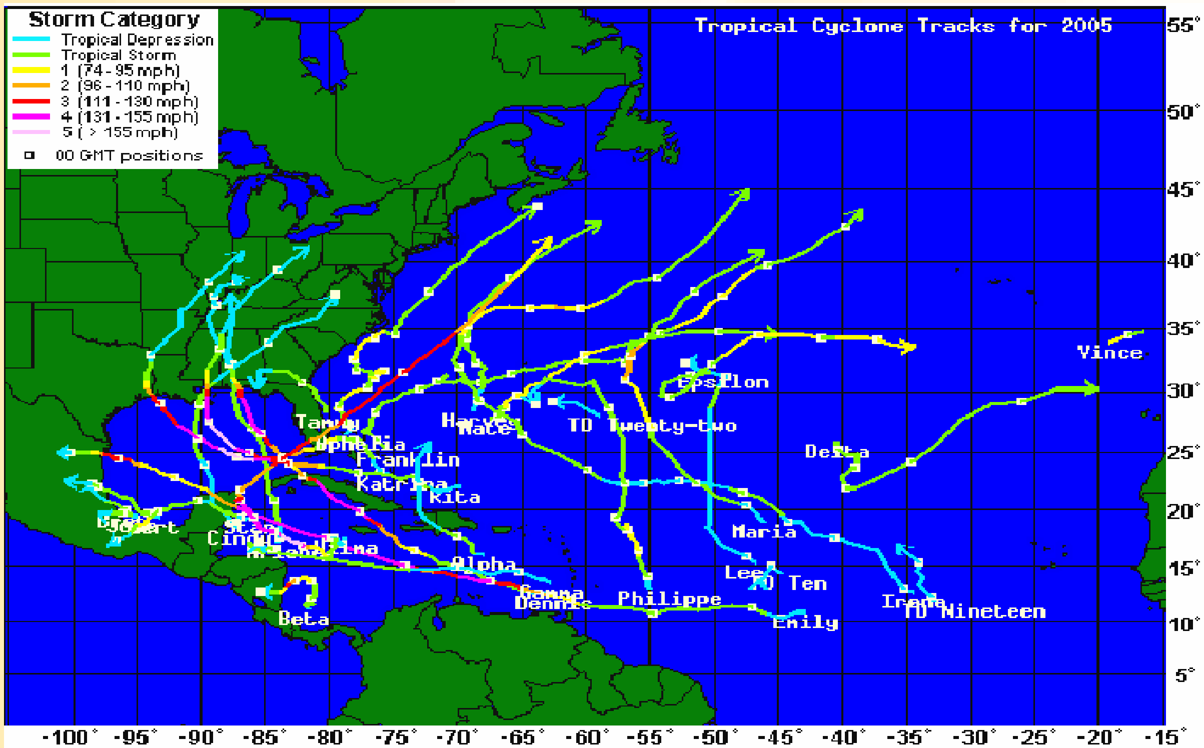
SHAI

Natural Hazards Assessment
Facilities in any geographic location are subject to a wide variety of natural phenomena such as windstorms, floods, earthquakes, and other hazards. While the occurrence of some of these events cannot be precisely predicted, their impacts are well understood and can be managed effectively through a comprehensive program of hazard mitigation planning.

Mitigation refers to measures that can reduce or eliminate the vulnerability of the built facility to hazards, whether natural or man made. The fundamental goal of mitigation is to minimize loss of life, property, and function due to disasters. Designing to resist any hazard(s) should always begin with a comprehensive risk assessment. This process includes identification of the hazards present in the location and an assessment of their potential impacts and effects on the built facility based on existing or anticipated vulnerabilities and potential losses.



It is common for different organizations to use varying nomenclature to refer to the components of risk assessment. For example, terrorism and foreign military power are referred to as "threats" by the intelligence community, while hurricanes and floods are referred to as "hazards" by emergency managers; however, both are simply forces that have the potential to cause damage, death, and injury, and loss of function in the built facility. The fundamental process of identifying what can happen at a given location, how it can affect the facility, and what the potential losses could be, remains essentially the same from application to application. Only after the overall risk is fully understood should mitigation measures be identified, prioritized, and implemented. There are four types of actions that can be taken to deal with the threat of natural hazards: mitigation, preparedness, response, and recovery.

Mitigation refers to long-term actions that reduce the risk of natural disasters, such as the use of flood gates, dams, wind resistant building construction, seismic bracing, etc.

Preparedness involves planning for disasters and putting in place the resources needed to cope with them when they happen. Examples include stockpiling essential goods and preparing emergency plans to follow in the event of a disaster.

