York City Fire Code is a City law that establishes fire safety requirements for buildings. Depending on the height of the home, its occupancy, and the width of the street on which it is located, sprinklers may be required. In some circumstances, exceptions to some Fire Code requirements can be requested when elevating an existing building, but it is at the discretion of the New York City Fire Department.

Other Considerations

Depending on the specific circumstances of the property and retrofitting strategy, other agencies with relevant codes may need to be involved, as well. For example, if the property is within a Historic District or is a designated landmark, the NYC Landmark Preservation Commission (LPC) would need to review the proposed project. Similarly, listing on the National or State Registers of Historic Places makes some structures exempt from certain NFIP standards, but these should be reviewed in coordination with LPC and the State Historic Preservation Office. There are also relevant State regulations, such as the Coastal Erosion Hazard Area and Wetland Regulations, which may prescribe specific requirements in certain areas. If some of the features of the retrofit strategy encroach in the public right-of-way, the NYC Department of Transportation would need to get engaged and a revocable consent may be needed. If a property needs to connect to existing sewer infrastructure, a permit with the Department of Environmental Protection may also be necessary. Finally, if a building contains rent stabilized or other subsidized units, and the retrofit strategy involves making significant changes to these units or removing some, it will be important to check the appropriate housing subsidy program rules.

STEP 4 IDENTIFY YOUR MITIGATION STRATEGY

Floodproofing Measures

To provide guidance, regulatory agencies divide retrofit strategies into four categories: Relocate, Elevate, Wet Floodproof and Dry Floodproof. These strategies address designing for resiliency through location and use of structural systems (the superstructure and the foundation), critical systems (mechanical, electrical and plumbing systems) and materials. FEMA's Building Science division provides technical design guidance for all categories of floodproofing construction standards through various publications, such as the *Engineering Principles and Practices of Retrofitting Floodprone Residential Structures*, *Floodproofing Non-Residential Buildings*, *Coastal Construction Manual*, *Reducing Flood Losses through the International Code Series* and other resources. Refer to <http://www.fema.gov/building-science> for the support documents appropriate to different mitigation strategies.

Use is a key determinant in identifying retrofit strategies. Under current federal standards, residential buildings are not allowed to dry or wet floodproof habitable spaces. Commercial uses are not allowed to be wet floodproofed. Factors such as technical parameters, code requirements, cost, homeowner preference, urban design and are also key elements in identifying appropriate retrofitting measures. Property owners should consult a structural engineer or design professional to verify which retrofit strategy is appropriate for their structure.



RELOCATE

This measure can offer the greatest security from flooding but may be impossible to achieve in dense, historic urban centers like New York City. Finding a site to relocate outside the floodplain on the existing lot or to relocate the building to an entirely different lot is rarely a viable option.



ELEVATE

Elevation of Structure

Elevating the lowest occupied floor of a building above the Design Flood Elevation (DFE) is a widely recognized best practice. This can be accomplished by lifting the existing superstructure or by relocating the lowest floor to above the DFE if the floor to ceiling height is sufficient. The most critical steps to elevating the superstructure involve construction of a new foundation. When elevating a building, areas below the DFE can be used only for vehicular parking, building access, crawl space and storage. Equipment, utility connections and all interior utility systems including ductwork must be relocated above the DFE.

In New York City, elevation is likely a limited strategy because of the pre-existing adjacencies and structural challenges related to the building typology. Because the uses under the lowest occupied floor are very limited, elevation also challenges New York's traditional relationship between buildings and the street, potentially resulting in safety and urban design issues. These particular urban challenges will be discussed later in more details. However, within the existing federal framework for building resiliency, elevation offers the benefit of reducing risks and flood insurance premiums.

PROS	CONS
<ul style="list-style-type: none">Reduces flood insurance premiumsReduces risk to structure and contents by providing complete protection against water damage	<ul style="list-style-type: none">Difficult or infeasible for semi- and attached buildingsIs expensive, sometimes more expensive than the value of the buildingRequires temporary relocation of inhabitantsMay have adverse impacts on streetscapeRequires new access

Fill Basement and or Cellar (non-structural elevation)

Related to structural elevation, filling a sub-grade basement or cellar of certain building types can achieve the same effect as structural elevation from an insurance standpoint, without some of its disadvantages. This strategy may need to be combined with the elevation of utilities and mechanical systems. A significant drawback is the loss of floor area resulting from the filling, which can make a notable impact if the space was occupied or generated rental income. When filling a sub-grade space that has one or more party-walls, consideration of impact on the adjacent property must be given. This strategy is most effective when the DFE is at or below the first occupiable floor.

