

# Making Buildings Resilient

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# MAKING BUILDINGS RESILIENT TO NATURAL DISASTERS & ACTS OF TERROR

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# COURSE DESCRIPTION

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This presentation focuses on how to prepare buildings for natural disasters and acts of terror. It identifies the elements of a building risk assessment, stressing realistic threats and realistic desired outcomes. It shows strategies for making building life safety systems more resistant to catastrophic events. The presentation presents the approach and some of the recommendations of the New York City Building Resilience Task Force, a group of professionals convened by the Mayor of New York to develop recommendations for the city and for building owners in the aftermath of Tropical Storm Sandy.



# LEARNING OBJECTIVES

1. Define Resiliency as it applies to the Building Industry
2. Explain how current and future climate change requires resiliency for lasting infrastructure and occupant safety
3. Explain professional liabilities when using climate projections for designs
4. Explain various City, State and National resiliency design guidelines

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# RISK ASSESSMENT

The First Step of Preparedness

- Identify plausible, defensible threats
- Identify desired outcomes for threats
- Review building for existing emergency assets
- Identify gaps in existing systems that preclude desired outcomes
- Develop strategies to overcome gaps with both hardware and personnel response

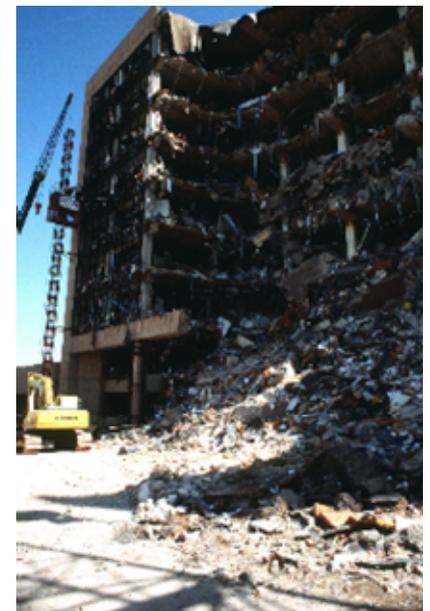
# MULTIPLE THREATS TO BUILDINGS

- Hurricane Storm Surge
- Extreme Precipitation Flooding – climate change
- High Wind Events – Nor'easters, Hurricanes
- Earthquake
- Drought – climate change
- Utility Failures – The Big Blackout
- Terrorism – impact on transportation and infrastructure



# EVENT IMPACTS ON BUILDINGS

- Loss of internal building services systems
- Disruption of internal life safety systems
- Reduction in accessibility
- Internal property damage
- Loss of utility service: power/gas/steam
- Loss of water and/or sewer service
- Injury or death for building occupants
- Partial or complete destruction of the building



# DESIRED OUTCOMES FOR THREATS

- Protect occupants during event
- Facilitate occupant exit if needed
- Support first responders
- Minimize damage to property
- Enable desired level of operation during prolonged event
- Expedite return to normal operation after event



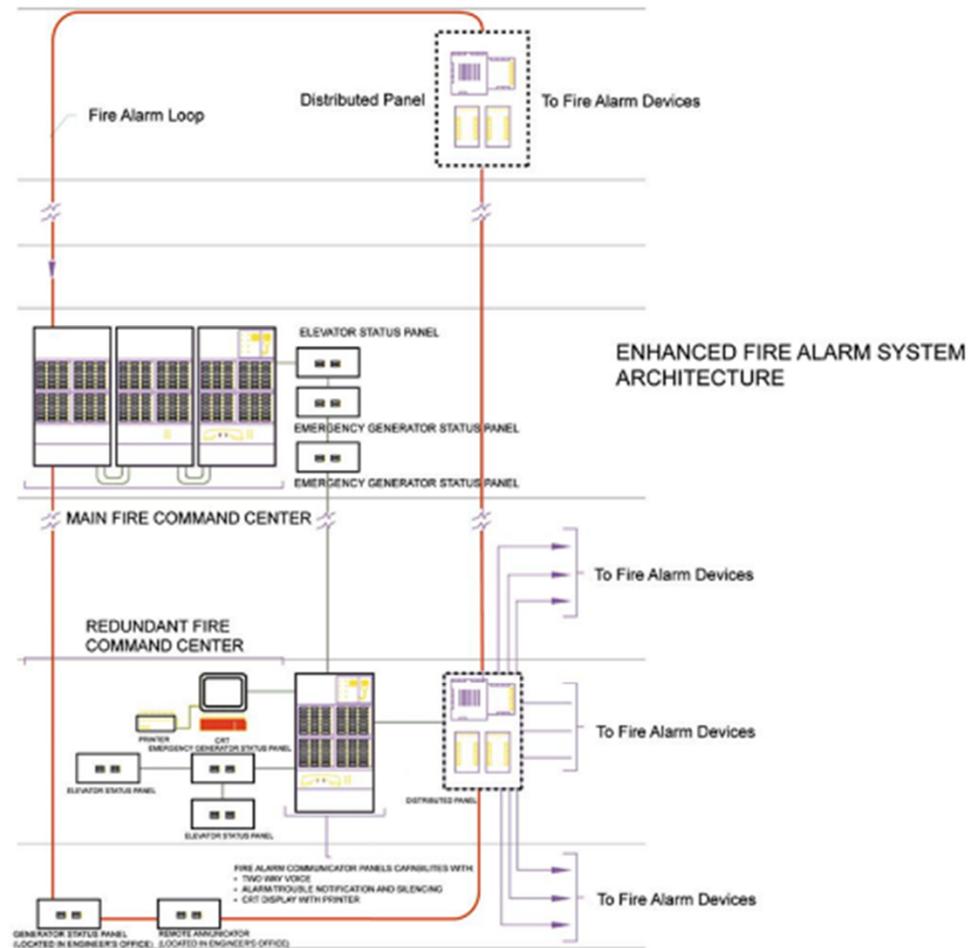
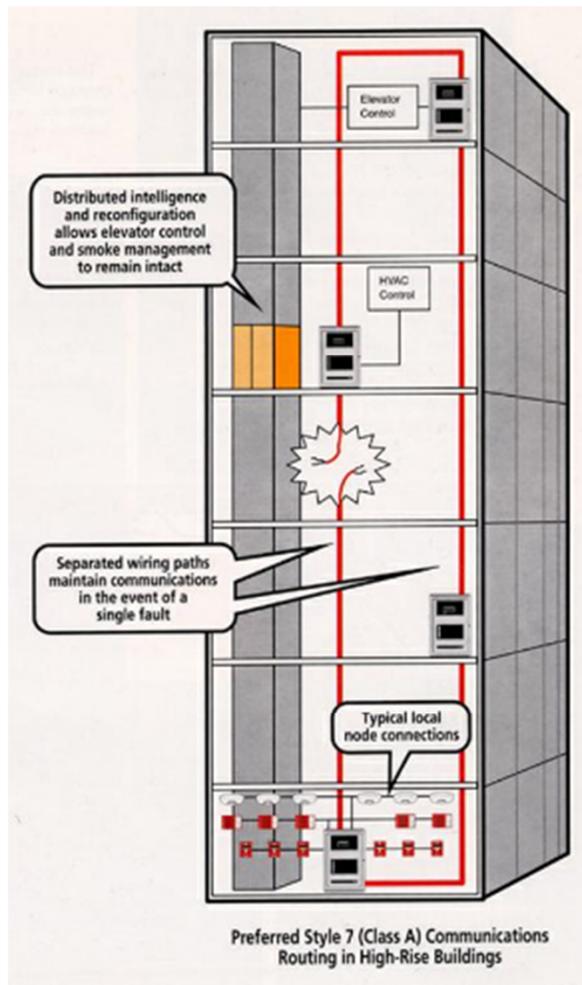
Structural integrity must survive the event to achieve these ends

