QUAKESMART
TOOLKIT

FLASH®
Strengthening Homes & Safeguarding Families

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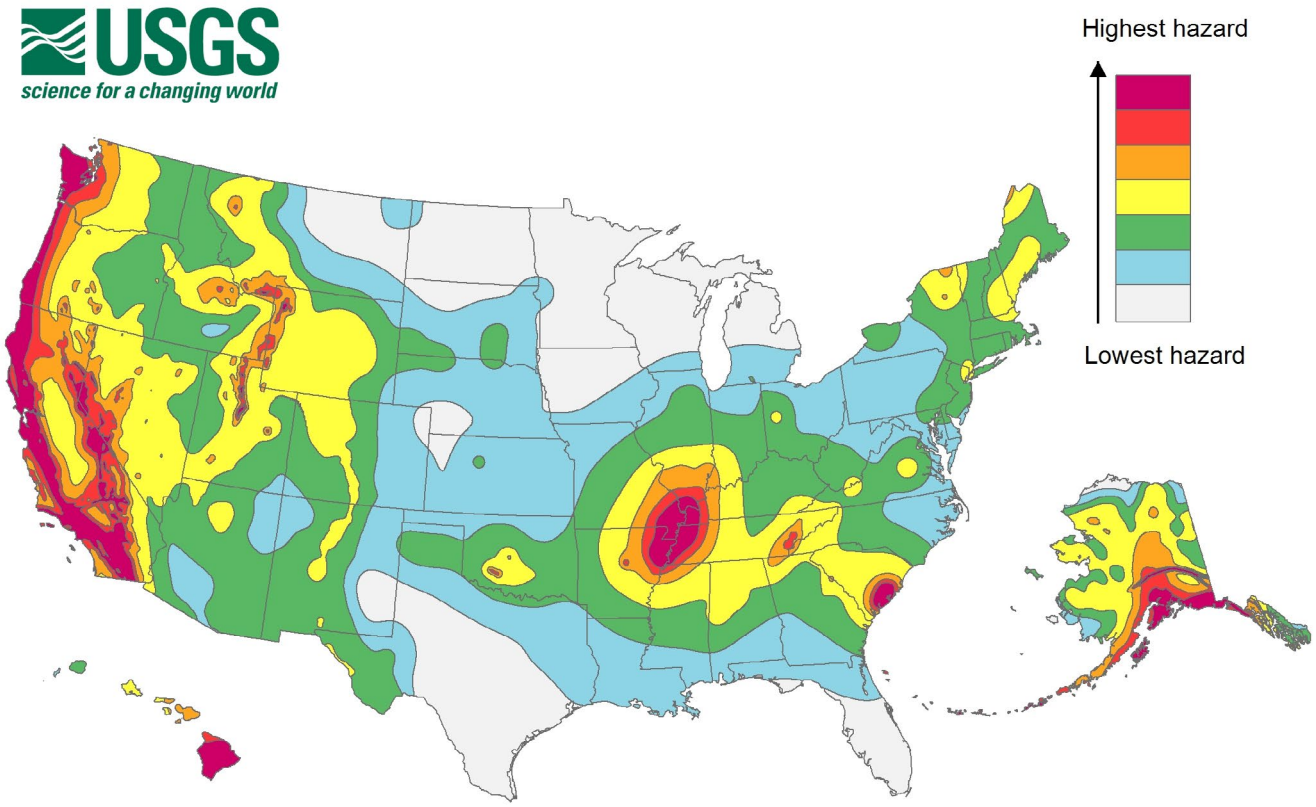
Introduction

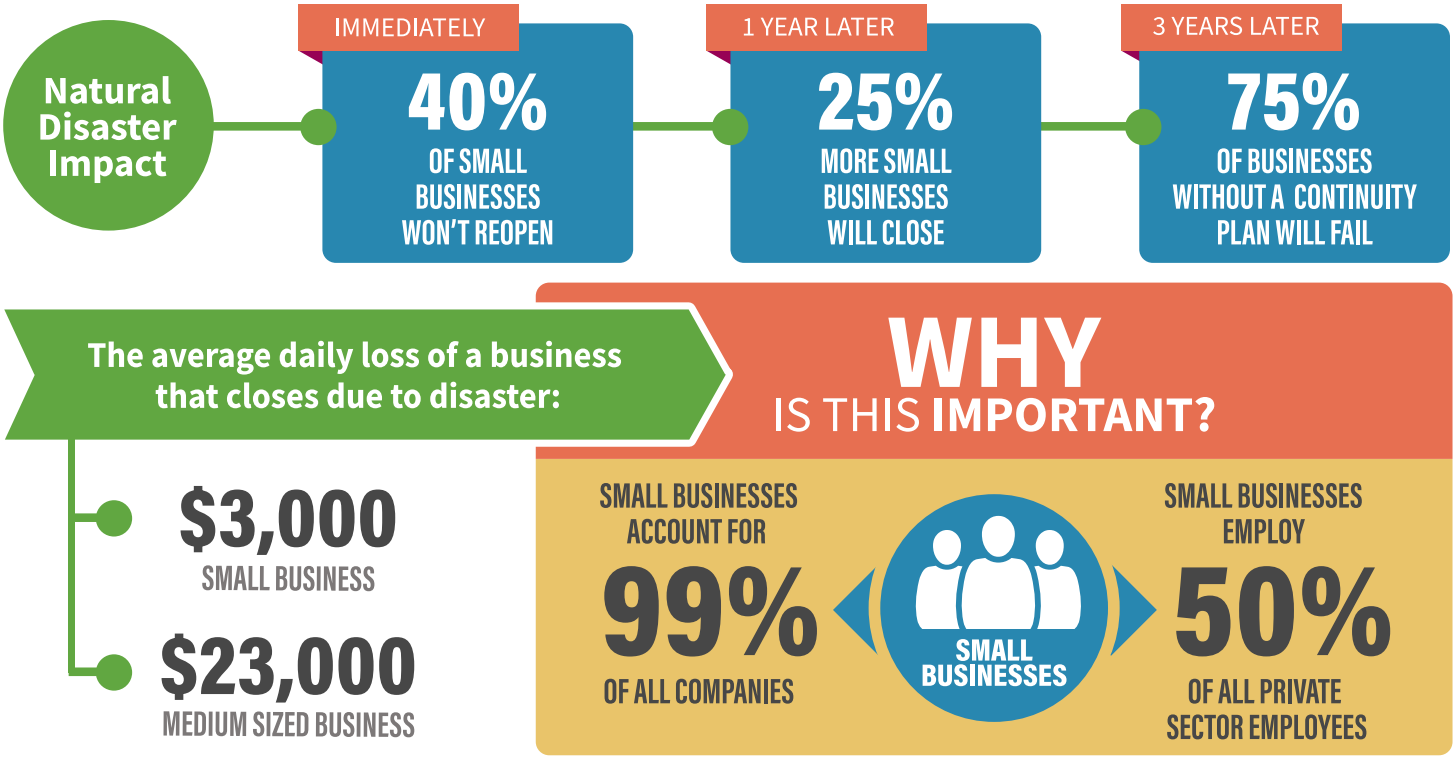
Should your organization be concerned about earthquake risk? Absolutely.

Unlike other natural disasters, we cannot predict earthquakes. And most of the United States is at some risk for earthquakes, not just the West Coast. Understand the risk earthquakes pose to your business, develop preparedness and mitigation strategies, and act before an earthquake to avoid potential injuries, damage, and losses.