PROS	CONS
<p>Reduces risk</p> <p>Can have limited impact on neighborhood fabric</p> <p>May provide reduced insurance premiums</p>	<p>May result in loss of floor area in basement; loss of parking; loss of income from rental unit</p> <p>Depending on neighbor's strategy, may create problems of hydrostatic pressure if building shares walls with adjacent structures</p> <p>Significant cost required to protect against hydrostatic pressure located in high water table</p> <p>Existing foundation may settle or fail due to surcharge associated with fill placement</p>

Abandon Lowest Occupied Floor and Wet Floodproof (non-structural elevation)

Similar to filling sub-grade spaces, elevation may be achieved by filling the below grade space and abandoning the remaining occupiable floor(s) below the DFE. If this strategy is taken, all enclosed spaces below the DFE and at or above grade must be wet floodproofed.

Elevation of Critical Systems

Elevating mechanical and plumbing systems, electrical utilities and other building system components increases a household's overall resiliency to flooding by reducing the amount of time before key systems are operational again after a flood.

PROS	CONS
<p>Reduces cost of repairs when flooding occurs</p> <p>Reduces the time it takes to get back home after a flood</p> <p>Depending on configuration, can be easy to implement as compared to other adaptive strategies</p> <p>Provide minimal credits for flood insurance policies</p>	<p>May result in loss of usable space</p> <p>Significant costs may be associated with complying with code provisions and required structural reinforcement</p> <p>May require temporary relocation of inhabitants</p>



WET FLOODPROOF

As stated in FEMA *Engineering Principles and Practices*, wet floodproofing may be used for structures that cannot physically be elevated, such as buildings with shared bearing walls. It entails allowing floodwaters to enter and exit the building in order to equalize hydrostatic pressure, reduce the danger of buoyancy from hydrostatic uplift forces, and limit damages to the structure and finishes. Utilities, controls and equipment must be elevated above the DFE. Such measures may require alteration of a structure’s design and construction, use of flood-resistant materials, adjustment of building operations and maintenance procedures, and relocation and modification of equipment and contents. The design should address how the required number of openings and their locations will be achieved since openings need to be installed on at least two sides of the building.

Uses permitted within wet floodproofed construction are limited to vehicular parking, crawl space, building access and storage. To limit the loss of useable floor area, the Flood Resilience zoning text amendment permits building owners who wet floodproof their ground floor to add an equivalent amount of space above the DFE within the existing zoning building envelope. Wet floodproofing commercial spaces is prohibited.

Openings for water penetration and exit must be engineered according to ASCE 24 requirements. A minimum of two openings is required for each enclosed area below the DFE, to be installed on at least two sides of each enclosed area. Each opening must be located no higher than one foot above the grade immediately under the opening. If interior grade is different from exterior grade, reference for the placement of the opening is taken from the higher of the two.

PROS	CONS
<ul style="list-style-type: none"> Can be combined with other adaptive measures to drastically reduce damage from flooding Accounts for hydrostatic pressure May be inexpensive 	<ul style="list-style-type: none"> Can mean loss of useable floor area May be difficult to retrofit existing structures to meet wet floodproofing requirements May have adverse visual impact on streetscape



DRY FLOODPROOF

Dry floodproofing involves making a building, or an area within a building, substantially impermeable to the passage of water. This translates to no more than 4 inches of water accumulating during a 24 hour period. Dry floodproofing of residential buildings or dwelling units within non-residential buildings is prohibited.

Buildings in poor structural condition may not be able to be dry floodproofed as this technique would put extreme pressure on exterior walls during a flood and cause structural failure. In general, dry floodproofing techniques are challenging and costly to implement. All buildings require an assessment to determine their structural integrity relative to the site’s DFE.