# ROLE OF CONVENTIONAL LIFE SAFETY SYSTEMS

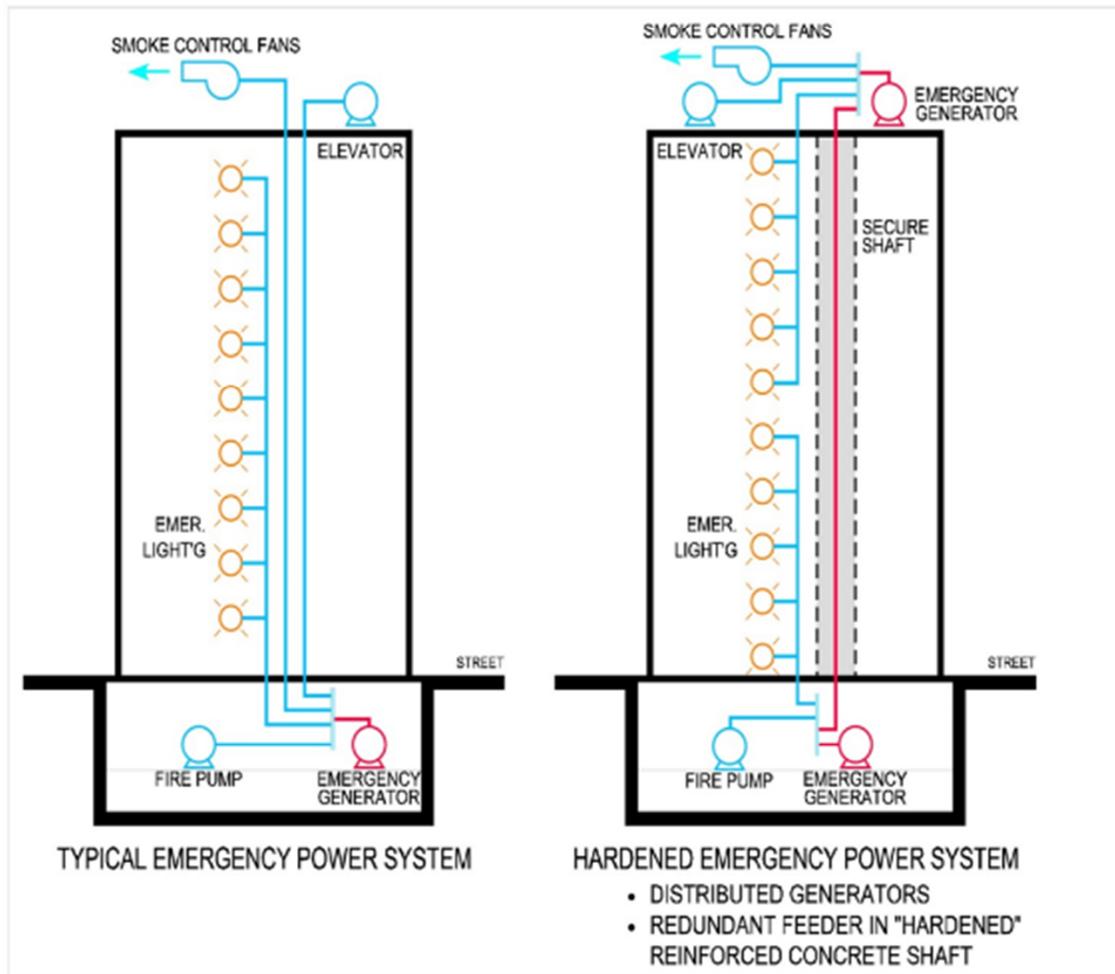
- Notify occupants of event
- Direct occupants to appropriate response to event
- Protect occupants during event
- Facilitate occupant exit if needed
- Support first responders



