

Building Science Support and Code Changes Aiding Sandy Recovery

Hurricane Sandy Recovery Fact Sheet No. 3

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FEMA

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Two years ago, Hurricane Sandy made landfall, devastating New Jersey and New York with tens of billions of dollars in damages. Since then, recovery activities have focused on increasing resilience of buildings and the lifeline infrastructure.

Significant progress on this front includes:

- Deployment of the Hurricane Sandy Mitigation Assessment Team (MAT) to assess damage and make recommendations
- Updated building codes at the local, State, and national levels
- Recovery projects across New Jersey, New York, and New York City to restore critical facilities and infrastructure
- Developing a culture of resilient recovery in building mitigation and risk reduction actions

Hurricane Sandy MAT Report

Immediately after Hurricane Sandy, the Federal Emergency Management Agency (FEMA) MAT collected field data to determine why certain buildings performed better than others.

The [MAT investigation report, FEMA P-942](#) (Figure 1), released at the 1-year anniversary, contains 52 observation-based recommendations focusing on:

- Adequacy of building codes, local construction requirements, building practices, and material (Figure 2)
- Aiding resilient community recovery efforts
- Disaster-resistant building repairs and new construction

In addition, seven Recovery Advisories and two Fact Sheets were released shortly after the event to provide guidance on specific widespread problems the MAT observed.

In addition, FEMA offered many Building Science courses and briefings and held meetings with communities to provide mitigation advice for reconstruction. Over the past 2 years, the MAT has met with almost 5,000 engineers, architects, contractors, and local officials to help them through the recovery process, and the team remains available to assist via the [Building Science Helpline](#).

Many MAT recommendations for building stronger are already being applied in New York and New Jersey, as described below.

Building Code Changes

Updating building codes to increase hazard resistance is an important step toward mitigating future storm damage. The MAT observed many vivid examples of increased community resilience through building codes, which evolved directly from

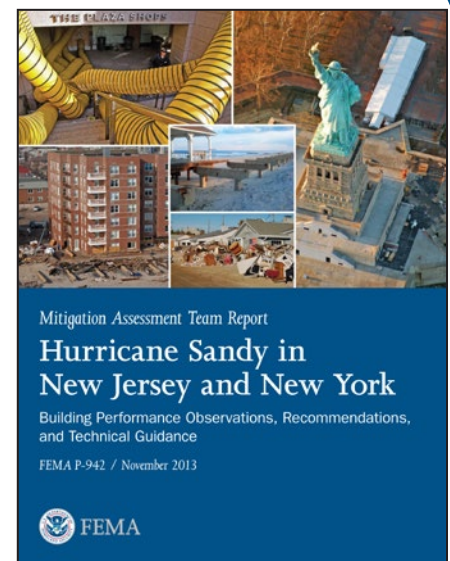


Figure 1: FEMA MAT report



Figure 2: House being elevated on piles in Tuckerton, NJ

disaster lessons learned. The MAT identified 47 recommended actions related to building codes and standards; to date, 28 of those post-Sandy building code updates have been partially or fully enacted, consistent with MAT report recommendations. Some key successful code changes are summarized below. The numbers in parentheses are cross references to the MAT report conclusions and recommendations.

New Jersey

The MAT recommended several improvements to the New Jersey Uniform Construction Code (UCC) for consistency with the National Flood Insurance Program (NFIP).

- One successful example includes explicitly linking the rehabilitation subcode to the prior approval process under which local floodplain administrators make Substantial Damage and Substantial Improvement determinations (#6)
- Modifying the UCC section on coastal high hazard areas to refer to American Society of Civil Engineers (ASCE) 24, *Flood Resistant Design and Construction*, for all buildings on pile foundations (#6) (Figure 2)
- The New Jersey Department of Environmental Protection, in conjunction with the New Jersey Department of Community Affairs (NJDEP), is reviewing its regulations that apply to buildings and other structures and has identified inconsistencies that must be resolved to ensure consistency with the UCC and minimum standards of the NFIP (#2)
- NJDEP, in conjunction with Rutgers University, has developed several new courses, and continues to promote existing courses on flood mitigation requirements, including: Residential Construction in Coastal Areas, Electrical Equipment in the Special Flood Hazard Area (SFHA), Before Disaster Strikes - Are You Ready?, and What Happens When You Don't: Wind, Seismic, Snow & Flood Requirements for Non-Structural Building Components (#4)

New York City

The MAT recommended several improvements to the New York City Building Code, also for consistency with the NFIP, as well as for clarity and enforceability. The NYC Department of Buildings made the following updates to the NYC Construction Code:

