Overview – Damage from Hurricane Sandy

Storm presented two main types of flood hazards – stillwater flooding and wave action

- Atlantic Coast shorelines (e.g., SI South Shore, Rockaways) faced storm surge plus wave action
  - Damage from flooding and impact of wave action
  - Severe structural damage concentrated in areas directly facing shoreline
- Upper Harbor and other areas to the north generally experienced inundation only
  - Damage primarily to building systems and contents
Floodproofing Requirements for Buildings

Local codes must comply with FEMA standards in order to maintain eligibility for National Flood Insurance Program

NYC Building Code contains floodproofing requirements

- In Appendix G of NYC Building Code
- Code references FEMA Flood Insurance Rate Maps (FIRMs), first issued for NYC in 1983, which identify:
  - Geography within which requirements apply – 100-year flood zone
  - Elevation to which buildings must be raised or floodproofed - Base Flood Elevation (BFE)
  - Some buildings may be elevated to a higher elevation – Design Flood Elevation (DFE)
- Requirements apply to new construction or to improvements that exceed 50% of market value of building

Two main techniques of floodproofing exist – applicable to different building types

Wholly residential buildings cannot use dry floodproofing
Importance of Codes to Coastal Resilience

Code requirements are an effective tool for preventing severe damage to buildings

Most buildings in the coastal area predate floodproofing requirements

- 84% of buildings in inundation area were built before 1983, when first FEMA Flood Insurance Rate Maps (FIRMs) were issued

Newer buildings constructed to code requirements fared better in the storm

- 98% of buildings destroyed by the storm were built before 1983
- 94% of red-tagged buildings were built before 1983

Severe damage was concentrated in 1- and 2-family homes

- 88% of destroyed buildings and 90% of red-tagged buildings were 1- or 2-family homes
- A large majority of red-tagged buildings were in Staten Island and Queens

<table>
<thead>
<tr>
<th>Year Built</th>
<th>Inundation area</th>
<th>Destroyed by Storm</th>
<th>Red tags</th>
<th>Yellow Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1983</td>
<td>84%</td>
<td>98%</td>
<td>94%</td>
<td>67%</td>
</tr>
<tr>
<td>1983-2001</td>
<td>9%</td>
<td>&lt; 1%</td>
<td>4%</td>
<td>23%</td>
</tr>
<tr>
<td>2002 or later</td>
<td>5%</td>
<td>&lt; 1%</td>
<td>1%</td>
<td>9%</td>
</tr>
<tr>
<td>No Data</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land Use</th>
<th>% of Total Destroyed by Storm</th>
<th>% of Total Red Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>One &amp; Two Family</td>
<td>88%</td>
<td>90%</td>
</tr>
<tr>
<td>Multi-Family Walk Up</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Mixed Residential &amp; Commercial</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Commercial &amp; Office</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Public Facility &amp; Institution</td>
<td>&lt; 1%</td>
<td>1%</td>
</tr>
<tr>
<td>Vacant</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Open Space &amp; Recreation</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Industrial &amp; Manufacturing</td>
<td>&lt; 1%</td>
<td>1%</td>
</tr>
<tr>
<td>Multi-Family Elevator</td>
<td>&lt; 1%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Transportation &amp; Utility</td>
<td>&lt; 1%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Parking</td>
<td>&lt; 1%</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>
Floodproofing Requirements for Buildings

Different floodproofing standards apply in areas where stillwater flooding is expected (A-zone) and where wave action is expected (V-zone)

A-zone

- Elevate lowest floor above BFE
- Enclosure below the BFE must be wet flood proofed
- Enclosed space below the BFE shall be used solely for parking, storage and building access
- Utilities must be elevated above the BFE or designed to prevent water from entering and accumulating
- Commercial or mixed-use buildings can opt to dry floodproof non-residential spaces below the BFE

V-zone (high-velocity wave action zone)

- Building elevated above BFE on piles or columns above open foundation – no enclosure below the BFE (breakaway walls only)
- Offers less resistance to waves passing beneath building
Floodproofing Techniques: Example

Elevation of lowest floor containing habitable space
Floodproofing Techniques: Example

Flood shields (non-residential spaces only)
Floodproofing Techniques: Example

Elevation of mechanical space
Recent Construction: Examples

Newer buildings constructed to code requirements fared better during the storm

*The Edge, Williamsburg, Brooklyn*
Recent Construction: Examples

Newer buildings constructed to code requirements fared better during the storm

*The View, Long Island City, Queens*

Photo: Anthony DeMundo for New York Daily News
Recent Construction: Examples

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Recent Construction: Examples

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Arverne by the Sea, The Rockaways, Queens
FEMA Flood Maps and Inundation from the Storm

Flooding during Hurricane Sandy substantially exceeded both the boundaries and the flood heights of the current FEMA 100-year flood zone.

Sandy inundation area extended beyond current FEMA-designated flood zone:

- Roughly 1/4 of red-tagged buildings,
- Over 2/3 of the residential units, and
- More than 1/2 the buildings in the inundation area were outside the current FEMA 100-year flood zone.
Need for Upgrades to Building Code, Zoning, and Flood Maps

Prior to the storm, PlaNYC identified the need for improvements to flood zone regulations

- FEMA update of flood maps, including designated Base Flood Elevations

- Upgrades to floodproofing requirements of Building Code (Appendix G) to require freeboard:
  - elevating buildings 1-2 feet further to provide an additional margin of safety

- Corresponding amendments to Zoning Resolution to accommodate floodproofing requirements including freeboard
Zoning Issues: Example

**Limitations**

- Zoning Resolution does not allow 1-2 feet of additional building height to accommodate freeboard
- For some buildings, this can prevent use of all of floor area, discourage flood protection
Shaping New York City’s Future After Sandy
Hurricane Sandy: Initial Lessons for Buildings
December 17, 2012
View the full video of Commission discussion