Response refers to actions taken after a disaster has occurred. The activities of police, firefighters, and medical personnel during and immediately after a disaster fall into this category. This also includes communication with employees.

Recovery encompasses longer-term activities to rebuild and restore the community to its pre-disaster state. This is also a good time to engage in activities that reduce vulnerability and mitigate future disasters, such as strengthening building codes or modifying procedures and corporate policies.

Recommendations

Design professionals agree that the most successful way to mitigate losses of life, property, and function is to design buildings that are disaster resistant. This approach should be incorporated into the project planning, design, and development at the earliest possible stage so that design and material decisions can be based on an integrated a whole building approach.

A variety of techniques are available to mitigate the effects of natural hazards on the facility. Depending on the hazards identified, the location and construction type of a proposed building or facility, and the specific performance requirements for the building, the structure can be designed to resist hazard effects such as induced loads. Later in the building's life cycle, additional opportunities to further reduce the risk from natural hazards may exist when renovation projects and repairs of the existing structure is undertaken. When incorporating disaster reduction measures into building design, some or all of the issues outlined below should be considered in order to protect lives, properties, and operations from damages caused by natural hazards.

Earthquakes

Building design will be influenced by the level of seismic resistance desired. This can range from prevention of nonstructural damage in frequent minor ground shaking to prevention of structural damage and minimization of nonstructural damage in occasional moderate ground shaking, and even avoidance of collapse or serious damage in rare major ground shaking. These performance objectives can be accomplished through a variety of measures such as structural components like shear walls, braced frames, moment resisting frames, and diaphragms, base isolation, energy dissipating devices such as visco-elastic dampers, elastomeric dampers, and hysteretic-loop dampers, and bracing of nonstructural components.

Hurricanes, Typhoons, and Tornadoes

The key strategy to protecting a building from high winds caused by tornados, hurricanes, and gust fronts is to maintain the integrity of the building envelope, including roofs and windows, and to design the structure to withstand the expected lateral and uplift forces. For example, roof trusses and gables should be braced; hurricane straps should be used to strengthen the connection between the roof and walls; and doors and windows should be protected by covering and/or bracing. When planning renovation projects, designers should consider opportunities to upgrade the roof structure and covering and enhance the protection of fenestration.

Flooding

Flood mitigation is best achieved by hazard avoidance—that is, proper site selection away from floodplains. Should buildings be sited in flood-prone locations, they should be elevated above expected flood levels to reduce the chances of flooding and to limit the potential damage to the building and its contents when it is flooded. Flood mitigation techniques include elevating the building so that the lowest floor is above the flood level; dry flood-proofing, or making the building watertight to prevent water entry; wet flood-proofing, or making uninhabited or non-critical parts of the building resistant to water damage; relocation of the building; and the incorporation of levees and floodwalls into site design to keep water away from the building.

Rainfall and Wind-Driven Rain

One of the primary performance requirements for any building is that it should keep the interior space dry. All roofs and walls must therefore shed rainwater, and design requirements are the same everywhere in this respect. For example, roof drainage design should minimize the possibility of ponding water, and existing buildings with flat roofs should be inspected to determine compliance with this requirement.

Differential Settlement (Subsidence)

Ground subsidence can result from mining, sinkholes, underground fluid withdrawal, hydrocompaction, and organic soil drainage and oxidation. Subsidence mitigation can best be achieved through careful site selection, including geotechnical study of the site. In subsidence-prone areas, foundations should be appropriately constructed, basements and other below-ground projections should be minimized, and utility lines and connections should be stress-resistant. When retrofitting structures to be more subsidence-resistant, shear walls, geo-fabrics, and earth reinforcement techniques such as dynamic compaction can be used to increase resistance to subsidence damage and to stabilize collapsible soils.

Landslides and Mudslides

Gravity-driven movement of earth material can result from water saturation, slope modifications, and earthquakes. Techniques for reducing landslide and mudslide risks to structures include selecting non-hillside or stable slope sites; constructing channels, drainage systems, retention structures, and deflection walls; planting groundcover; and soil reinforcement using geo-synthetic materials, and avoiding cut and fill building sites.

The main natural hazards that affect the United States are;

- Earthquakes (ground movement, liquefaction of sands, landslides)
- Volcanic eruptions and related events
- Landslides, rock-falls
- Fast floods and mudflows in mountain areas, floods in river valleys, plains and coast
- Erosion, causing loss of productive land
- Soil problems (shrinking and swelling of clays, quick clays, collapsing soils)
- Dissolution features (caves, pipes)
- Deterioration of abandoned mines (collapsed shafts, subsidence, water rise, gases)
- Coastal erosion