Several measures need to be implemented to dry floodproof a building:

- Strengthening the foundation, floor slabs and walls to resist hydrostatic loads and buoyant forces
- Installing backflow preventers
- Applying a waterproof and impermeable coating or membrane to exterior walls
- Sealing all wall penetrations including windows, doors and locations where utilities enter the building
- Strengthening walls to withstand flood water pressures and flood debris

Although FEMA does not recognize dry floodproofing as an acceptable strategy for residential structures, it can be appropriate for commercial uses, building access in existing mixed residential and commercial use buildings, as well as for community facility use.

PROS	CONS
<p>Can have limited impact on building design and neighborhood fabric</p> <p>Can provide reduced insurance premiums for some uses</p> <p>Can be combined with other adaptive measures to reduce damage from flooding</p>	<p>May be costly as it requires a structural retrofit</p> <p>Not approved for new or substantially improved residential buildings</p> <p>Need to account for flood waters entering through shared structural walls</p> <p>Wood frame buildings may not be able to withstand dry floodproofing</p> <p>Building may require structural reinforcement to accept flood load pressure</p> <p>All means of egress that are blocked must be replaced with alternate means of egress above the DFE, making this option extremely challenging for many urban properties located at or close to the lot line and/or with narrow streetwalls</p>

Deployable flood barriers

Deployable flood barriers in windows and doors are often considered part of a dry floodproofing approach. To be compliant with the NYC Building Code, flood barriers must be integrated within the building structure. Freestanding flood barriers that can be deployed around an entire site or group of sites to achieve protection beyond the site are categorized as “active” floodproofing measures because they require human intervention. They are currently not allowed for new or substantially improved buildings and result in lesser flood insurance premium reductions than passive flood barriers that are part of the structure of the building.

PROS	CONS
<p>May have limited impact on building’s structure and appearance</p> <p>May be less expensive depending on the structure and site conditions</p> <p>Can be combined with other adaptive measures to reduce damage from flooding</p> <p>May be applied at block-scale</p>	<p>Not approved by FEMA for residential buildings</p> <p>Can cause structural damage if not correctly sized for exerted loads or capacity of existing building</p> <p>Does not protect against water penetrating from adjacent buildings or through sewer systems</p> <p>Protects against short-term flooding only</p> <p>Requires advance notice of coming floodwaters and installation expertise, time, expense</p> <p>Vulnerable to human error since barriers require a set up in advance of a flood event</p> <p>Most flood barriers require a storage space within or close to the building</p>

STEP 5 DESIGN YOUR STRATEGY

When designing a retrofit strategy, several criteria must be taken into account to inform the decisions. *Technical Criteria* relate to the buildings skeleton and organs, in other words, what makes it stand and operate. *Urban Design Criteria* relate to the character of the building and its relationship to the public street, its neighbors and the neighborhood as a whole.

Identify the physical and operational characteristics to inform design decisions and best practices

Identify building type



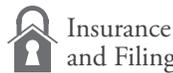
Select approach

Substantial Damage
Substantial Improvement



Alternative
Strategies

Assess Feasibility



Insurance
and Filing



Individual or
Communal



Fees and
Construction Cost

TECHNICAL CONSIDERATIONS

A building is a structure divided into two distinct elements, the superstructure and the foundation. For a building to withstand dead and live loads, there must be a continuous load path from the roof through the superstructure to the foundation. The structure alone does not make a building complete. It relies on its critical systems to function. Mechanical, electrical and plumbing systems are the foundation of the critical systems. Enabling an inhabitant to stay in a structure depends on the continuous function of the critical systems to provide them with access to food, water, and heat while the structure provides them with shelter.



