ELEVATING HISTORIC BUILDINGS TO PREVENT FLOOD DAMAGE

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Session H3-Moss
A. Use Hazard Mitigation design principles to prevent damage to Historic Buildings from future disasters, and still maintain their Historic integrity.
C. Use National Flood Insurance regulations to reduce costs for flood insurance.
D. Compare costs of post-hurricane repairs of elevated versus non-elevated structures.
E. Good and Bad Examples of Elevated Houses
F. How to "Elevate" Row-houses and commercial Buildings.
H. Structural Considerations.
I. Flood Panels & Flood Vents.
J. Water-Repellent Materials
We are currently experiencing the age of the Superstorms, starting with Hurricane Sandy in 2012. In 2017, we saw Hurricane Harvey hit Houston, Texas:
Hurricane Irma in Florida & the Caribbean 2017
Notice the surviving elevated houses behind the scattered two-by-fours of demolished houses.
Hurricane Maria
Puerto Rico 2017
2017 hurricanes cost over $200 billion

The $200 Billion figure has increased since this image was downloaded in late 2017.
This is a relatively new house, but what they did could be applied to almost any building constructed in the possible path of severe storms: 40’ deep pilings, walls & roof of reinforced concrete, breakaway siding & stairs, hurricane-resistant windows, sealing the doors before storm landfall.
“Climate change and rising sea level mandate a new kind of assessment of the vulnerability of historic resources, requiring stakeholders to look at adaptation options and to decide what will be saved for future generations.

The concept of preservation has been that historic buildings should be kept intact, and in place. Unfortunately in many places, that tenet will be directly challenged by rising sea level; the most dramatic effect of changing climate.

The full scenario will play out over decades and centuries, but now is the time to reassess what needs to be preserved and to align the resources.”

John Englander, in ForumJournal, Summer 2015 | Vol. 29 No. 4
A. BASIC PRINCIPLES OF HISTORIC ELEVATIONS
How to elevate historic properties to avoid or minimize damage in the next flood or hurricane and to retain their historic characteristics

1. Retain the scale of the original house when building the new elevated portion.

2. Make the elevation height as small as possible.

3. Disguise the height of the elevation with landscaping and by raising the grade at the foundation wall.

4. Add flood vents, fill basement up to grade level to create crawl space, move utilities to an upper level.

5. Three feet of smooth foundation wall surface (concrete, block, stucco) is acceptable visually, but any foundation greater than that should be covered with the same material as the upper body of the house.

6. A one-story porch, at grade level, can usually be added to provide a visual transition from the elevated house to the ground level.
Good examples look like this:
Good examples:
Notice the use of Latticework under the porches
Good examples
The following are good examples of how to elevate historic properties, and what the State Historic Preservation Office is looking for from the applicants and their Architects & Engineers.
4’-4” from top of grade to top of first floor
Original

Elevated
ELEVATIONS OF ROWHOUSES

You should not “elevate” rowhouses or commercial buildings as you would a detached single-family house. Rowhouses are separately-owned but attached to their neighbors, often with shared structural walls. To physically raise one of several units that is connected to the units on each side would be extremely expensive, and you may damage the other units in the process.

The correct elevation process is as follows:
1. Abandon the lowest (basement) level, which is usually below the street level. This will now be a Crawl Space. Fill the Crawl Space up to the outside grade with gravel, flowable fill or concrete.
2. The lowest occupied level (First Floor) would then be several feet above the street level, and usually above the Base Flood Elevation (BFE).
3. Relocate all the utilities to an upper level (first floor, attic, roof).
4. Allow flood water to enter and exit crawl space by installing breakaway windows and doors or flood vents.
6. With no change to the exterior appearance, you have made the house flood-resistant, with little or no damage during the next flood event.
Bad examples of Rowhouse Elevations look like this:
ELEVATIONS OF COMMERCIAL BUILDINGS:

“Flooding is an ongoing part of life in the riverside town of Darlington, Wisconsin. Following the devastating damage from the 1993 floods, the town could follow one of the three routes: do nothing and continue to suffer the periodic floods; move the central business district out of the floodplain and upset the local economy and sense of community; or do something innovative. The town took advantage of the very high ceilings common to many of the older buildings. Their height allowed first floors to be elevated out of flood danger with minimal impact to other historic features.”
ELEVATIONS OF COMMERCIAL BUILDINGS:
Basements were filled with sand and gravel, floodproofing that portion of the building most vulnerable to flooding, and all utilities were upgraded and raised to upper floors or roofs. All these measures were implemented without altering the exteriors or disrupting the historic integrity of these older buildings.
Comparison of hurricane damage to elevated and non-elevated structures:
The two adjacent properties in Louisiana were damaged during Hurricane Isaac (Aug, 2012).
House on the left: The slab-on-grade house was severely damaged. High winds caused roofing loss, and 5 feet of flood water damaged interior and exterior finishes.

