



Earthquakes strike suddenly, without warning, and can occur at any time of the year, day or night. In regions of high seismicity, most buildings have been designed to resist earthquakes and to protect occupants from collapse. However, past earthquake performance of some older buildings has revealed deficiencies that can lead to substantial damage and possible collapse. Buildings known to have these deficiencies include: unreinforced masonry, older vintage concrete tilt-ups, and non-ductile (ductility is the ability of a structure to bend and sway without failure) concrete frames. Nonstructural elements can also be an issue because of inadequate bracing of architectural elements such as partition walls and ceilings, unanchored mechanical and electrical equipment, and content improperly restrained furniture, fixtures, etc. In some instances, nonstructural elements are also a life-safety concern because of falling hazards. The following tips may assist those in areas of moderate and high seismicity.

## ACTION TO BE TAKEN BEFORE AN EARTHQUAKE:

### Plant Management/Emergency Team:

- Determine if the facility is safe by identifying and understanding where possible problems can occur.
- Strengthen and secure facility's now by reducing or eliminating identified hazards.
- Develop an emergency preparedness plan that includes: evacuation and reunion plans, training and practice drills, inspection checklists, shutdown procedures, out-of-region contacts for vendors and emergency services, etc.
- Maintain emergency equipment and supplies in easily accessible locations (i.e., shipping container located away from any potential falling hazards).

### Buildings and Nonstructural Elements:

- Assess seismic adequacy of buildings and nonstructural elements.
  - A seismic risk assessment can be performed by qualified licensed Structural Engineers that specialize in earthquake mitigation to determine how the buildings and nonstructural elements will perform in a future earthquake and identify potential vulnerabilities and concerns.
- Identified mitigation measures should be implemented to reduce business interruption, loss of market share, property damage, occupant injuries, insurance costs, threat to shareholder equity, and litigations costs.
- Some cost-effective measures can include:
  - Providing an emergency gas shutoff valve to limit potential gas leakage.
  - Bolting and bracing mechanical and electrical equipment to prevent damage from shifting and falling injury to nearby occupants.
  - Bolting and bracing potential falling objects such as bookcases and cabinets.
  - Bracing all suspended ceilings and light fixtures to prevent them from falling on occupants below.
  - Bracing hot water heaters, especially gas-fired units, to avoid pipe failures, water damage and gas leakage.
  - Providing egress corridors free of falling objects and debris that could impede exits through any passageway.

### Emergency Equipment:

- As a minimum, the following equipment and supplies should be considered food and water, first aid kits, shelter materials such as blankets and tents, flashlights and spare batteries, portable battery-powered radios and spare batteries, satellite phones, and rescue equipment such as ropes, jacks, and cutters.
- Provide adequate emergency power back-up (i.e., generators and fuel).

## ACTION TO TAKE DURING EARTHQUAKE:

### Plant Management/Emergency Team:

- If you are inside a building when the shaking starts:
  - Drop where you are, cover and hold on.
  - Stay away from windows to prevent injury from shattered glass.
  - Stay away from hazards such as heavy objects that can fall.
  - Stay indoors until shaking stops and it is safe to exit.
- If you are outside when the shaking starts:
  - Find clear area and sit on the ground.
  - Stay away from power lines, trees and streetlights.

## ACTION TO TAKE AFTER EARTHQUAKE:

### Plant Management/Emergency Team:

- The Earthquake Emergency Response Team should be prepared and trained in recovery and salvage efforts specific for each location.
- The site should be secured and a Command Center should be established to direct the recovery operation.
- Survey and identify life-safety hazards such as: permanently deformed structures (leaning or tilting), extensive cracking and distortions to structural elements, leaking gas or flammable materials, spillage of toxic chemicals, unstable ceilings, partition walls, etc., and injured or trapped occupants. Expect aftershocks and never enter an unsafe building because further damage can occur and lead to possible life-safety hazards.
- Structural damage should always be assessed by a licensed Structural Engineer familiar with earthquake damage to determine whether the building can be occupied, the extent of damage, and what remediation measures should be implemented.
- Designated key personnel and emergency contractors should be called to coordinate and start repairs and salvage. Ensure that all contractors are familiar with Company Policy Programs and share responsibility for fire safe conditions at all times.