

Hardening Mechanical Systems for the Next Disaster

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Seminar Agenda

- Disasters and Threats Impacting Facility Function
- Common Facility Weaknesses
- Strategies for Overcoming Facility Weaknesses and Threats
- Practical Solutions for Hardening Mechanical Systems

Disasters and Threats Impacting Facility Function

- Natural Disasters
 - Large-Scale with Advanced Notice: Hurricanes, Tropical Storms, Blizzards, and Other Storm Front Systems
 - Large-Scale with Varying Notice: Floods, High-Speed Gusts, Dust Storms, Volcanic Eruptions, Cold/Heat Waves, Droughts
 - Varying Scale with Short Notice: Tornadoes, Earthquakes, Tsunamis, Hailstorms, Wildfires
 - Localized with Short Notice: Thunderstorms, Flash Floods, Sinkholes, Avalanches, Landslides, Limnic Eruptions
- Epidemics
- Space Disasters: Impact Events, Solar Flares

Disasters and Threats Impacting Facility Function

- Manmade Threats
 - Active Shooter Incidents
 - Workplace Violence and Crime
 - Biological, Chemical, Biochemical, and Explosive Attacks
 - Cybersecurity Threats: Data Breaches, System Shutdown, Etc.
 - Physical Access Breach



What Disasters and Threats Are Likely to Happen?

- When assessing natural disasters:
 - Climate and geography
 - Geological history and trends
- When assessing manmade threats:
 - Local and regional history and culture
 - Economic trends
 - Local, regional, and national politics and other social factors
 - Building occupants and their professions and clientele
- Epidemics and space disasters, not bounded by consistent variables, should be addressed from a risk assessment standpoint



Image Credit: Shin Godzilla by Noger Chen. Cropped for ASHRAE Commercialism Compliance.

Probability	Severity			
	Minor	Noticeable	Substantial	Catastrophic
Frequent	High	High	Very High	Very High
Likely	Medium	High	High	Very High
Probable	Low	Medium	High	Very High
Unlikely	Low	Medium	Medium	High
Rare	Low	Low	Medium	Medium

Risk Matrix

- Used to define risk by identifying probability and severity of the adverse event
- Risk matrices may be adjusted to reflect specific objectives
 - Probability can be oriented towards confidence levels in lieu of frequency
 - Categories can be changed or added to reflect different ranges of magnitudes

Examples:

- Earthquakes in San Francisco, CA
Probable and Catastrophic → Very High Risk
- Hurricanes in Fort Lauderdale, FL
Likely and Catastrophic → Very High Risk
- Hailstorm with Dime-Size Hail in Nashville, TN
Probable and Noticeable → Medium Risk

Example: Facility Adjacent to Wetlands

- Natural Threats:
 - Flood and storm surge
 - Natural encroachment
- Risk:
 - **Probable frequency** of flood or storm surge event with **substantial severity** results in **high risk**



Common Facility Weaknesses

- Envelope openings not rated for secure or resilience measures
 - Windows that are not impact-rated or, if needed, blast-rated or with window barriers
 - Entries with few lines of sight
- Outdoor air intakes and exhaust air openings without dampers connected to an emergency shut-off mechanism
- Unsecure networks supporting building automation systems
- Accessible utility service areas and connection points
- Lack of or minimal facility setback from roads
- Lack of physical and cyber access monitoring