Planning can help minimize losses from earthquake impacts, as well as other disasters. For every $1 dollar spent on earthquake building retrofits, $13 dollars were saved according to a National Institute of Building Sciences national estimated average benefit cost ratio.

Preparing for earthquakes will not only increase the safety of employees and customers, it will help you stay in business after an earthquake. Maintaining business continuity is essential for you, your employees, and your customers. Consider the importance of providing goods and services to customers and the supply chain; maintaining cash flow; preserving competitive advantage and reputation through recognition; and meeting legal, regulatory, financial, and contractual obligations.



Source: Bruce Blythe, CEO, Crisis Management International in Blindsided: A Manager's Guide to Catastrophic Incidents in the Workplace by Bruce T. Blythe (Portfolio Hardcover, August 22, 2002)
2014 data from the Federal Emergency Management Agency (FEMA) and US Department of Labor

Organizations can invest in simple mitigation actions to stay operational and lessen losses from an earthquake's impact. These can be investments of time, expertise, and money. The QuakeSmart Resilience Program (**QuakeSmart**) can help organizations determine where to make those investments.

Among the impacted small businesses in 2017 disaster-affected areas, 61% had revenue losses ranging from $1 to $25,000, and 35% had revenue losses over $25,000 (Federal Reserve Bank of San Francisco). For example, Anheuser-Busch invested $11 million to retrofit its California brewery just before the 1994 Northridge earthquake and saved $2 billion, protecting its market share and employees (National Institute of Building Sciences).

Program Overview

QuakeSmart is a Federal Emergency Management Agency (FEMA) program that guides businesses and organizations of all sizes to identify potential vulnerabilities and learn ways to reduce earthquake-related losses**. QuakeSmart** moves organizational leaders through a three-step process to:

- Identify your risk,
- Develop and execute an **Action Plan**, and
- Be recognized and inspire others.

QuakeSmart outlines six focus areas for businesses and organizations to improve earthquake readiness: **STAFF, SPACE, SYSTEMS, STRUCTURE, SURROUNDINGS, and SERVICE**. Your organization can complete one or all the six areas. What matters most is focusing on what you believe is most critical to protect.

STAFF includes planning and preparedness activities to protect your onsite and remote employees, contractors, and team before an earthquake so that your business can maintain or rapidly resume operations afterward.
Watch Video

SPACE includes nonstructural mitigation options to secure the contents of your building. Contents include computers, electronics, filing cabinets, freestanding partitions, furniture, hanging artwork, office equipment, and tall shelving.
Watch Video

SYSTEMS include nonstructural architectural elements, equipment, fixtures, utility systems, and more. Examples include air compressors; automatic fire sprinkler piping and heads; backup power sources; built-in partitions; exterior signs; exterior veneer; freestanding walls or fences; heating, ventilation, and air conditioning (HVAC); piping; propane, fuel or filtration tanks; roof parapets; suspended light fixtures; suspended T-bar ceilings; suspended space heaters; stairways; water heaters; and windows.
Watch Video

STRUCTURE includes architectural and structural building elements (ceiling, floor, structural walls/columns) focusing on construction methods that may create or increase the risk of collapse or failure during an earthquake. Concrete tilt-up, improperly welded steel frame, unreinforced masonry, unreinforced or under-reinforced concrete, or unreinforced soft-story construction create building weakness in the face of earthquake shaking. This section also focuses on building façades that use unreinforced or unanchored brick or exterior architectural elements.
Watch Video

SURROUNDINGS include everything outside your building's walls that may cause damage, disrupt your business or organization operations, or create conditions that prevent employees and customers from entering or leaving your workplace. Examples include a neighboring business' unreinforced brick building, large trees, a nearby river, a gas station, railroad tracks, or hazardous materials storage sites. Watch Video

SERVICE includes opportunities for your organization to engage, support, and give back to your community following an event by asking, "What kind of help can we provide after a disaster?" You and your employees could deliver free ice, help prepare meals, remove debris from homes, or help staff a local volunteer agency. Watch Video

Lessons Learned – COVID-19

There are important lessons learned from the COVID-19 pandemic relevant to earthquakes. Pandemics can have multiple "waves" of outbreaks that cause ongoing challenges for businesses. Similarly, within the months following a large earthquake, aftershocks can be equally or even more damaging than the main quake. After the Christchurch, New Zealand earthquake in September 2010, destructive aftershocks lasted until late 2011.

For businesses that survived during the pandemic, how did they withstand multiple shutdowns and disruptions in supplies and services for customers? How can these strategies be implemented to mitigate the impacts of expected aftershocks?

Beyond the main shock of an earthquake and any aftershocks, concurrent and cascading disasters such as fire following the earthquake can compound injuries, damage, business interruption, and increased repair or recovery costs. The key is to prepare or mitigate before the first disaster happens. Also, consider supply chain impacts from an earthquake: even if your location has a low earthquake risk, are your materials or products manufactured or distributed in an area prone to earthquakes? Are you importing or exporting items through locations vulnerable to earthquakes?

Begin the **QuakeSmart** program by completing the **Back-to-Business Self-Assessment** to identify vulnerabilities from any source.

QuakeSmart will provide you with tools to create your business continuity planning, including the **FEMA Business Continuity Plan** and the **Disaster Resistant Business (DRB) Toolkit**.

For more information or assistance, contact **info@flash.org** or (877) 221-7233.

The **QuakeSmart Nonstructural Assessment Program (QSnap)** is an additional resource for businesses and organizations who wish to increase earthquake resilience in the workplace. **QSnap** is a free safety review to identify potential nonstructural hazards that may cause injuries, disruption, and cascading disasters like fire-following earthquakes. Where offered, participating fire departments provide the **QSnap** earthquake safety assessment to the building owner or tenant as an added feature of routine annual fire inspections. The program is relatively new, so your community may not have an official **QSnap** program at this time. However, you can request the **QSnap** materials by contacting info@flash.org.

CASCADING DISASTERS – FIRE-FOLLOWING EARTHQUAKES

Earthquakes can cause catastrophic damage, but that damage can also ignite fires caused by ruptured gas lines, damaged electrical equipment, and interior flooding. It's difficult to control fires after an earthquake when water lines are damaged, and transportation routes are blocked. History shows us the risk of fire-following earthquakes after the 1906 San Francisco and 1994 Northridge earthquakes. In San Francisco, fire destroyed over half of the city. More than 14,000 gas leaks and 110 fires occurred after the Northridge earthquake.

A CASE STUDY: THE NISQUALLY EARTHQUAKE

During the 2001 Nisqually Earthquake in the Pacific Northwest, some businesses reported that trained employees immediately dropped under desks or tables and held on ("Drop, Cover, and Hold On"). They were uninjured and ready to assist others after the shaking stopped. Other businesses reported frantic and varied employee reactions to the earthquake, including scrambling out of buildings into falling glass and bricks, as well as standing in doorways. These actions are unadvisable and dangerous.

Prepared businesses reported employees expressing thanks that their employer provided earthquake awareness training, as well as appreciation for senior management personally checking on employees after the event.

Source: What Businesses Learned From The Nisqually Earthquake Of February 28, 2001. CREW.

Benefits

By participating in **QuakeSmart**, you will:

- Learn ways to protect your staff, customers, and investments against earthquakes.
- Receive important business continuity planning tools.
- Gain peace of mind that your organization is prepared not only for earthquakes, but for other business interruptions or natural disasters.
- Potentially qualify for new insurance coverage or discounts offered for an earthquake-strengthened organization or business.
- Receive materials to help promote your business or organization as **QuakeSmart**, including a recognition certificate; a web badge to display on your organization's website; and a sample news release to recognize and acknowledge your organization's participation in **QuakeSmart**, along with tips for media placement.
- Become an inspiration to others to improve community resilience.