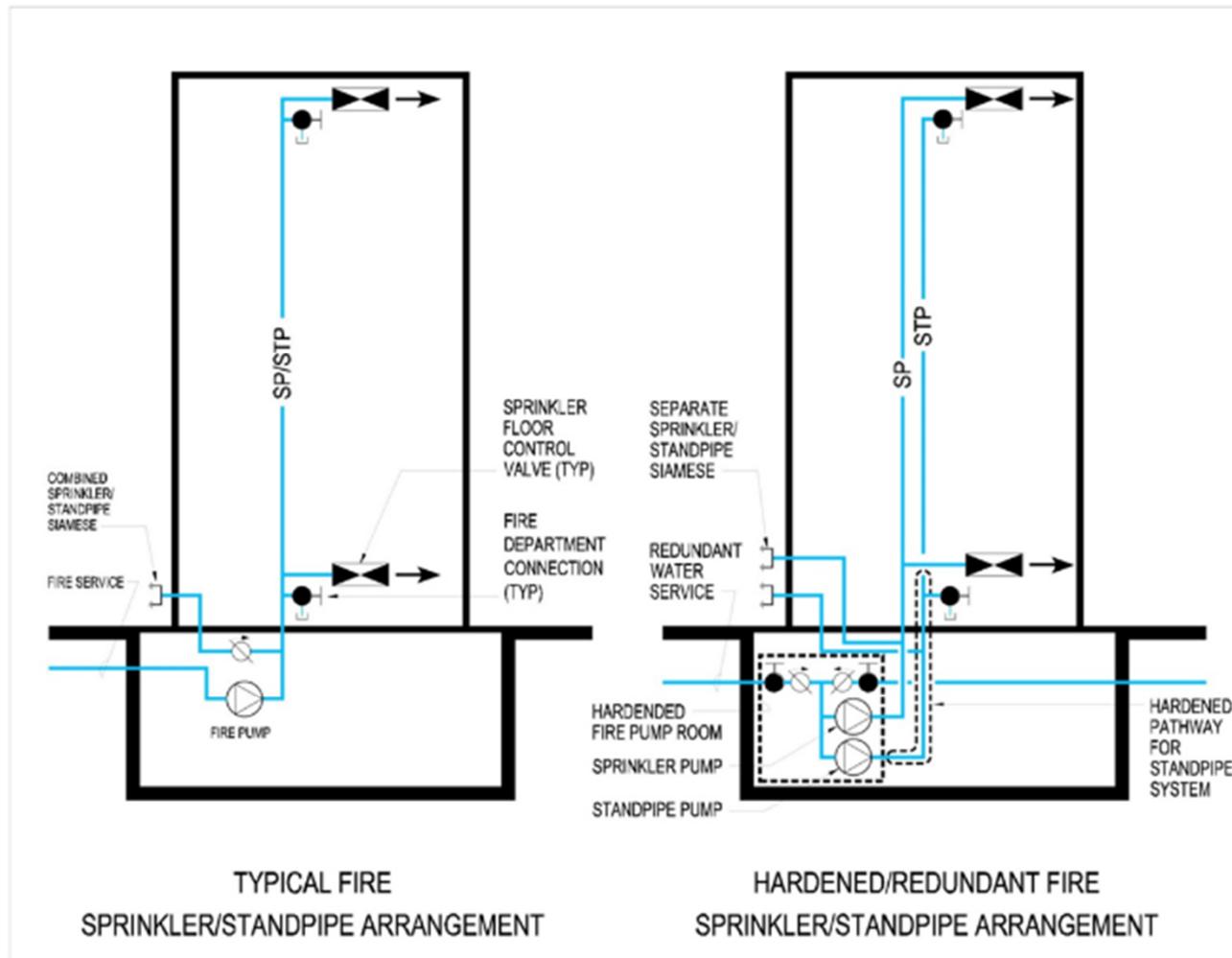
# IMPROVED FIRE ALARM SYSTEM WITH REDUNDANT RISERS AND DISTRIBUTED INTELLIGENCE



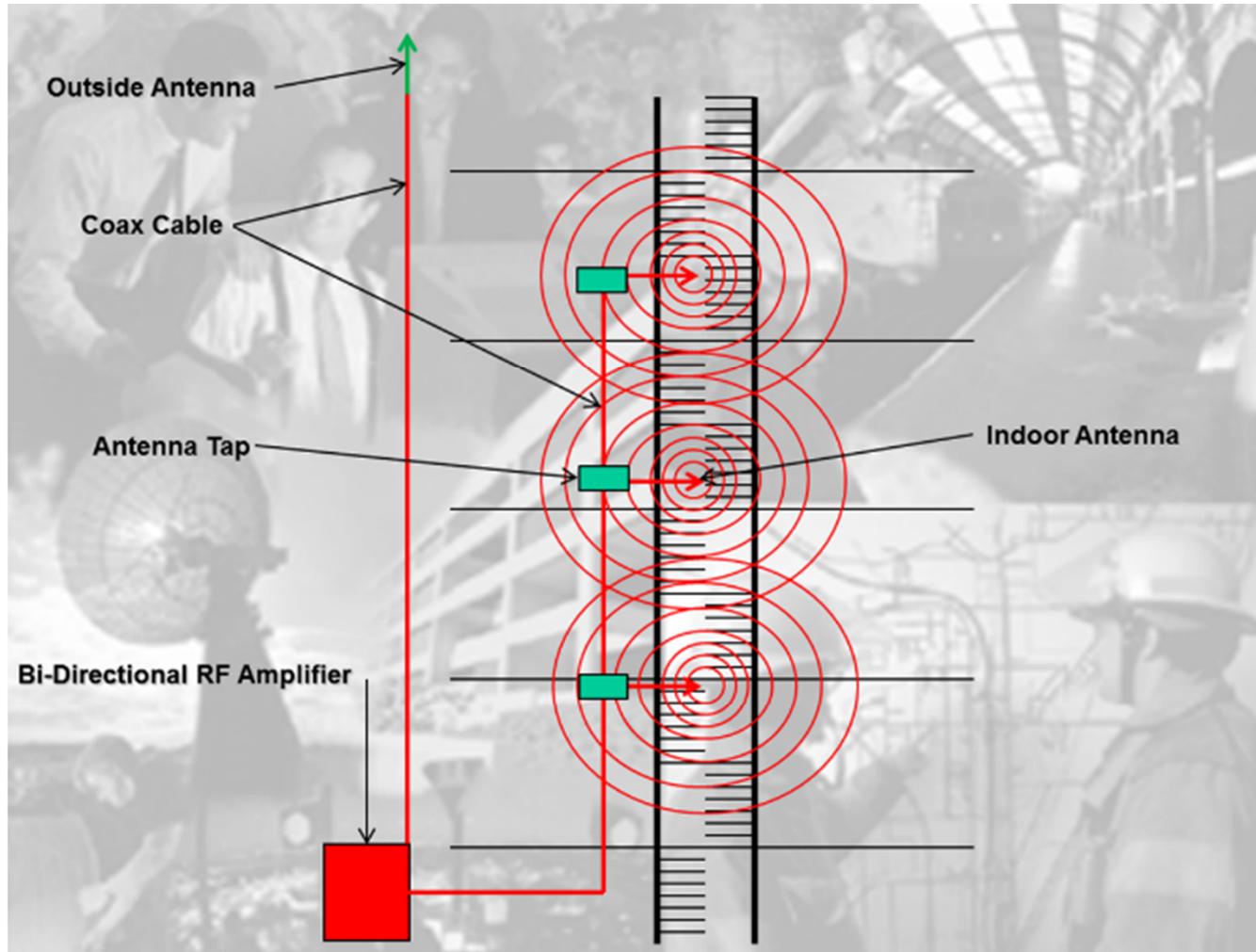