- Added a "flood zone compliance special inspection" of work related to raising, lifting, elevating, or moving buildings and to specify requirements for the construction documents needed for these special inspections (#15)
- Improved consistency with NFIP requirements for dry floodproofing and expanded and clarified requirements related to human intervention needed for dry floodproofed nonresidential buildings (#13 and #16)
- Required relocation and protection of building systems, cables, and fuel storage in floodprone areas through amendments to the fire, electrical, and mechanical codes (#34 and #44a)
- Other amendments endorsed by the MAT report:
 - Require all dwellings and most commercial buildings to be elevated to at least the **base flood elevation** (BFE) plus 2 feet
 - Require essential facilities to be elevated or protected to the higher of the 500-year flood elevation or the elevation required by the ASCE Standard 24, *Flood Resistant Design and Construction* (ASCE 24)

New York State

The MAT recommended improvements to the New York State Uniform Code for consistency with the NFIP and for increasing the resilience of construction in flood hazard areas.

- The New York State Division of Code Enforcement and Administration already requires 2 feet of freeboard for residential buildings (#30a) and is considering the following proposals to amend the State's Building Code:
 - Revise the minimum elevation requirement for **non-residential buildings** to be BFE plus 2 feet as was already required for residential buildings (#12) (Figure 3)

Terminology

Base flood elevation (BFE): The height of the base (1-percent-annual-chance or 100-year) flood in relation to a specified datum.

Freeboard: The vertical difference between the lowest floor of a building and the BFE, usually expressed in feet. It can be thought of as a factor of safety to compensate for the fact that flood levels can reach higher than the BFE.



Figure 3: House elevated above BFE after Hurricane Sandy (Freeport, NY)

- Adopt the 2015 International Codes
- The New York State Department of Environmental Conservation has been approved for a grant through FEMA's Hazard Mitigation Grant Program to develop training on flood provisions of the State Building Code (#10)
- The New York State Hospital Code is considering a revision to require elevation to the 0.2-percent-annual-chance flood instead of the BFE (#30a)

FEMA Flood Map Terms

Coastal A Zone: The portion of the coastal Special Flood Hazard Area (SFHA) referenced by building codes and standards, where base flood wave heights are between 1.5 and 3.0 feet, and where wave characteristics are deemed sufficient to damage many NFIP-compliant structures on shallow or solid wall foundations.

Zone V: Under the NFIP, an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action from storms or seismic resources. The area is subject to inundation by the base flood, where wave heights or wave runup depths are 3.0 feet or higher.

International Codes

FEMA participates in the triennial code development to propose changes based on experience from post-flood investigations documented in MAT reports. Changes to the 2015 International Residential Code supported by the Hurricane Sandy MAT report recommendations include:

- Require elevation and anchoring for underground and above-ground tanks (#22)
- Require an exterior door to be installed at the top of stairways enclosed by breakaway walls to minimize intrusion of waves and wind-driven rain (#22)
- Require 1 foot of freeboard above the BFE in all flood hazard areas (#22)
- Require that dwellings in Coastal A Zones be regulated by the same requirements as those in Zone V (#22)
- Adding commentary to ASCE 24-14, a reference standard to the 2015 International Codes, that states it is the intent of the standard's section on Utilities to include emergency power systems (#33a)

The 2015 International Building Code includes a change to reference flood provisions of NFPA 99, *Standard for Health Care Facilities*, for essential electrical systems and components in hospitals and other 24-hour medical care facilities whereas it had previously only been referenced for hyperbaric facilities (#18). Furthermore, new or replacement essential electrical system generators must be located and installed according to ASCE 24 for hospitals and other 24-hour medical care facilities located in flood hazard areas.

FEMA Guidance

FEMA developed Hurricane Sandy Recovery Advisory No. 7, *Reducing Flood Risk and Flood Insurance Premiums for Existing Residential Buildings in Zone A*, and a related NFIP Write Your Own Bulletin. The guidance explores the unique challenges faced when rebuilding in dense urban settings. FEMA is continuing efforts to identify effective alternative mitigation measures and evaluate potential associated flood insurance premium reductions (#25d).

FEMA Building Science has developed a model flood damage prevention ordinance that is specifically written to coordinate with building codes. This ordinance has been made public and is ready to be used for regulating development in flood hazard areas (#3, #7).

Recovery Actions

New Jersey Department of Community Affairs Community Development Block Grant (CDBG) Disaster Recovery Action Plan:

Proposed relief actions include:

- Grants up to \$150,000 for reconstruction, rehabilitation, elevation, and mitigation of damaged residences (#30).
- Grants to support the training of code enforcement officials in mitigation measures (#4).