STRUCTURAL SYSTEMS

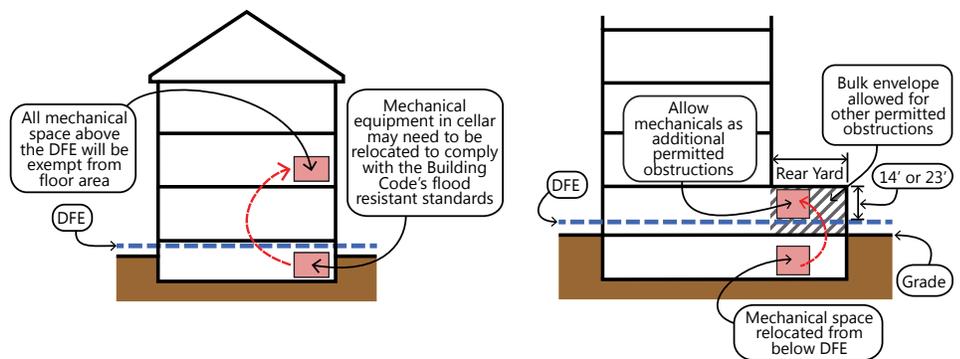
Physical characteristics associated with structural systems serve as predictors for flood damage. Sandy demonstrated that buildings tied to sub grade foundation and especially masonry structures can resist flood impact loads significantly better than other structures. In addition, many buildings in the floodplain are either attached (sharing one or both structural bearing walls) or mid to large scale detached structures. These building types are sufficiently heavy and connected to their foundations and thus suffered little to no structural damage. Much of the damage to this type of building was to interior finishes, critical systems and contents. The *FEMA Mitigation Assessment Team (MAT)* report concluded that few major structural issues related to damage of basement and sub-grade areas were encountered during Sandy. The structural integrity of foundation and masonry buildings was an important consideration to the development of alternative adaptation measures for the case studies. The buildings that are most vulnerable to flood damage, and that comprised the majority of structural failures during Sandy, are one story combustible structures such as bungalows and small detached homes.



CRITICAL SYSTEMS

Like organs to the body, building systems are critical to the everyday functioning of any building type. As stated in the FEMA MAT report, these systems include Mechanical, Electrical, and Plumbing (MEP), elevators, emergency power systems, fuel tanks, sump pumps and other related equipment such as communication and alarm systems. The inundation of critical systems can cause the building to be uninhabitable or to have limited functionality for weeks or even months. This in turn poses significant risk to the occupants of the buildings, especially vulnerable populations such as the elderly and people with disabilities. Many buildings that did not incur substantial damage during Hurricane Sandy did experience damage to the building's systems such as furnaces, boilers, water heaters, and electrical panels.

Building systems are often placed, or centralized, on the lowest floor of the building (often sub-grade) due to building code requirements or simply because the upper floors are more desirable for occupiable or rentable space. Appendix G of the New York City Building Code requires that all new and substantially improved buildings locate utilities and equipment at or above the DFE as specified by ASCE 24, Table 7-1, or be designed, constructed, and installed to prevent water from entering or accumulating within the components. A description of the most common elements of critical building systems found within New York City low to medium density residential and mixed-use typologies is found in the appendix section of this report as well as Appendix I of the Building Code.



Although it is not required for buildings that are not substantially improved, FEMA recommends that all buildings elevate critical utility systems to the BFE or higher. If space on a higher floor is not available, NYC Building Code allows equipment to be relocated to a platform as part of an addition to the building. If equipment cannot be relocated above the DFE it should be raised as high as possible in its current location and protected from water inundation by code compliant encapsulation techniques. For additional information on mechanical specifications, refer to the New York City Building Code. The Department of City Planning's recent Flood Resilience zoning text amendment provides additional flexibility for the location of such equipment.

Due to the unique nature of each system and its relation to the physical structure of the building, careful consideration must be taken to the particular approach to mitigate flood risk through location of the critical systems. This is especially important in dense environments like New York City where additional structural loads, clearance and ventilation requirements and/or loss of usable space may have other repercussions on existing systems as well as on the economic viability of the building. Relocating critical systems can be an opportunity to also upgrade systems and improve energy efficiency.

COST CONSIDERATIONS

Cost will be an important consideration in the design process for retrofitting buildings. In addition to the construction costs and fees associated with the different professionals, often including structural engineers, who will be involved, property owners may be faced with the loss of usable square footage. The loss of floor area related to the wet floodproofing of the ground floor and the inability to replace basements, cellars or ground floor spaces may be a severe challenge, especially for homeowner and property owners who need rental income to support their mortgage payments. However, retrofitting a building will decrease flood insurance rates and increase the resale value of the building.

URBAN DESIGN CONSIDERATIONS

Retrofitting buildings to better withstand extreme weather is essential, but it shouldn't come at the expense of a vibrant streetscape. Mitigating the potential negative impacts of some retrofit strategies and thinking of the building within the context of its immediate environment and the public realm is critical to ensuring the continued vibrancy of the community. This is especially important in historic and dense urban environments like New York City with strong and cherished neighborhood characters.