# IMPROVED EMERGENCY POWER SYSTEM



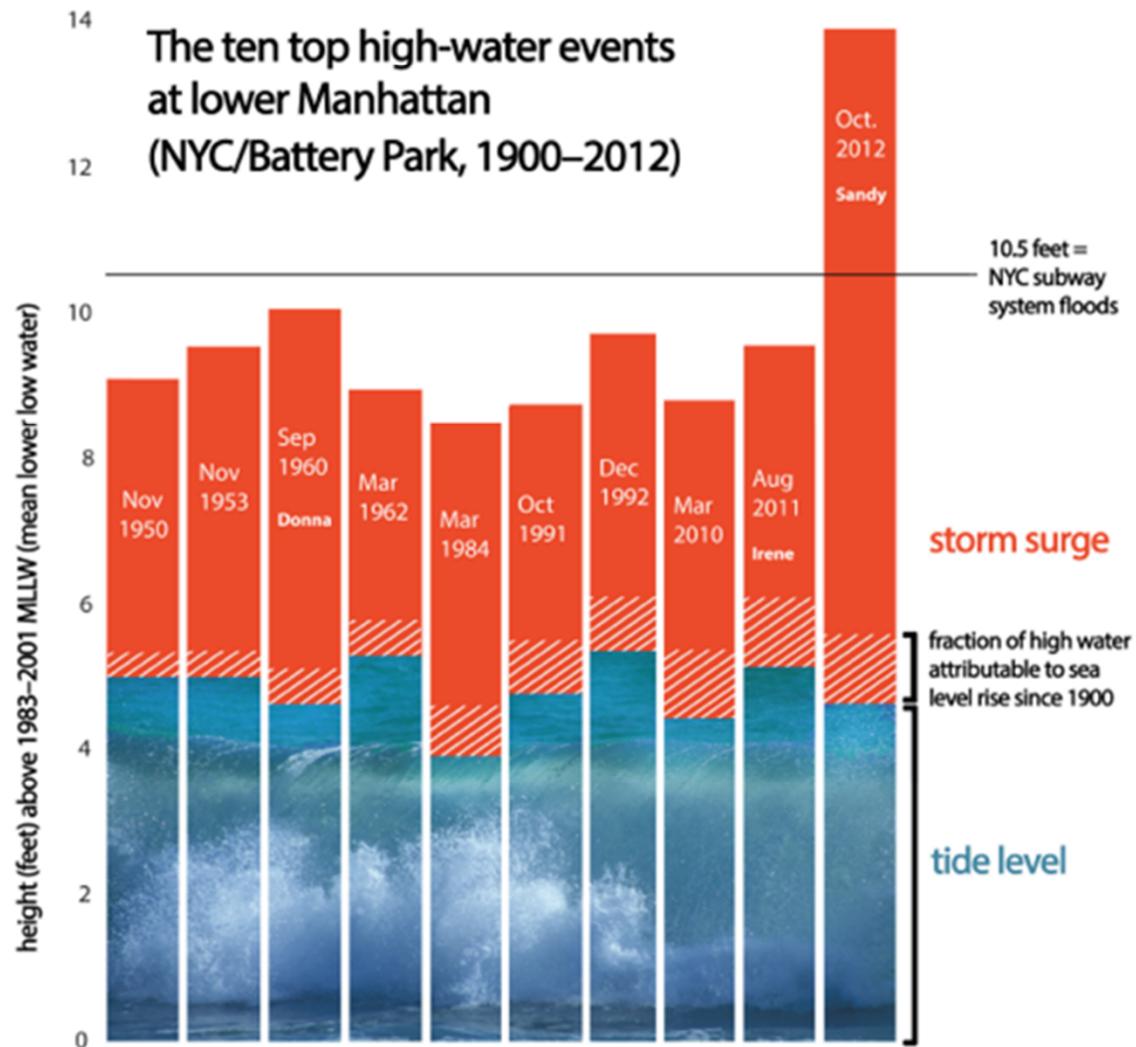
# IMPROVED SPRINKLERING/STANDPIPE SYSTEM