1. IDENTIFY YOUR RISK

Complete the **Back-to-Business Self-Assessment** to identify areas where your organization can prepare, mitigate risk, and better ensure a return to operation following an earthquake.

2. DEVELOP AND EXECUTE AN ACTION PLAN

a. Based on the information in the **Back-to-Business Self-Assessment**, complete the **Action Plan** for **STAFF, SPACE, SYSTEMS, STRUCTURE, SURROUNDINGS, and SERVICE** to identify preparedness and mitigation actions needed to ensure safety and business continuity. Completing this plan will bring you one step closer to **QuakeSmart** recognition. It may also help you qualify for insurance, discounts, or other financial incentives.

b. Review the **QuakeSmart Quick Reference Guide** to determine which preparedness and mitigation actions you want to take based on the potential impacts to your organization and add them to your **Action Plan**. Consider your options when planning for earthquakes, including priority preparedness or mitigation actions, and the potential to phase actions according to priorities and available resources.

c. Use the Cost Estimation Worksheet in the Appendix or the comprehensive spreadsheet available online.

d. Perform preparedness and mitigation activities as prioritized in the **Action Plan**. Document your actions as instructed in the checklists for **STAFF, SPACE, SYSTEMS, STRUCTURE, SURROUNDINGS, and SERVICE**.

e. Document any items you were unable to complete and schedule your next priority items at a predetermined time (e.g., one year later). Review to make sure secured items are still in place and include any new furniture or equipment.

3. BE RECOGNIZED AND INSPIRE OTHERS

a. Complete and submit the application to be recognized as a **QuakeSmart Business** or **QuakeSmart Organization.**

b. Share the story of your resilience success widely. Use social and traditional media, press releases, and your website to inspire others to increase their resilience.

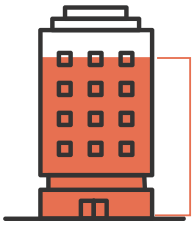
*After you have completed these three steps, you will be eligible to become **QuakeSmart**. Enjoy the peace of mind of knowing you have done your part to promote safety, mitigate potential loss, and protect your business or organization.*

1. IDENTIFY YOUR RISK

Back-to-Business Self-Assessment

PLANNING SCENARIO

On December 1 of this year, an earthquake strikes your community and damages the structure and contents of your organization's building. Due to damage, your facility has been temporarily 'red tagged' during a rapid assessment by the building department and is closed. A more thorough structural evaluation is needed to determine if your structure is safe or can be made safe for reopening. In the meantime, no one can occupy the building.



80% **of a building's value is in its equipment, inventory, and other contents**

Source: FEMA E-74, Reducing the Risks of Nonstructural Earthquake Damage - A Practical Guide

Because of the number of buildings damaged in your community, your building's detailed structural evaluation will take place three days after the earthquake. Assume you will not be able to access your facilities for at least three days.

Depending on your organization, expect that 50% of inventory (product) is unsellable, or 50% of the equipment is damaged. Assume that all utilities are interrupted.

The building inspection will show that the damage is repairable to the structure, so add one additional day to your closure to address necessary cleanup, repairs, and replacement of contents. Based on this scenario, answer the 16 questions in the **Back-to-Business Self-Assessment** to identify your risk.

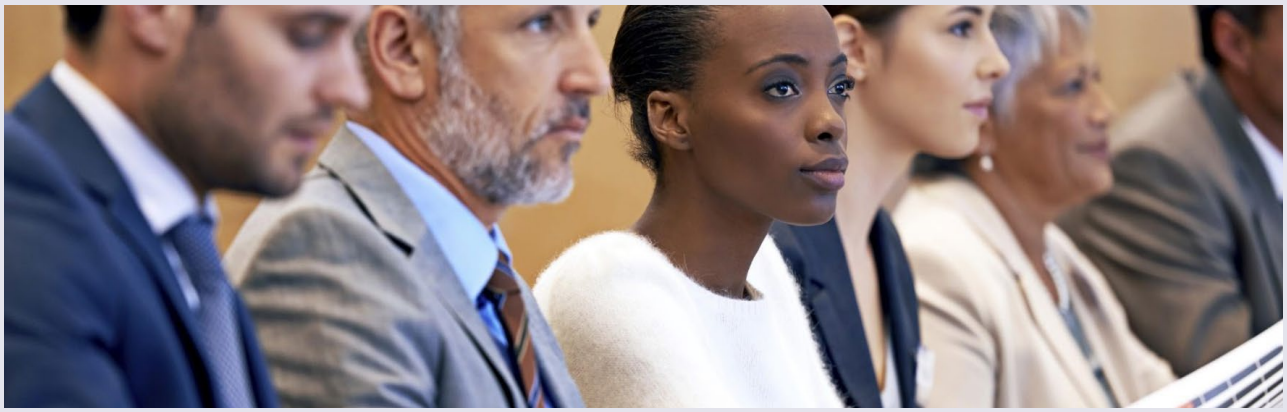
ASSESS YOUR READINESS

Based on the planning scenario, answer these 16 questions to identify focus areas for your **QuakeSmart Action Plan**.

IMPACTS		RESOURCES THAT MITIGATE DAMAGE, DISRUPTIONS, AND INJURIES
SPACE/SYSTEMS/STRUCTURE		
1. Can your organization operate without computers, copiers, fax machines, files, inventory, or special equipment (e.g., x-ray equipment, cash register, credit card readers)?	❑ Yes ❑ No	QuakeSmart Program - **SPACE**
2. Can your organization operate without gas, power, water, internet, or telecommunications?	❑ Yes ❑ No	QuakeSmart Program - **SYSTEMS**
3. Can you still operate your organization without access to the damaged building?	❑ Yes ❑ No	QuakeSmart Program - **STRUCTURE**
IMPACTS TO PEOPLE (STAFF/CUSTOMERS/VENDORS/SUPPLIERS)		
4. Can you pay your employees without business income?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
5. Are your employees able to commute to work?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
IMPACTS ON YOUR ORGANIZATION		
6. Is your organization easily accessible to the public, your customers, and employees (e.g., parking, online)?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
7. Can your employees work remotely from home while the building is closed (e.g., do they have what they need right now)?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
8. Are you communicating status with employees, key customers, vendors, and suppliers throughout your recovery?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
9. If you can't operate the organization without access to the damaged building, will you need to relocate?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
10. Have you set priorities on what operations your organization needs to recover (1st, 2nd, 3rd, etc.)?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
11. Are your suppliers up and running, or do you have sufficient parts/supplies on hand to continue without resupply?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
12. Does your insurance cover earthquake-related damages and losses to your property, contents, and inventory?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
13. If your property was damaged in an earthquake, can you prioritize repairs to protect against potentially damaging aftershocks over the next few weeks/months?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**

IMPACTS		RESOURCES THAT MITIGATE DAMAGE, DISRUPTIONS, AND INJURIES
14. Are you able to ship your product or provide services to your customers based on your current impacts?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
15. Do you still have all your customers/clients after the disaster?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**
OVERALL OPERATIONS (SURVIVABILITY)		
16. Will your losses be too much for your organization to survive if it is closed/inaccessible for at least 3–7 days?	❑ Yes ❑ No	QuakeSmart Program - **STAFF**

WHEN DISASTERS DISRUPT THE WORKFORCE – THE COVID-19 PANDEMIC



Employees are the essential engine of businesses, and few companies can succeed without them. No disaster demonstrated this more than the COVID-19 pandemic that affected hundreds of thousands of U.S. businesses and millions of American workers. Lockdowns, quarantines, closed businesses, social distancing requirements, and the overarching threat of infection sent U.S. businesses into a whirlwind of challenges nearly overnight with devastating economic consequences.