What to Ask When Addressing Facility Weaknesses

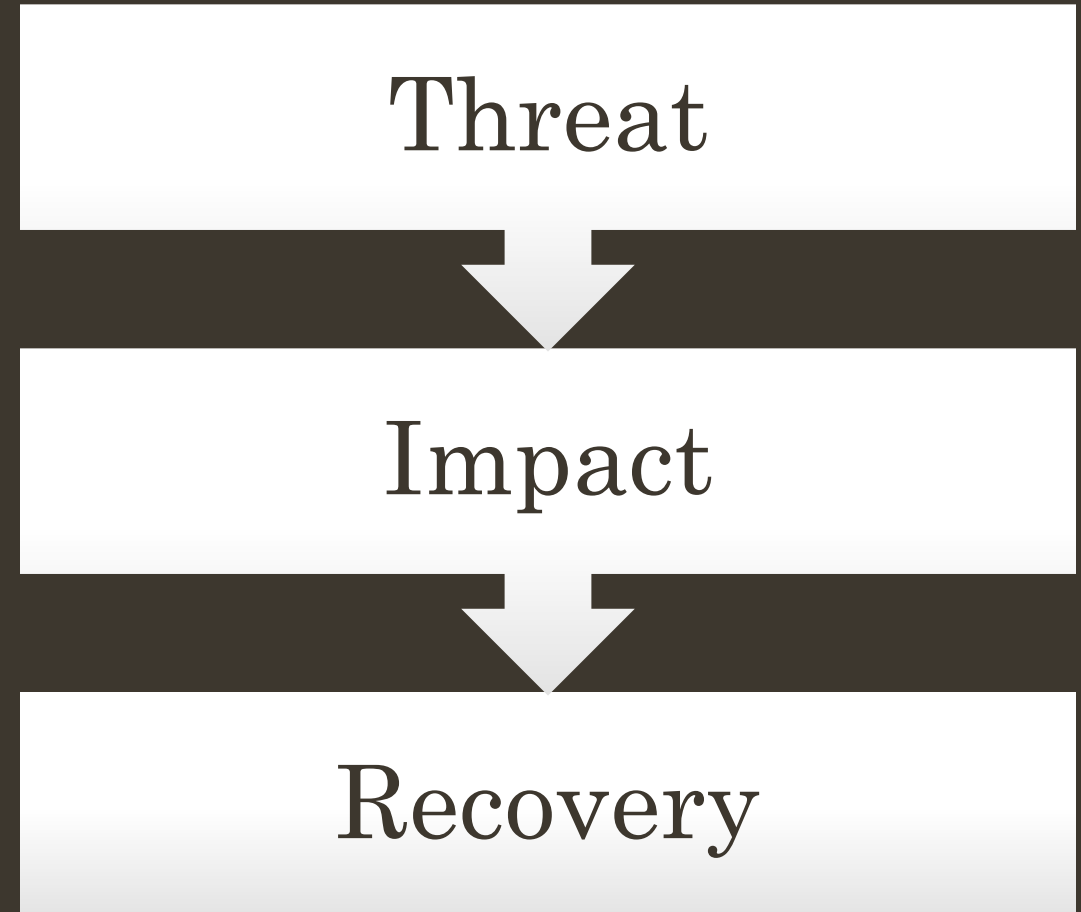
- Is the weakness a result of the facility's design or construction?
- Does a building code, adopted standard, or rating encourage or require the presence of that weakness?
- Is the local utility infrastructure or service causing the facility to have a vulnerability?
- Are municipal services mitigating or amplifying threats to the facility?
- Are economic and tax incentives encouraging or discouraging facility weaknesses?

Considerations in Addressing Facility Weaknesses

- Can a renovation or repair address the facility weakness?
 - Is this renovation or repair cost-effective?
- Can the building's function be exempt by code from requiring that weakness?
- Can a waiver be obtained from the Authority Having Jurisdiction?
- Does the element of the building rating causing the weakness need to be pursued? Is there an alternative element that is more appropriate for the facility's function?
- Can the local utility service provide upgraded infrastructure to harden utility service?
- Are there ways to dialogue with the municipality to communicate the building's functions and how best to protect those functions for the community's benefit?

Resilience Assessment Pathway

- Identify threats, their impacts, and how vulnerabilities are exploited
- Assess recovery from those impacts and vulnerabilities during recovery
- Maximum resilience =
 1. Minimal impact
 2. Rapid recovery
 3. Marginal vulnerability during and after recovery



Strategies for Overcoming Facility Weaknesses and Threats

- Control facility entry points and access
 - Both at exterior entries and into separated interior areas
- Provide a level of monitoring physical access to a facility
 - Scale monitoring based on facility size and function
- Ensure utility service during outages based on critical function
- Harden the facility envelope against both natural and manmade disasters
- Design facility systems (e.g., HVAC, plumbing, electrical, life safety) to avoid being exploited by manmade threats

Practical Solutions for Hardening Mechanical Systems

- Ensure utility service is locked and only accessible by building and utility system owners
- Install occupant-accessible emergency shut-off controls for HVAC systems
 - Shut-off controls can shut off the HVAC system or close ventilation and exhaust air dampers
- Place building automation system, associated controls, and submeters on a secure network
- Depending on facility function, provide redundancy for HVAC and plumbing systems
 - Typical redundancy includes backup unit arrangement
 - Consider redundancy, partial or complete, in terms of heat sources (e.g., cogeneration with a boiler)
- Ensure utility redundancy and backup systems depending on facility function
 - Battery backup systems, multiple circuit or plumbing paths entering the building or certain interior areas



Thank you for your time!
Questions?

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