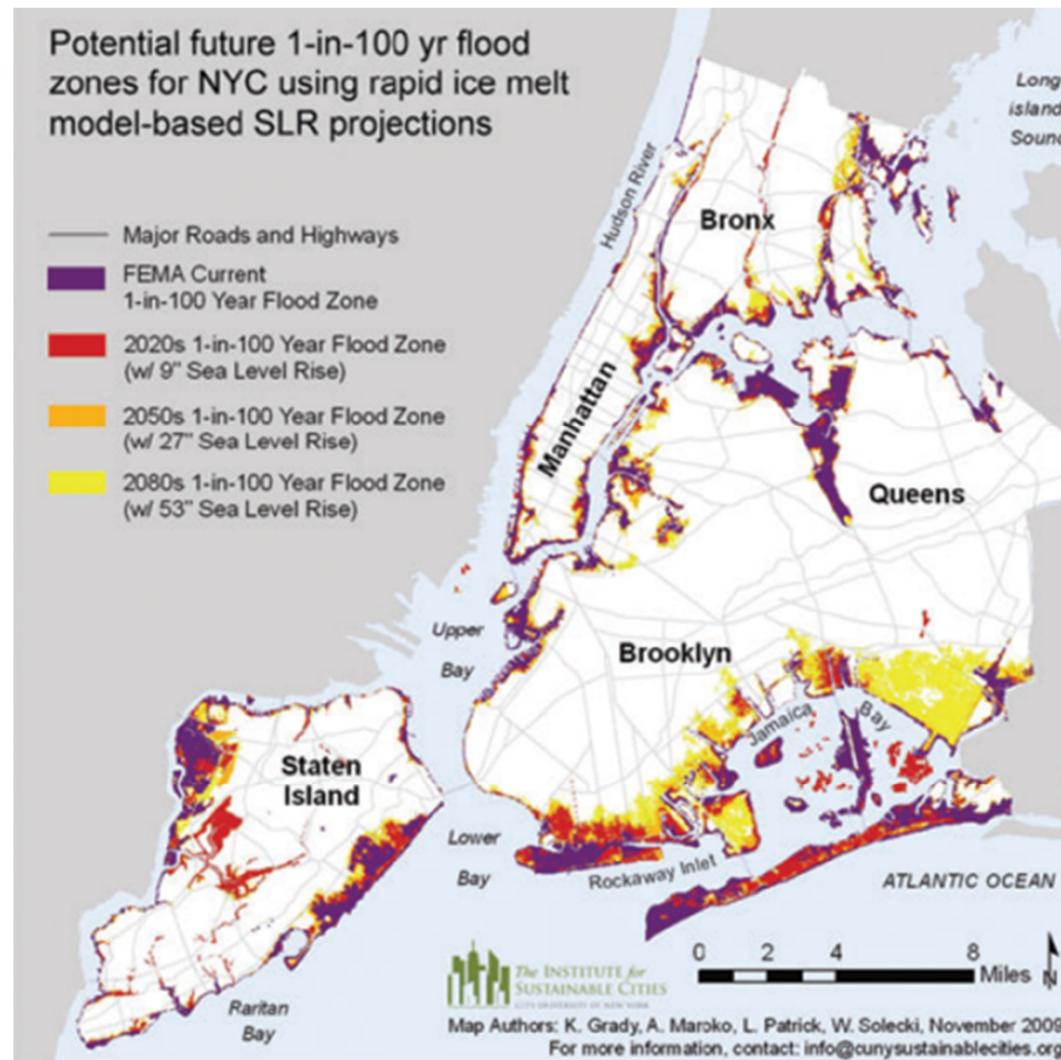
# MAINTAINING WIRELESS CONNECTIVITY



# WHY WAS SANDY SO DEVASTATING TO NEW YORK CITY

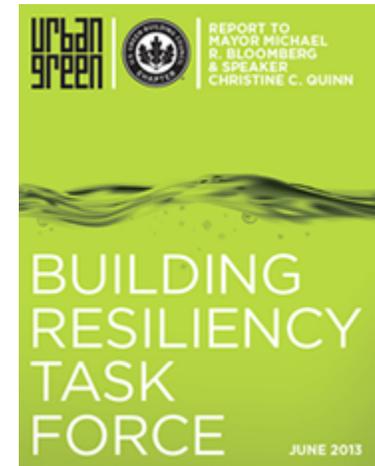


# THE PRIMARY PROBLEM: NEW YORK CITY IS UNDER WATER



# THE NEW YORK CITY RESPONSE

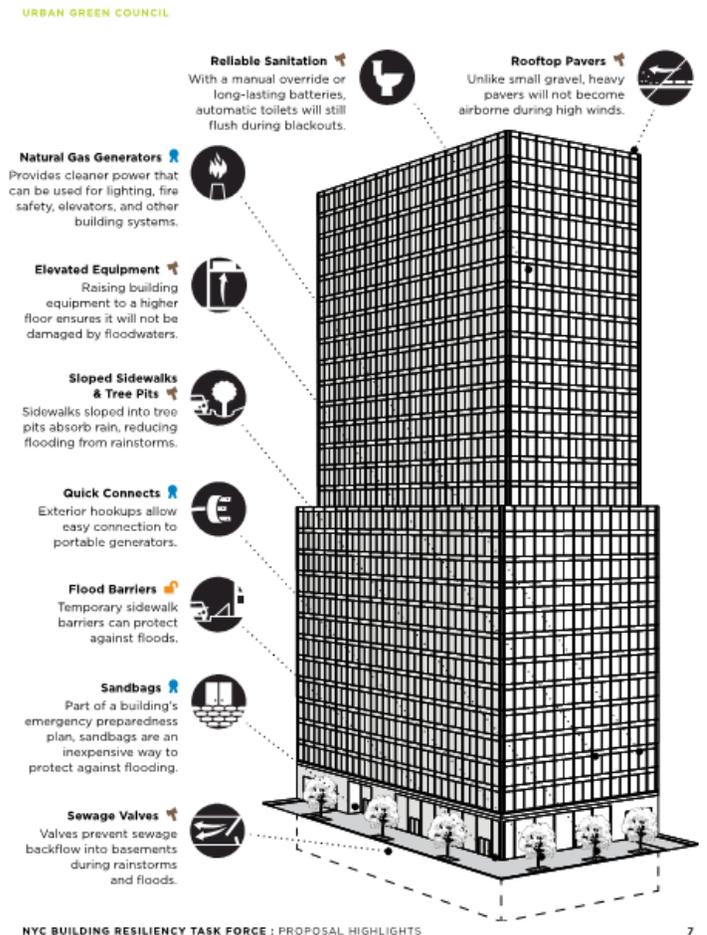
- The New York City Special Initiative for Rebuilding and Resiliency
  - Citywide Infrastructure and the Built Environment
  - Community Rebuilding and Resiliency
  - Outreach
- AIA New York Chapter “Post Sandy Initiative”
- The New York Building Resiliency Task Force
  - Recommendations for building code changes to make buildings more resilient
  - Recommendations for public initiatives to reduce disaster impact



# THE NEW YORK CITY BUILDING RESILIENCY TASK FORCE

The Building Resiliency Task Force is comprised of over 225 experts from throughout the built environment community.

- Steering Committee