The Department of City Planning, in its 2013 *Designing for Flood Risk* report and Flood Resilience zoning text amendment, has outlined key urban design principles for designing buildings in a floodplain. They are detailed in four categories: use, access, parking and streetscape and visual connectivity.



DUMBO, Brooklyn



USE

Buildings often contribute to the character of a place by offering human-scale architectural elements associated with their use, particularly on the first floor. When buildings are elevated and the area below the building is wet floodproofed — in which case, the use below the DFE is converted to crawl space, parking, access, or storage — the result may be blank walls at grade. Using screening, landscaping and/or other creative design solutions can help mitigate these issues.



Broad Channel, Queens



ACCESS

Inviting access and enhanced connectivity must be provided when relocating access points. Due to new flood-resistant construction standards, first floors in the floodplain will typically be elevated above sidewalk grade and, if spaces are reconfigured, access points may need to be added, removed, or reconfigured. This elevation results in longer stairs or ramps, and the potential need for lifts. Where dry floodproofing is allowed, doorways at grade and window openings below the DFE will need to be protected by temporary flood barriers erected before a storm event, or be constructed with impermeable materials.

Elevated buildings pose challenges for accessibility. Ramps can be difficult to accommodate, particularly on smaller lots. Even smaller buildings that are not required to meet Americans with Disabilities Act (ADA) standards, have the challenge of integrating longer runs of stairs into building or landscape design.

Where possible, building entrances should be located as close to the sidewalk level as possible in order to provide visual and physical connectivity to the street. The Flood Resilience zoning text amendment encourages the placement of stairs and vertical circulation within the building by exempting such space from counting towards floor area.



PARKING

The location of parked vehicles and curb cuts has the potential to disconnect the visual and physical continuity of the streetscape and to adversely affect the pedestrian experience. To minimize these impacts, designers should locate parking, garage entries, and curb cuts strategically. If ground-level parking is the only feasible option, then garage doors and curb cuts should be designed to minimize their impact on the pedestrian realm. For instance, if possible, a garage door should be set back underneath a porch rather than projecting to the face of the building. Where parking is provided underneath a building, it should be screened from view on the street.



STREETSCAPE & VISUAL CONNECTIVITY

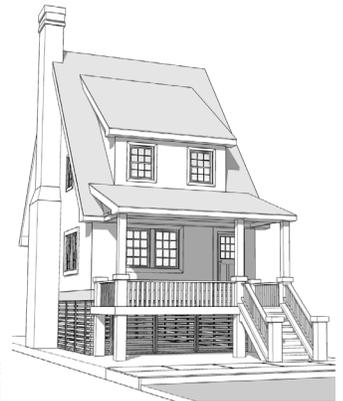
Ground-floor level windows and doors facing the street have been historically prevalent features of buildings in New York City and can create a sense of security and comfort for pedestrians. These architectural elements also provide visual interest, which in turn promotes a walkable, vibrant neighborhood. Elevating the first floor of a building can limit this visual connectivity. When elevating buildings in residential neighborhoods, designers should consider adding elements that enhance visual connectivity to the street. In accordance with the above principles, the New York City Zoning Resolution requires homes to provide specific streetscape mitigations such as planting along the streetwall, open or covered porches, stair turns, or raised yards.



Landscape Plantings



Stair Turn



Covered Porch

The addition of these elements can help mitigate the visual disconnection caused by elevating buildings and help preserve the safety, comfort, and visual interest of the streetscape. On commercial streets, this visual connectivity, in addition to physical access, is important to the viability of retail. Where dry floodproofing is feasible, the commercial space can remain at sidewalk level. Where it is not feasible, but retailers are interested in either elevating their first floor or moving to a second floor, designers will need to find new ways to maintain visual access and engagement between the inside of the building and the sidewalk, while providing the necessary physical access.

Neighborhood Character

As the building stock in New York City's floodplains becomes more resilient, the form of neighborhoods will change. However, this change in building height and first floor elevations does not have to mean that neighborhoods will lose their sense of character. Designers should respect a neighborhood's character by taking cues from the existing context and built form including fenestration, rooflines, and other architectural elements. Most of all, they should get to know the place and its people to design a building that suits the neighborhood, while meeting the standards of flood protection.