Urban Green Council Building Resiliency Task Force: As New York City's leading advocate for urban sustainability, the Task Force has had 16 proposals enacted into NYC Building Code and local laws. Ten of those proposals either match or are directly related to MAT recommendations (#26, #32, #33, #42).

Hospital Mitigation Projects: Several hurricane-damaged hospitals have received funding to prepare for future storms, and are incorporating many MAT recommendations in their rebuilding strategies. Mitigation actions include:

- NYU Langone Medical Center will elevate critical equipment, install six submarine doors to dry floodproof sensitive areas, and install emergency generators, and is constructing a standalone co-generation power source that will be operational in 2016 (#32, #34, #40a)
- Coney Island Hospital will build a flood wall and a new floodproofed building (#34)
- Bellevue Hospital is elevating its drinking water and fuel pumps, and installing new drainage pumps (#32, #34, #39)

New Jersey, New York, and NYC Wastewater Collaboration: All three jurisdictions have agreed to a common recovery design standard, and are implementing multi-billion dollar floodproofing programs that include installing flood barriers, flood-resistant materials, submersible pumps, and elevated process controls, among other measures. Passaic Valley Sewerage Commission has implemented temporary mitigation measures until a floodwall can be built around the entire plant to protect it against the 0.2-percent-annual-chance flood (#47).

New Jersey Transit, Port Authority of New York and New Jersey, and Metropolitan Transportation Authority: These three establishments are implementing multi-billion dollar floodproofing programs that may include submarine-type doors at train and subway station entrances in low-lying areas, waterproof covers for ventilation grates, flood-resistant materials in areas of potential inundation, and floodproofing of maintenance, storage, and control facilities, including the use of flood barriers (#45).

New York State 2014–15 Budget Priorities: Resilience actions include creating a “College of Emergency Preparedness, Homeland Security and Cybersecurity,” equipping gas stations with back-up power, and expanding strategic fuel reserves, consistent with MAT recommendations (#10, #44a, #44b).

New York City CDBG Disaster Recovery Action Plan: NYC is using a variety of Federal sources to fund recovery projects including:

- **Build it Back Program:** The City is using these funds to strengthen New York City Housing Authority’s public housing facilities by installing flood-resistant backup power, elevating utility equipment, and rehabilitating community centers (#32, #40a).
- **Residential Building Mitigation Program:** This program offers loans and grants to property owners to cover the cost of flood mitigation measures (#25b).

Sandy Recovery Publications

- FEMA P-942, *Hurricane Sandy MAT Report* (2013): <http://www.fema.gov/media-library/assets/documents/85922>
- *FEMA Report to Congress, on Including Building Codes in the NFIP* (2013): <https://www.fema.gov/media-library/assets/documents/85960>
- *USACE Report to Congress, North Atlantic Coast Comprehensive Study* (due January 2015): <http://www.nad.usace.army.mil/CompStudy.aspx>
- *Hurricane Sandy Rebuilding Strategy*, released by Hurricane Sandy Rebuilding Task Force (August 2013): <http://portal.hud.gov/hudportal/documents/huddoc?id=HSRebuildingStrategy.pdf>
- *NYC Planning Report: Retrofitting Buildings for Flood Risk* (October 2014): <http://www.nyc.gov/html/dcp/html/retrofitting/index.shtml>

FEMA MAT Partner Web Sites

- FEMA Sandy Recovery Office: <http://www.fema.gov/sandy-recovery-office>
- American Institute of Architects, New York Chapter Post-Sandy Initiative: <http://postsandyinitiative.org/>
- Rebuild by Design, a collaboration of NYU, Rockefeller Foundation, and HUD: <http://www.rebuildbydesign.org/>
- Special Initiative for Resilient Recovery: <http://www.nyc.gov/html/sirr/html/home/home.shtml>
- Urban Green Council Sandy Resiliency Tracker: <http://urbangreencouncil.org/resiliencytracker>
- NYC Recovery Tracker: <http://www.nyc.gov/html/recovery/html/resources/resources.shtml>
- Sandy CDBG and recovery sites:
 - NJ <http://www.nj.gov/dca/divisions/sandyrecovery/>
 - NY <http://www.stormrecovery.ny.gov/>
 - NYC <http://www.nyc.gov/html/cdbg/html/home/home.shtml>
- FEMA Building Science Hurricane Sandy Tools: <http://www.fema.gov/hurricane-sandy-building-science-activities-resources>

Questions? Click on this “[Frequently Asked Questions](#)” link or contact the Building Science Helpline by email at FEMA-Buildingsciencehelp@fema.dhs.gov or by phone at 866-927-2104.