Businesses that survived met the challenge by adjusting physical site conditions, leveraging technology to allow home-based work, securing essential personal protective equipment, investing in sanitization tools, and adapting as the disaster continued to unfold. In 2020–21, Yelp reported that approximately 60% of businesses that closed during the COVID-19 pandemic will not reopen, with restaurants having suffered the most. In February 2021, The White House stated that since the beginning of the pandemic, 400,000 small businesses have closed with millions more in danger.

The extraordinary COVID-19 pandemic makes a strong case for contingency planning with the unthinkable in mind. As with COVID-19, businesses that anticipate the unexpected like a major earthquake will have a better survival opportunity. Use the **QuakeSmart** toolkit to anticipate and plan for business continuity during an earthquake scenario. Prepared businesses not only survive, they protect their most valued assets, their employees, as well.

2. DEVELOP AND EXECUTE AN ACTION PLAN

1. Based on the information in your **Back-to-Business Self-Assessment**, create an **Action Plan** for your **STAFF, SPACE, SYSTEMS, STRUCTURE, SURROUNDINGS,** and **SERVICE** to identify critical preparedness and mitigation actions needed to ensure safety and business continuity. Completing this **Action Plan** will bring you one step closer to recognition as a **QuakeSmart Business** or **QuakeSmart Organization**.

2. Review the **Quick Reference Guide** for each category to determine which preparedness and mitigation actions you want to take based on the potential impacts to your organization.

3. Use the **Cost Estimation Worksheet** to estimate the costs of mitigation. Organizations learn many mitigation costs are more reasonable than they previously thought and can be completed sooner, while other items will need to be scheduled and budgeted over a more extended period (e.g., structural retrofit).

4. If you are leasing your building, ask your building owner to approve your mitigation measures. Always check with your local building official before taking any mitigation activity. Determine whether your building meets the evaluation standards of FEMA P-154, ASCE 41-17, FEMA E-74, as well as other evaluation standards like the U.S. Resiliency Council Building Rating.

5. Perform the preparedness and mitigation activities as prioritized in the **Action Plan**. Document your activities in the checklists for **STAFF, SPACE, SYSTEMS, STRUCTURE, SURROUNDINGS**, and **SERVICE** with videos, photographs, receipts, or letters from an engineer, or registered design professional to retain for your records and use, where applicable.

STAFF

STAFF includes planning and preparedness activities to protect your onsite and remote employees, contractors, and team before an earthquake so that your business can maintain or rapidly resume operations afterward.

The **STAFF** portion of the **Action Plan** identifies essential planning and training steps focused on business continuity, employee education and training, crisis communications methods, and any contingencies specific to your business. While the **Action Plan** checklist is not all-inclusive, it will spark ideas and get you started. Use the **Action Plan** to map out and document actions taken. Once you perform steps 1–5, you will qualify as a **QuakeSmart – STAFF Member**.

WATCH VIDEO

2. DEVELOP AND EXECUTE AN ACTION PLAN - STAFF OVERVIEW

POTENTIAL PREPAREDNESS ACTION	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE	NOTES
1. Develop a **Business Continuity Plan** with a Crisis Communications Strategy		❑ Yes ❑ No ❑ Not Applicable	
2. Conduct an Employee Education Campaign		❑ Yes ❑ No ❑ Not Applicable	
3. Develop an Employee Training Program		❑ Yes ❑ No ❑ Not Applicable	
4. Conduct an Employee Training Session		❑ Yes ❑ No ❑ Not Applicable	
5. Register for the Great ShakeOut and Conduct an Earthquake Drill		❑ Yes ❑ No ❑ Not Applicable	
SUGGESTED ACTION: Build an Emergency Supply Kit		❑ Yes ❑ No ❑ Not Applicable	
SUGGESTED ACTION: Purchase a NOAA Weather Radio for Monitoring During an Event and Download a Mobile Alerting App		❑ Yes ❑ No ❑ Not Applicable	
SUGGESTED ACTION: Review Insurance Coverage and Create Inventory		❑ Yes ❑ No ❑ Not Applicable	

STAFF – ACTION PLAN

Use the **Action Plan** to identify preparedness and mitigation actions.

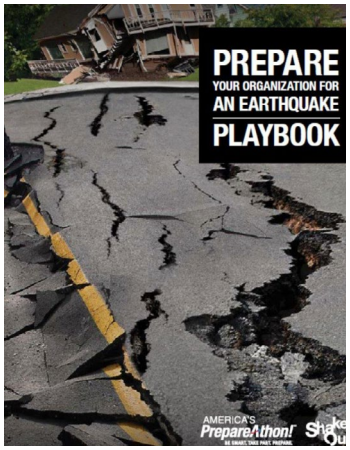
PREPAREDNESS ACTION	PREPAREDNESS SOLUTIONS	PREPAREDNESS RESOURCES
STEP 1: Develop a **Business Continuity Plan** with a Crisis Communications Strategy	Create a **Business Continuity Plan** that includes strategies for backing up and storing critical business documents and data. Build your **Business Continuity Plan** using the Disaster Resistant Business (DRB) Toolkit, an easy, step-by-step interactive guide that helps you navigate emergencies before, during, and after they occur. Learn how to build a team, prioritize operations, reduce risk, train employees, and exercise your disaster plan.	QUAKESMART Business Continuity Plan DRB Toolkit Business Continuity Plan-Builder (Use coupon code: quakesmart)
	Create a Crisis Communications Strategy that will become a part of your **Business Continuity Plan** and could be needed at any moment. It should include internal and external communication protocols for before, during, and after a disaster. Communication is especially critical with customers.	QUAKESMART Crisis Communications Plan
STEP 2: Conduct an Employee Education Campaign	Conduct an employee education campaign to explain the risk of earthquakes and to make employees aware of home hazards, preparedness actions, and mitigation activities. See How to Prepare for an Earthquake; FEMA P-909, Home and Business Earthquake Safety and Mitigation; and FEMA P-530, Earthquake Safety at Home.	How to Prepare for an Earthquake FEMA P-909, Home and Business Earthquake Safety and Mitigation FEMA P-530, Earthquake Safety at Home (March 2020)

2. DEVELOP AND EXECUTE AN ACTION PLAN - STAFF

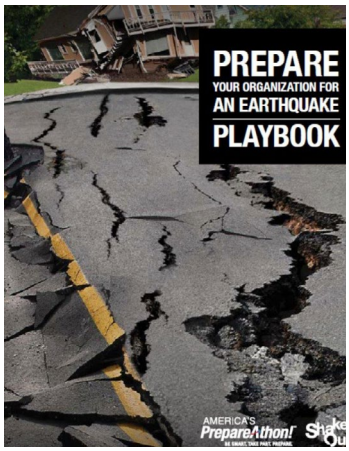
PREPAREDNESS ACTION	PREPAREDNESS SOLUTIONS	PREPAREDNESS RESOURCES
STEP 2: Conduct an Employee Education Campaign	Inspect2Protect.org can show employees what building code is used in their community, which provides insight into the construction practices used for their home, future home, office, or rental. The website will provide suggestions for renovations, retrofits, and upgrades to make their home or home office safer and stronger based on their building code. Renters may use these resources to identify risks and request their landlord to take strengthening actions. Some building departments in seismic regions, like the City of Los Angeles, have prescriptive plan sets to assist owners with mitigation of seismic risk, such as wood frame homes with cripple walls.	NO CODE. NO CONFIDENCE. inspect to protect Inspect2Protect.org FEMA P-1100, Volume 1: Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
	Educate employees on the safest actions to take during an earthquake. Consider developing a one-week campaign that ties into locally recognized events like a historic earthquake anniversary, a state ShakeOut campaign, and/or national events like National Preparedness Month, Fire Safety Month, or Building Safety Month. Share information via “lunch and learn” events; spotlight videos to watch at work or from home; email regular tips/ links to explain hazards and options to prepare at work and home.	Recommended Earthquake Safety Actions

There are several jurisdiction-level programs that provide grants to individuals to improve their home’s ability to survive an earthquake. The California Earthquake Authority (CEA)’s Brace and Bolt Grants include two programs to help fund seismic retrofits to homes built before 1980 in California, both offering grants of up to $3,000. And for qualified retrofitted homes, CEA offers a premium discount of up to 25%. Salt Lake City’s Fix the Bricks focuses on funding home retrofits for unreinforced masonry homes.