- Commercial Buildings Committee
- Residential Buildings Committee
- Critical Buildings Committee
- Special Committee on Homes
- Structure, Facade, and Interiors Working Group
- Electrical and IT Working Group
- HVACR, Plumbing, and Fire Protection Working Group



# NYCBRTF

## Philosophy

City regulation and programs have different types of goals for different types of buildings.

- Commercial Buildings – Insure evacuability and provide very temporary refuge during emergencies
- Residential Buildings – Insure minimum habitability during extended emergency events
- Critical Buildings – Insure minimum required functionality during extended emergency events



# NYCBRTF

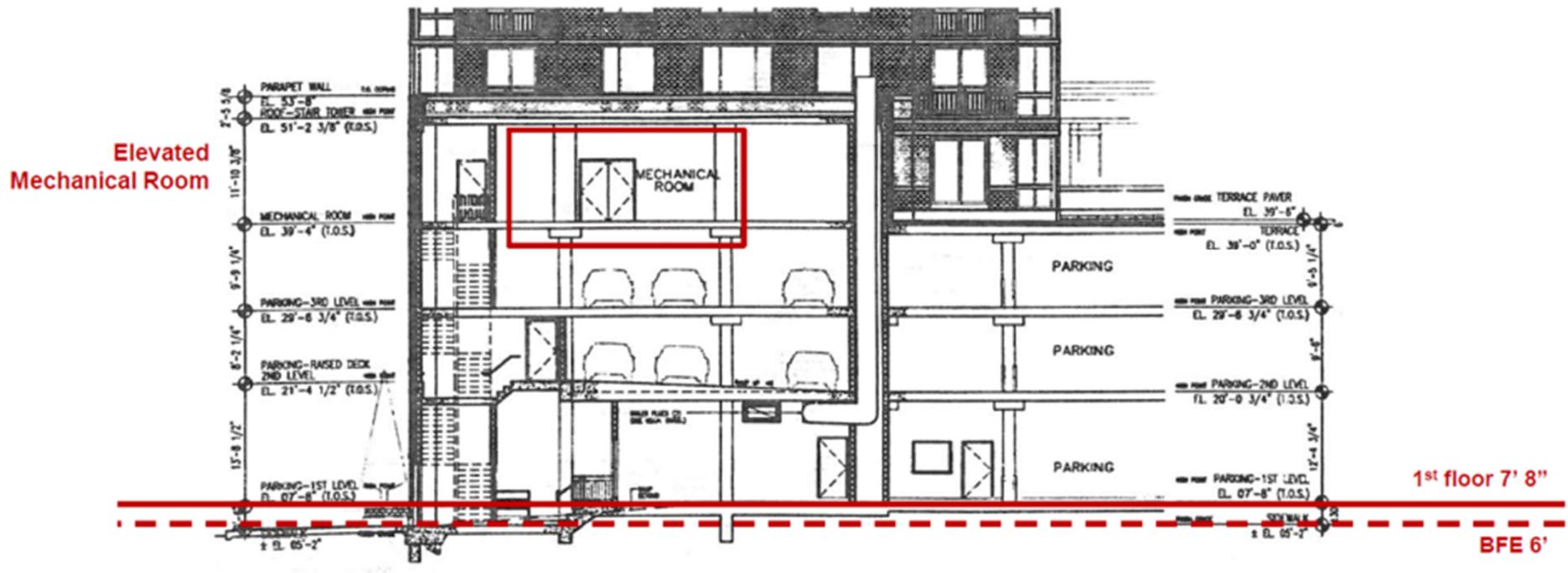
## Preventing Damage During Extreme Weather Events

Encourage owners to implement measures to resist damage to buildings, facilitate recovery and extend operability during emergencies.