House on the right: Elevated wood-frame house, built on masonry piers, received minor damage. Damage was limited to the exterior finishes, some roofing loss by wind. Water did not reach the first floor. Estimated damages based on depth-damage functions are included in Table 5-1.
<table>
<thead>
<tr>
<th>Description</th>
<th>Flood Depth Above Lowest Floor (feet)</th>
<th>Estimated Damages*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab-on-Grade</td>
<td>5</td>
<td>$148,243</td>
</tr>
<tr>
<td>Elevated</td>
<td>&lt;0</td>
<td>$4,000</td>
</tr>
</tbody>
</table>

* Assumes 1,600-square-foot residence with building construction cost of $100 per square foot.
One House damaged during Hurricanes Katrina (2005) and Isaac (2012)

Table 5-2: Estimated Katrina versus Isaac (pre- versus post-elevation) Damages at Lakeshore Drive Property

<table>
<thead>
<tr>
<th>Description</th>
<th>Flood Depth Above Lowest Floor (feet)</th>
<th>Estimated Damages*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab-on-Grade</td>
<td>5</td>
<td>$162,643</td>
</tr>
<tr>
<td>Elevated</td>
<td>&lt;0</td>
<td>No observed damage</td>
</tr>
</tbody>
</table>

* Assumes 2,000-square-foot residence with building construction cost of $100 per square foot.
National Flood Insurance Program (NFIP) Regulations that apply to historic properties:

1. Congress created the National Flood Insurance Program (NFIP) to provide federally supported flood insurance coverage, which generally was not available from private companies.

2. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which works closely with private insurance companies, licensed & regulated by the states, to offer flood insurance to homeowners, renters and business owners. In order to qualify for flood insurance, the structure must be in a community that has joined the NFIP and agreed to enforce sound floodplain management standards.
3. Reduction in flood insurance premiums: Buildings that are elevated to or above the BFE, or mitigated in other ways, can qualify for flood insurance at rates that are generally less than the rates of non-elevated properties. This is true for historic as well as non-historic properties.

4. Reduction in flood insurance premiums can also be accomplished by one or more of the following:
   a. Fill basements up to the level of the exterior grade and add flood vents in the walls.
   b. Elevate utilities (electric, plumbing, heating) to a floor above the BFE.

For more information, go to: FloodSmart.gov
ASCE 24 Flood Resistant Design and Construction: Published by the American Society of Civil Engineers (ASCE)

ASCE 24-14 is a referenced standard in the New York State Building Code, as well as in many other states. ASCE 24 states the minimum requirements and expected performance for the siting, design and construction of buildings and structures in flood hazard areas.

FEMA deems ASCE 24 as meeting or exceeding the minimum National Flood Insurance Program (NFIP) requirements for buildings and structures.

Elevation of a property, in most cases, must be elevated or protected to the Base Flood Elevation (BFE) (plus two feet in New York State, and in many other states).
ASCE 24-14 Provisions:

1. Flood openings in walls below elevated buildings must allow for the automatic entry and exit of floodwater.

2. The difference between the exterior and interior floodwater levels shall not exceed one foot.

3. Stairways and ramps must be designed and constructed to resist flood loads, or to break away.

4. Utilities and equipment must be at or above BFE.

5. Buried tanks that are below the design flood elevation must be anchored, so they don’t float during flood.
Flood vents
Flood and air vents:
These devices provide a way to ventilate basements and crawl spaces to remove unwanted moisture, and to allow flood waters to enter and exit. The vent is latched closed until water enters and lifts the internal float, which rotates the door open and relieves the hydrostatic pressure. FEMA requires one square inch of opening for every square foot of enclosed area.
Structural Considerations to resist Hurricane Damages:

1. Designer should calculate design loads and conditions (hydrostatic & hydrodynamic loads, wave loads, floating debris loads, and erosion and scour) under the assumption that the flood level will exceed the BFE.
2. Use flood damage-resistant building materials and methods above the lowest floor, using drainable, dryable interior wall assemblies.
3. Use strong connections between the foundation and the elevated building to prevent the building from floating or washing off the foundation from surge action.
4. Use special Connectors to hold down the roofs and walls, to prevent blow-off during high wind events. This helps save the interiors from water damages. The goal for historic buildings is mount connectors & brackets to cause the least amount of harm to the building fabric and appearance.
Wall to floor and First story wall to Second floor wall

Rafter to wall

Wall to foundation
Flood barrier (Panel) Systems:
Temporary, movable opening protections, installed prior to a predicted flood event. They are installed on permanent jamb brackets.

The goal for historic buildings is mount them to cause the least amount of harm to the building fabric and appearance.
Water-repellant materials, used to repair historic properties, that can be used to avoid damage during a flood:

1. Sealing masonry walls: Sealant is often proposed for keeping flood water out of the lower parts of masonry walls, but it needs to be “breathable”, for historic properties. It needs to be a sealant that resists moisture from entering the wall but allows moisture already inside to get out. An approved substance is siloxane clear water-repellant coating.

2. Wood siding can be sealed by installing rubberized or plastic membrane on the lower portion of the wall under the wood siding, up to one foot above the expected flood level. The siding may have to be cleaned or replaced after the flood, but the more important wood sheathing, studs and plaster will be protected by the added exterior membrane.
Good Example of an Elevation Project in Owego, NY

Before
During the Flood of 2011-Tropical Storm Lee
Before and After
Flowable-fill added to fill basement

Disconnection and prep of water and sewer
Site prep - removal of existing walks and plants
Final wall set to start building forms for slab

Elevated house looking north/front
Slab (looking front/west)

Rebar in preparation for concrete slab
New foundation west/back wall
Front view finished foundation

Pier installation front side
Filled beam pockets on east wall showing flood vent

House back on new foundation (west/back)
Adding pillar supports (good half used as template for new base construction)

Ding room support was to replace old L-beam support
stone facing on foundation to mimic original laid-stone foundation
Good Example of Historic District with Elevated Houses

BayHead, New Jersey
BayHead, New Jersey-Yacht Club

Before

After
FOR MORE INFORMATION:

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