Additionally, the U.S. Small Business Administration offers mitigation assistance to rebuild stronger after disasters by increasing its disaster assistance loan up to 20% of verified physical damage for mitigation improvements.

PREPAREDNESS ACTION	PREPAREDNESS SOLUTIONS	PREPAREDNESS RESOURCES
STEP 3: Develop an Employee Training Program	Develop a training program that provides several activities for employee engagement. The training should: • Educate employees about your organization's business continuity and crisis communication plans. • Include basic first aid and CPR or other selected training. • Practice "Drop, Cover, and Hold On," especially explaining locations to take cover at work and home. • Incorporate drills or exercises after training to provide an opportunity to practice their new skills. Contact the fire department and local and federal emergency management agencies for training resources. Design training elements you want to be included in your workplace emergency response, such as how to perform CPR and first aid, light search and rescue, evacuation and floor sweeps, fire extinguisher use, accounting for employees, shelter in place, etc. Review your **Business Continuity Plan**, Crisis Communication Strategy, and Employee Education Campaign. Use the Prepare Your Organization for an Earthquake Playbook to facilitate this discussion and engage your employees. Update your **Business Continuity Plan** with changes to emergency response roles and activities. Use your education campaign to recruit volunteers for emergency roles and training.	 Prepare Your Organization for an Earthquake Playbook. FEMA 7 Steps To A Disaster Resilient Workplace

2. DEVELOP AND EXECUTE AN ACTION PLAN - STAFF

PREPAREDNESS ACTION	PREPAREDNESS SOLUTIONS	PREPAREDNESS RESOURCES
STEP 4: Conduct an Employee Training Session	At least once a year, conduct employee training on selected emergency response roles. Provide equipment to match the training level, such as personal protective equipment (PPE) and first aid supplies (bandages, medical tape) for employees taking first aid and CPR. Conduct a drill or exercise at the end of training or within the year for them to practice what they learned. Refresh annual training with lessons learned from recent disasters or experiences and include them in future training.	 Prepare Your Organization for an Earthquake Playbook. FEMA
STEP 5: Register for the Great ShakeOut and Conduct an Earthquake Drill	Register your organization to participate in your region's Great ShakeOut earthquake drill and then conduct your drill accordingly. Before you begin the campaign, contact and inform your local Emergency Manager about your events; they may offer you additional ideas, resources, or support. Make the event fun and engaging. The core of ShakeOut is a simple, 1-minute "Drop, Cover, and Hold On" drill. Have all employees participate in the core drill, then add additional elements to exercise your trained personnel to practice what they know. Use any lessons learned to update your emergency procedures and **Business Continuity Plan**.	ShakeOut™ Great ShakeOut
SUGGESTED ACTION: Build an Emergency Supply Kit	Build an emergency kit with supplies that you may need before, during, and after an earthquake or other event. Check it annually to ensure nothing has expired or needs to be replaced. Emergency supplies should match the level of your trained employees (e.g., crowbar and fulcrum for search and rescue, space blankets for first aid, etc.).	QUAKESMART Emergency Supply List

SUGGESTED ACTION: Purchase a NOAA Weather Radio and Download a Mobile Alerting App	Purchase a NOAA Weather Radio with single area message encoding (SAME) and download a severe weather or emergency alerts app for your mobile device. Smartphone apps provide information about shelters, how to provide first aid, and how to seek assistance for recovery. Also, the U.S. Geological Survey manages the Earthquake Notification Service, which provides free notification emails when earthquakes happen in your area or anywhere in the world. Sign up for Earthquake Early Warning where it is available. Earthquake Early Warning systems can give users seconds or tens of seconds advance warning of earthquake shaking waves to take protective actions. You may also sign up to receive emergency notifications from your local emergency services. Check out the available emergency alerts from Ready.gov. Emergency information will be provided immediately after an earthquake through radio and TV broadcasts and via wireless emergency alerts texted to cell phones. Designate a Team Leader and assign them to monitor your NOAA Weather Radio during an event. Listen and heed instructions given by local emergency management officials. Have backup batteries and chargers for all devices.	NOAA Weather Radio All Hazards Earthquake Early Warning QUAKESMART Emergency Alerts Ready.gov
SUGGESTED ACTION: Review Insurance Coverage and Create Inventory	Meet with your insurance agent annually to review your insurance, especially property coverage limits, deductibles, and coinsurance requirements using the Insurance Coverage Discussion Form. Because earthquake damage is usually not covered in most policies, ask your agent if your property and contents are covered in an earthquake. If not, ask about adding earthquake coverage. If you cannot afford earthquake coverage for the entire business, determine the most critical elements of your organization, and make sure insurance protects those areas. Maintain current photos or videos of your inventory, premises, equipment, supplies, etc. Make sure to add any new equipment to the insurance policy as soon as it is installed. Review the policy annually.	QUAKESMART Insurance Coverage Discussion Form

For additional information, refer to Prepare Your Organization for an Earthquake and How to Prepare for an Earthquake.

Many of the action plan activities under the QuakeSmart STAFF section can be incorporated into ongoing employee awareness, education, and training programs as additional content or features.