- Raise critical building systems above flood level
- Protect critical areas with dry flood-proofing, including both permanent and temporary flood barriers
- Allow barriers on sidewalks in emergencies
- Encourage wet flood proofing when appropriate
- Select mechanical equipment for extreme conditions beyond current design standards

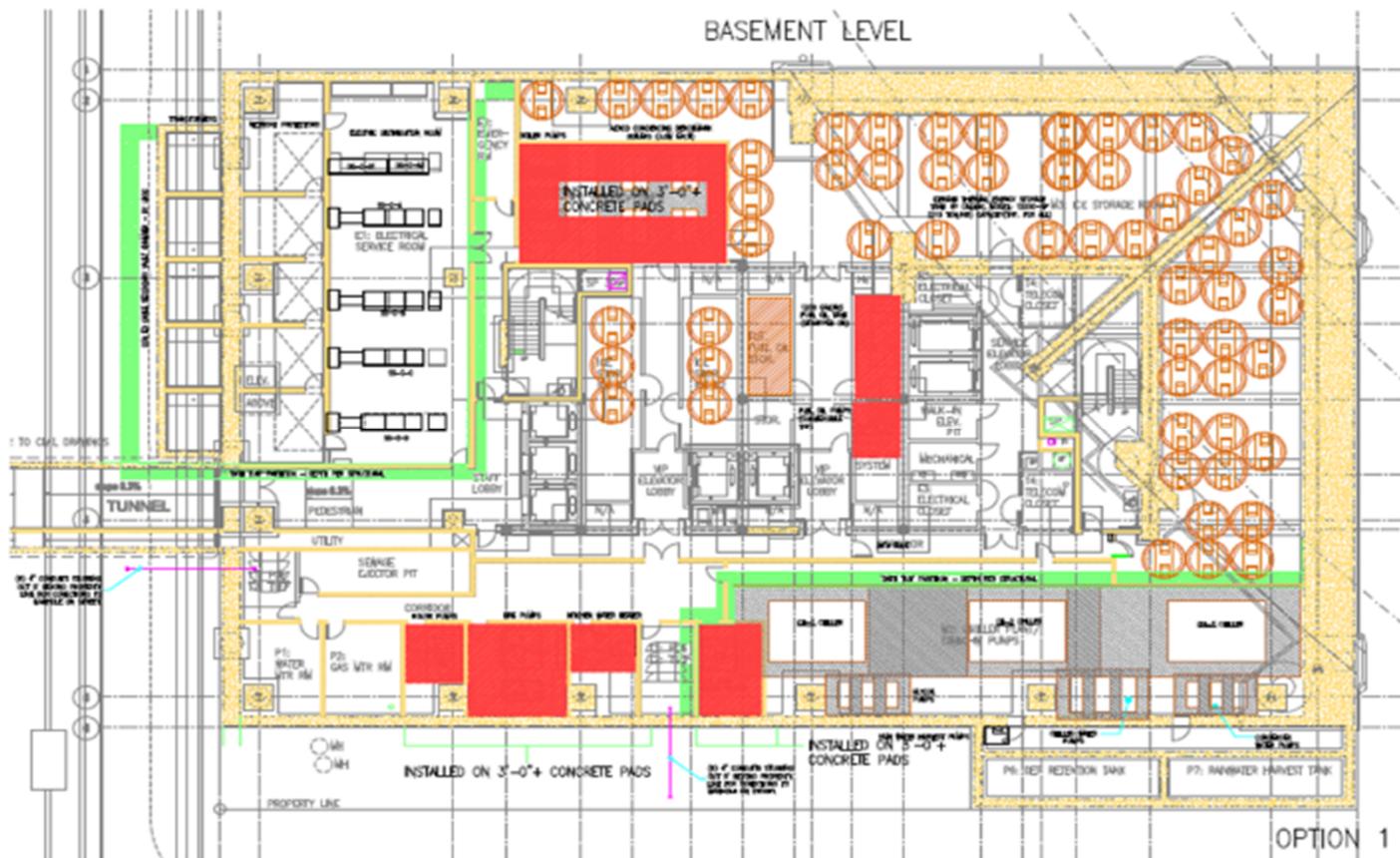
# BUILDING FLOOD-PROOFING

Raise Critical Functions Above Flood Level



# BUILDING FLOOD-PROOFING

Create a Bath-Tub for Critical Functions Below Flood Level



# FLOOD HAZARD MITIGATION

- Flood barrier systems
  - Temporary
  - Permanent
- Relocation of infrastructure
- Strengthen existing structures
- Plumbing modifications
- Manage water not entering building
- Back-up mitigation measures



Image source: US Flood Control



# INFRASTRUCTURE FLOOD-PROOFING

Subway tunnels



Inflatable tunnel plugs under review by MTA

Aqua-barriers were used at some tunnel entrances during CAT-90 SANDY



# NYCBRTF

## Backups Against Utility Failures

- Preserve appropriate level of building functionality during utility outages through onsite power supply and water storage
- Encourage onsite backup generators, through less stringent standards than required for life safety generators
- Develop and implement standards to allow safe islanding of cogeneration and renewable energy assets
- Facilitate sharing of backup and standby power between buildings
- Encourage addition of building connections for temporary external services such as generators or boilers
- Encourage extension of back-up power to domestic water booster pumps, limited receptacles on each floor, etc.
- Implement and encourage peak load management
- Improve efficiency of systems used during utility failures to extend useful life of backup supply of fuel or water
- Reduce stormwater runoff through building water retention, green roofs, or permeable paving

Provide buildings with passive systems that can improve comfort and provide limited water supply when connection to all utilities is lost.