SHORT-TERM ADAPTATION MEASURES

Developing a retrofitting solution that works for the unique conditions of each building will take time, effort, and money. However, it does not mean that homeowners and property owners cannot take the small but significant steps to learn more about assessing their risk and adapting their buildings. Below is a summary of best practices assembled by FEMA and New York City's Office of Emergency Management (OEM). Many of these best practices can be found in FEMA *Flood Preparation and Safety*, released in 2008 and FEMA P-312 *Homeowner's Guide to Retrofitting 3rd Edition*, released in 2014.

Determine your risk

The most important step a homeowner can take is understanding their building's flood risk. Getting an elevation certificate, which contains an accurate determination of Floodplain and BFE; ground elevations adjacent to structure foundation; and elevation of lowest floor, lowest occupiable floor, and mechanical equipment, is a significant first step. The certificate must be completed by a land surveyor, engineer, or architect who is licensed by the state of New York and is required by the National Flood Insurance Program to certify the reference level of a specific building within a floodplain for insurance rating purposes.

Understand your insurance needs and purchase requirements

Flood damage is not covered by a basic homeowner's policy. Homeowner and property owners can protect their home by purchasing flood insurance. Most insurance is provided through the federal government's National Flood Insurance Program (NFIP) and goes into effect 30 days after purchase. To estimate your premium, or learn more about flood insurance, visit the NFIP's website, www.floodsmart.gov.

Homeowner and property owners in the 1% annual chance floodplain with a Federally-backed mortgage are required by law to purchase flood insurance.

Keep good records of your possessions

In the event of a flood, insurance providers require property owners to provide documentation to justify their claims. New Yorkers living in the floodplain should keep copies of their most important documents (mortgage papers, deed, passport, bank information, vehicle titles, and receipts for major appliances) in a secure place outside the home and the floodplain. Taking photos of valuable possessions and keeping receipts for any expensive household items are also important.

Elevate service equipment to minimize damage

If elevating critical systems is not feasible in the short term, homeowner and property owners can try to elevate service equipment installed outside the building, such as an electric meter or incoming electric, telephone, and cable television lines. These can generally be installed on the same wall at a higher level. When moving electrical panels to an elevation above the lowest floor, additional components, such as a service disconnect, may need to be incorporated into the system to meet the requirements of the National Electrical Code. Equipment typically placed on the ground (e.g., air conditioning compressors, heat pumps) can also be raised above the DFE on pedestals or platforms. Inside the home, raising the main electric switch box is also a good idea.

Install backflow valves to prevent reverse-flow flood damages

When flooding occurs, it can inundate and overload sanitary sewer systems, combined sanitary/storm sewer systems, and lead to water entry in buildings through sewer lines, toilets or drains. The best solution to this problem is usually to install a backflow valve. These valves include check backflow valves, which prevent water from flowing back into the home. In order to perform, valves must be inspected regularly and cleaned as necessary. It is also recommended to try to keep storm drains clear of debris to facilitate the flow of water during a flood.

Minimize structural damage from heavy equipment

In the event of a flood, structural damage to a building can be caused by heavy equipment dislodging and moving within or outside the house. To avoid these issues, washing machines and dryers can be elevated on masonry or pressure-treated lumber at least one foot above the projected flood level. If this is not possible, heavy equipment or furniture should be anchored to the home as much as possible. Anchoring the fuel tank by running straps over it and attaching the straps to ground anchors is a good option.

Coastal flooding in New York City is generally predicted, giving time to homeowner and property owners to prepare their home. When a flood event is announced, homeowner and property owners will reduce flood damage by moving essential items or large furniture and equipment to an upper floor, bringing outside furniture inside the home and driving their car to higher ground, outside of the floodplain.

Follow evacuation procedures

Retrofitting and resiliency strategies are designed to protect buildings and their contents, not lives. The most important decision residents living in the floodplain need to make must be based on life safety. That means strictly follow evacuation procedures. OEM's Know Your Zone campaign and website (http://www.nyc.gov/html/oem/html/get_prepared/know_your_zone/knowyourzone.html) provides New Yorkers with a template for flood emergency evacuation. Every resident living in the floodplain should be familiar with these best practices and have a plan.

Adapting to flood risk is a long process. Education and an understanding of risks and best practices is essential in increasing preparedness. To learn more, refer to <http://www.ready.gov/floods> and http://www.nyc.gov/html/oem/html/ready/flooding_guide.shtml.