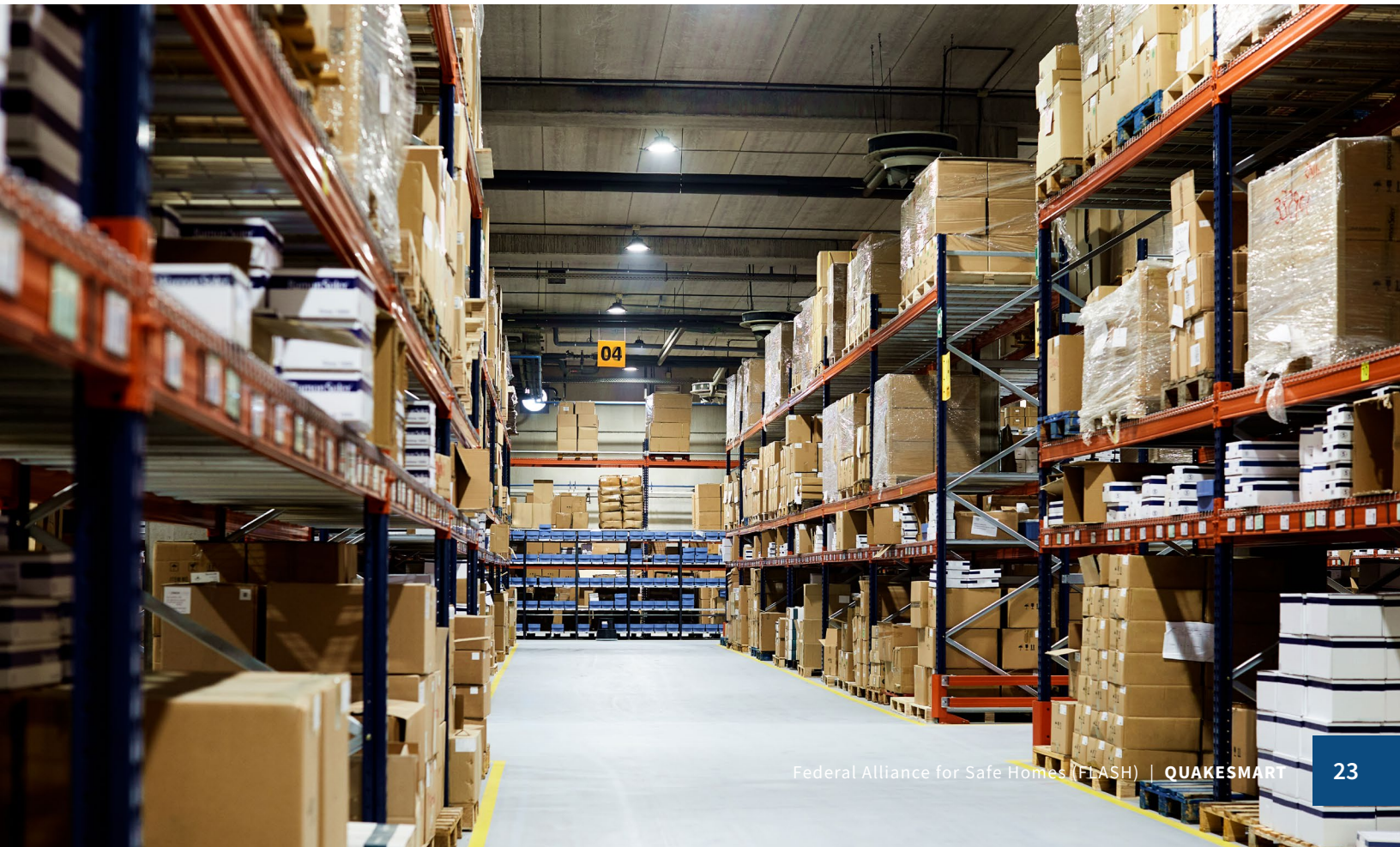
STAFF - NOTES

SPACE

SPACE includes nonstructural mitigation options to secure the contents of your building. Contents include computers, electronics, filing cabinets, freestanding partitions, furniture, hanging artwork, office equipment, and tall shelving. Complete the **SPACE Action Plan** to identify and address your onsite and offsite contents and inventory, including for home-based or remote employees.

Be sure to consult and follow all applicable building codes, including permitting requirements, when securing your SPACE and consider the unique risks in your organization related to your function. For example, California's building codes address **SPACE** risks for hospitals by specifying equipment that must be anchored or restrained and defining acceptable restraint products and methods. You will be eligible for recognition as a **QuakeSmart – SPACE Member** by performing all applicable activities in this section of the **Action Plan**.

WATCH VIDEO



2. DEVELOP AND EXECUTE AN ACTION PLAN - SPACE OVERVIEW

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Computers, TVs, or Office Equipment	Monitor/laptop or TV strapped to desk or table, desktop latched to the desk, desk or table secured			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Miscellaneous Furniture such as Equipment Racks; Small Objects; Shop/Gym Equipment; Floor-Mounted Objects; Wheel-Mounted Furniture; or Vending Machines	Furniture braced/ secured to floor and wall studs or fastened to wall studs where possible			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Tall Furniture, Bookcases, or Shelving	Secured to wall studs with engineered earthquake brackets or flexible earthquake fasteners and anchored to the floor Library shelving or stacks should be engineered			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Shelves or Display Cases with Supplies, Folders, or Book	Secured to wall studs and bolted to the floor Guards installed to keep books and other items from falling			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Tall File Cabinets	Fastened to wall studs Connected multiple cabinets together Installed positive catch latches in non-locking drawers			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Drawers and Cabinets	Installed latches/ locks on drawers and cabinets			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Lockers	Anchored and laterally supported lockers			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Compressed-Gas Cylinders	Secured with adequate tank anchorage system			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

QUESTIONS TO ASK ABOUT YOUR SPACE

- Which areas of the building have a higher occupant load and hence a potentially higher life safety risk?
- Are there heavy, unstable items currently located near a desk or bed, which could be moved?
- Are the exits and exit pathways clear, or are there items that could block doors, corridors, or stairways if they were to fall?
- What is the probability that someone will be injured by falling objects?
- Can items no longer serving a useful function be removed?
- Are all hazardous materials stored properly?
- Which items can be relocated to prevent possible injury and do not need to be anchored in order to prevent damage or loss?
- If something slides or falls, in what direction is it likely to move?
- Is a suspended item currently hanging where it may impact a window, wall, or other item?

Source: FEMA E-74, Reducing the Risks of Nonstructural Earthquake Damage - A Practical Guide

2. DEVELOP AND EXECUTE AN ACTION PLAN - SPACE OVERVIEW

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Hazardous Materials	Removed or secured all hazardous chemical cabinets ensuring no loose containers or unprotected breakable glassware			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Fragile Artwork and Pictures	Secured to wall studs with screws or onto tables or shelves with earthquake putty, museum wax, or some other seismic safety device Used closed hooks for hanging art and pictures Considered earthquake protections for heavy sculptures and any fragile items			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Freestanding Half-Height Partitions	Braced/secured to floor and wall studs where possible			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Ceiling Fixtures	Fastened ceiling fans and light structures to ceiling and secured with diagonal safety cables			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

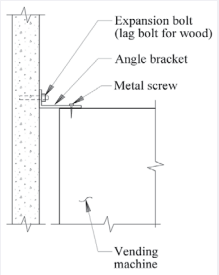
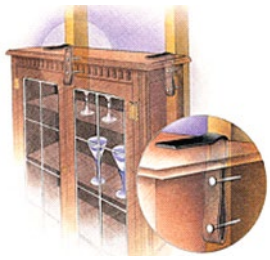
A CASE STUDY: THE NISQUALLY EARTHQUAKE

Several businesses that experienced the Nisqually earthquake found that the seismic restraints on computers, monitors, and critical office equipment were a good investment. Those that believed that $10-$15 was too costly to protect a $200-$300 monitor, lost production capabilities while waiting for replacement monitors. Some thought a CPU on the floor did not need restraining, but some CPUs were lost because the cables and cords pulled the circuit boards and mouse ports hard enough to destroy them. If you have restraints already, check them semi-annually to see if they have been moved or overlooked. A hospital reported one TV set fell from its bracket because its restraint was not latched.

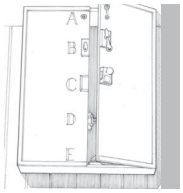
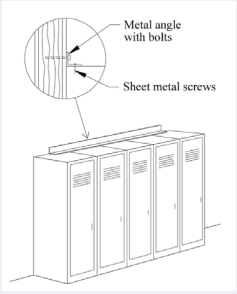
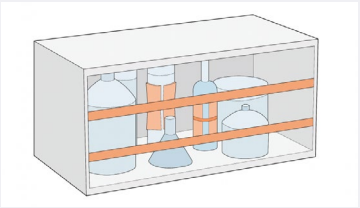
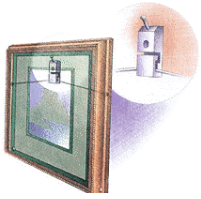
Source: What Businesses Learned From The Nisqually Earthquake Of February 28, 2001. CREW.