- Encourage operable windows
- Encourage building envelope performance above code mandated levels
- Encourage configuration of building water distribution to enable service to be limited to critical uses during emergencies
- Educate building operators and occupants on 'passive operation' of buildings

# NYCBRTF

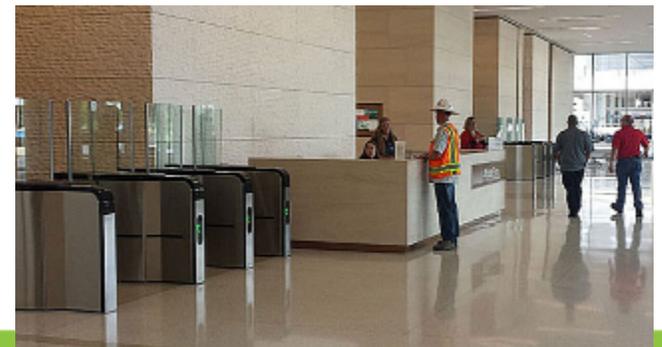
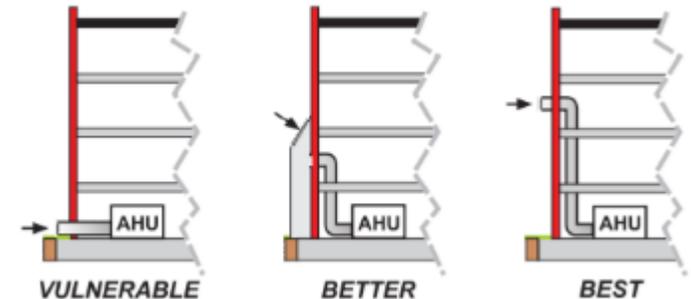
## Emergency Preparedness Plans (EPP)

Operational plans can help mitigate damage to buildings and protect people.

- Require EPPs for all buildings with annual submission (like lead paint forms)
- City EPP's should include:
  - Notification plans to alert citizens of impending emergencies
  - Suspension of rules such as water discharge to streets so owners can respond to hazards
  - Relocation plans for movable assets to minimize damage
- Pre-negotiated agreements with contractors to facilitate rapid repair after events

# MINIMIZING CHEM BIO THREAT

- Secure outdoor air ventilation inlets
- Isolated lobby air systems
- Central HVAC shut-down
- Air or smoke purge system (100% exhaust and outdoor air make-up)
- Isolated or remote mail processing center
- Standardized mail screening and facilities for secure vetting
- Lobby security screening remote from elevator shaft

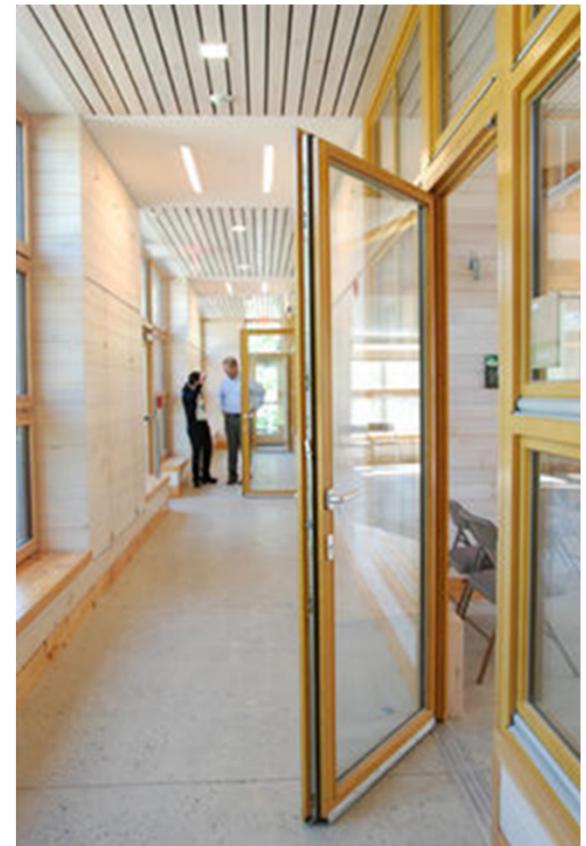


# WATER STORAGE

- For commercial buildings used for temporary shelter, existing NYC building tanks may be adequate
- For commercial buildings, isolation of water supply to limited outlets is desirable
- For residential buildings, 2 days supply at 10 gallons per day per person is desirable
- For residential buildings, water supply on each floor, but not in each apartment is desirable

# RESILIENT DESIGN WISH LIST FOR NEW BUILDINGS

- Be aware if your site is a flood-prone area
- Build to resist damage from rain and flooding
- Build superinsulated envelopes
- Incorporate passive solar design in heating climates
- Minimize cooling loads in cooling climates
- Provide opportunity for natural ventilation
- Maximize daylighting
- Provide backup renewable energy systems
- Plan for water shortages
- Address fire resistance and durability
- Consider resilience at community scale and support local food production



# CHECKLIST FOR EXISTING BUILDINGS

For all buildings:

- Have a detailed emergency plan to achieve desired outcomes
- Permanent or deployable temporary flood-proofing measures
- Sump pumps on emergency circuits
- Convenience receptacles each floor on emergency circuits
- At least one elevator on emergency circuits
- Emergency generator or emergency feed for external power

For residential buildings:

- At least one convenience receptacle in each apartment on emergency power
- Potable water storage of at least 20 gallons per occupant provided to one securable public faucet each floor
- Domestic water lift pump on emergency power

# QUESTIONS?

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