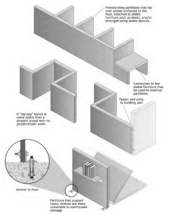
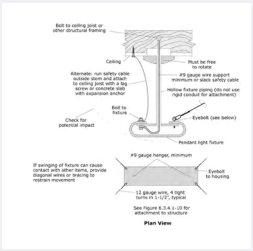
SPACE – ACTION PLAN

Use the **SPACE Action Plan** to identify the preparedness and mitigation actions. Keep in mind that there are various methods to properly secure items, but no matter what method is used, it is critical that the fastening is securely into the studs behind the wall or floor, as appropriate. Wall coverings like drywall and gypsum board are not strong enough to hold heavy items during an earthquake.

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
Computers, TVs, or Office Equipment	Use earthquake straps to connect monitor/laptop/TV/ equipment to the desk or table. Latch desktops to their desk, and secure desks. Attach desktop-to-desk and desk-to-wall or -floor straps.  
Miscellaneous Furniture such as Equipment Racks; Small Objects; Shop/Gym Equipment; Floor-Mounted Objects; Wheel-Mounted Furniture; or Vending Machines	Brace/secure to floor and wall studs where possible, taking into consideration different methods for each type of equipment as detailed by *FEMA E-74, Reducing the Risks of Non-Structural Earthquake Damage*. 
Tall Furniture, Bookcases, or Shelving	Secure to wall studs with engineered earthquake brackets or flexible earthquake fasteners, and anchor to the floor. For all tall furniture and other bookcases, shelving, and cabinets, consider the objects within furniture, shelves, or other structures, and account for heavy or fragile items. Move heavy books and items to the lowest shelves, and make sure the wall or partition used to anchor shelves or other furniture is strong enough to support potential earthquake loads. Library shelving or stacks should be engineered. 

2. DEVELOP AND EXECUTE AN ACTION PLAN - SPACE

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
Shelves or Display Cases, Supplies, Folders, or Books	Shelves should be secured to wall studs and bolted to the floor. Install guards to keep books and other items from falling.  
Tall File Cabinets	Fasten to wall studs. Connect multiple cabinets together. Install positive catch latches in non-locking drawers. 
Drawers and Cabinets	Install latches/locks on drawers and cabinets.  
Lockers	Anchor and laterally support lockers. 
Compressed-Gas Cylinders	Secure with adequate tank anchorage system.
Hazardous Materials	Remove or secure all hazardous chemical cabinets ensuring no loose containers or unprotected breakable glassware. FEMA E-74, *Reducing the Risks of Non-Structural Earthquake Damage* and the EPA's *Managing Your Hazardous Waste: A Guide for Small Businesses* provide additional guidance about hazardous waste. Secure the furniture containing hazardous materials to the wall studs and bolt to the floor if the furniture is not independently secured. 
Fragile Artwork and Pictures	Secure to wall studs with screws or onto tables or shelves with earthquake putty, museum wax, or some other seismic safety device. Use closed hooks for hanging art and pictures. Also consider earthquake protections for heavy sculptures and any fragile items. Brace/secure to floor and wall studs where possible.  

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
Freestanding Half-Height Partitions	Brace to the structure above the ceiling line. 
Ceiling Fixtures	Fasten ceiling fans and lights to ceiling and secure with diagonal safety cables. 

For more guidance, refer to FEMA E-74, Reducing the Risks of Non-Structural Earthquake Damage for detailed technical information.

SPACE - NOTES

SYSTEMS

SYSTEMS include nonstructural architectural elements, equipment, fixtures, utility systems, and more. Examples include air compressors; automatic fire sprinkler piping and heads; backup power sources; built-in partitions; exterior signs; exterior veneer; freestanding walls or fences; heating, ventilation, and air conditioning (HVAC); piping; propane, fuel or filtration tanks; roof parapets; suspended light fixtures; suspended T-bar ceilings; suspended space heaters; stairways; water heaters; and windows.

The **SYSTEMS Action Plan** includes Do-It-Yourself (DIY) activities and retrofitting activities that require a skilled professional and engineer. Be sure to consult and follow all applicable building codes and permitting requirements when performing mitigation activities.

Like the other sections of the Action Plan, the **SYSTEMS** list is not all-inclusive. Organizations are eligible for recognition as a **QuakeSmart – SYSTEMS** Member after completing two DIY activities or one of the skilled professional activities.

WATCH VIDEO

2. DEVELOP AND EXECUTE AN ACTION PLAN - SYSTEMS OVERVIEW

A CASE STUDY: THE NISQUALLY EARTHQUAKE

Many suspended ceilings and light fixtures that were not seismically restrained fell during the Nisqually earthquake. One company thought their light fixtures were properly restrained but found that they were restrained with only one wire, which then became dangerous pendulums. Another business had a swinging light fixture cut off a sprinkler head.

During the Nisqually earthquake, most of the damage to the contents of a building was caused by water from broken overhead pipes. Flexible pipe and/or connections may have prevented or minimized damage.

Source: What Businesses Learned From The Nisqually Earthquake Of February 28, 2001. CREW.

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Built-In Partitions (Walls)	Secured to the ceiling of the structure and wall studs, where possible Added reinforcement if made of heavy materials or supporting shelves			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Water Heater	Wrapped two heavy metal straps 1 1/2 times around the tank, then secured each end to wall studs Installed flexible connection for gas/water			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Windows	Installed protective film covering			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Suspended Light Fixtures	Fastened to the ceiling of the structure and braced with diagonal wires by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Suspended T-Bar Ceilings	Fastened and anchored grid to structure by a professional using diagonal hangers or bracing wires			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Suspended Space Heater	Secured to building and fuel connections reinforced by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
HVAC Equipment and Ducts	Anchored by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Automatic Fire Sprinkler Piping and Heads	Fastened to structure and connections (joints) reinforced by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Air Compressor	Anchored by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

2. DEVELOP AND EXECUTE AN ACTION PLAN - SYSTEMS OVERVIEW

NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Piping	Secured to structure and reinforced by a professional at vulnerable spots (joints, bends) and between floors			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Exterior Signs	Fastened to building, as applicable, and reinforced by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Exterior Veneer	Properly anchored/adhered by a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Roof Parapets	Reinforced and/or braced parapets to roof using engineer recommendations that include flashing and weatherproofing			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Propane, Fuel, or Filtration Tank	Consulted an engineer to inspect and determine reinforcement recommendations			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Freestanding Walls or Fences	Consulted an engineer for reinforcement recommendations			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

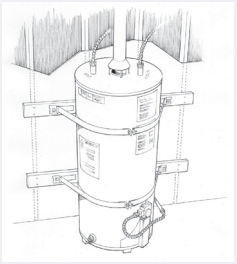
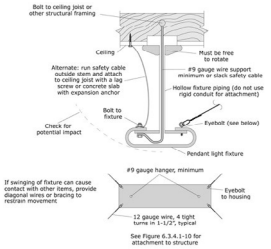
NONSTRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Stairways	Installed sliding connections and enclosure materials with a professional			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Backup Power Source	Installed an emergency generator or backup power source (e.g., solar) with a professional and ensured it was protected against earthquake motion			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

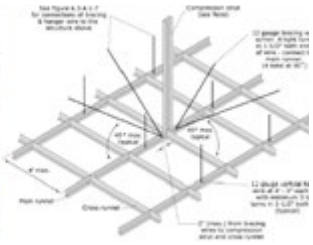
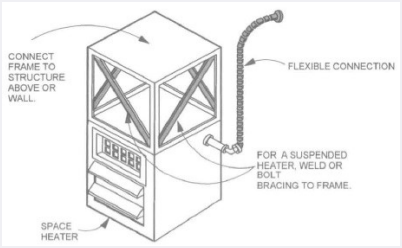
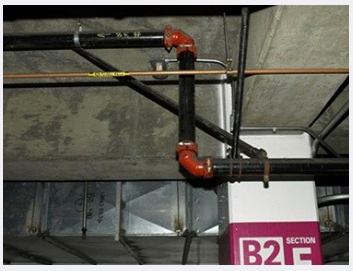
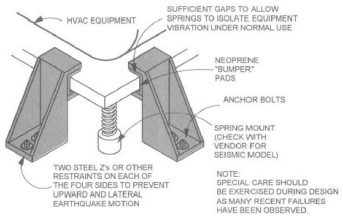
Use the Cost Estimation Worksheet to determine the approximate costs of mitigation.

A building façade is technically nonstructural, but it is addressed in the STRUCTURE section of the toolkit.

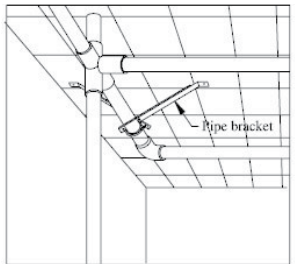
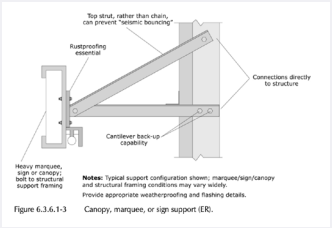
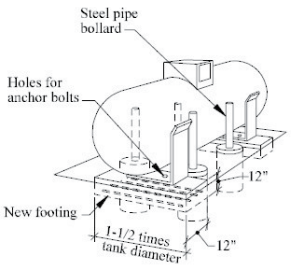
SYSTEMS – ACTION PLAN

Use the **SYSTEMS Action Plan** to identify preparedness and mitigation actions.

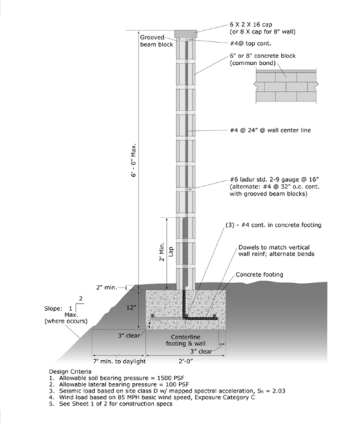
NONSTRUCTURAL RISKS	MITIGATION SOLUTION
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES	
Built-in Partitions (Walls)	Secure to the ceiling of the structure and wall studs, where possible, and add reinforcement if made of heavy materials or supporting shelves. 
Water Heater	Wrap two heavy metal straps 1 1/2 times around the tank, then secure each end to wall studs. Install flexible connection for gas/water. 
Windows	Install a protective film on windows to help hold glass fragments together. Create landscaping areas with restricted pedestrian access to reduce the risk beneath large glass panes or tall curtain walls. If replacing windows, choose those with laminated glass or another type that will remain in the frame when glass is cracked. See FEMA E-74 about overhead glazing or skylights. 
PROFESSIONAL SERVICES REQUIRED	
Suspended Light Fixtures	Fasten to the ceiling of the structure and brace with diagonal wires via a professional.  

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
PROFESSIONAL SERVICES REQUIRED	
Suspended T-Bar Ceilings	Fasten and anchor grid to the structure using diagonal hangers or bracing wires via a professional.  
Suspended Space Heater	Secure to the building structure and reinforce connections to fuel lines and other piping via a professional. Consult local building codes. 
HVAC Equipment and Ducts	Securely mount equipment to the floor, wall, or roof. If on vibration isolators, ensure adequate lateral restraint; for roof-mounted HVAC units, securely attach curbs supporting vibration isolators to the structural roof framing. Gas or fuel lines should have a flexible connection to accommodate movement. Securely mount wall- or window-mounted AC units to the wall or shelf. All actions should be done by a professional.  
Automatic Fire Sprinkler Piping and Heads	Have a professional fasten to the structure and reinforce connections (joints). Look for other equipment/hazards that may move and damage the system. 
Air Compressor	For equipment on vibration isolators, install snubbers or bumpers, or otherwise anchor to the structure via a professional. 

2. DEVELOP AND EXECUTE AN ACTION PLAN - SYSTEMS

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
PROFESSIONAL SERVICES REQUIRED	
Piping	Secure to structure and add reinforcement at vulnerable spots (joints, bends) and between floors via a professional. 
Exterior Signs	Fasten to building, as applicable, and reinforce via a professional. 
Exterior Veneer	Consult with an engineer to determine if the veneer is properly attached to the structure with anchors or adhered. Considerations may include support by shelf angles at each floor, connection to a structural back-up wall at adequate spacing, and proper maintenance. 
Roof Parapets	Reinforce and/or brace parapets to roof using engineer recommendations that include flashing and weatherproofing. 
Propane, Fuel, or Filtration Tank	Consult an engineer to inspect and determine a recommendation. FEMA E-74 provides guidance for different types of storage tanks. 

A building façade is technically nonstructural, but it is addressed in the STRUCTURE section of the toolkit.

NONSTRUCTURAL RISKS	MITIGATION SOLUTION
PROFESSIONAL SERVICES REQUIRED	
Freestanding Walls or Fences	Freestanding (cantilevered) walls or fences built of reinforced or unreinforced masonry are vulnerable to damage or collapse during an earthquake, which can cause injury, block entrances and exits, and lead to security breaches. Consult an engineer for reinforcement recommendations. 
Stairways	Ensure they have a fixed connection to one floor and a sliding connection to the other floor. If the stair enclosures have brittle materials (unreinforced masonry), encapsulate or replace via a professional. 
Backup Power Source	Consider an emergency generator or backup power source (e.g., solar). Ensure the power source is properly secured against earthquake movements by a professional. 

For more guidance, refer to FEMA E-74, Reducing the Risks of Non-Structural Earthquake Damage for detailed technical information.

SYSTEMS - NOTES

STRUCTURE

STRUCTURE includes architectural and structural building elements (ceiling, floor, structural walls/columns) focusing on construction methods that may create or increase the risk of collapse or failure during an earthquake. Concrete tilt-up, improperly welded steel frame, unreinforced masonry, unreinforced or under-reinforced concrete, or unreinforced soft-story construction create building weakness in the face of earthquake shaking. This section also focuses on building façades that use unreinforced or unanchored brick or exterior architectural elements.

Whether you own or lease your business or organization's building, you should take steps to understand its vulnerability to earthquakes by assessing structural risk and more complex nonstructural risk. The evaluation will require a structural engineer or registered design professional to identify weaknesses and design appropriate mitigation measures using established standards.

WATCH VIDEO

2. DEVELOP AND EXECUTE AN ACTION PLAN - STRUCTURE OVERVIEW

Building evaluations using FEMA P-154, ASCE 41, and the U.S. Resiliency Council Building Performance Rating System can estimate a building's earthquake safety and expected performance. FEMA P-154 uses a rapid visual screening (RVS) procedure to identify, inventory, and screen potentially seismically hazardous buildings by various screeners, including design professionals and general contractors. If a building is determined to be potentially dangerous, it should be evaluated by a professional with earthquake design performance expertise.

Another standard, ASCE 41, Seismic Evaluation and Retrofit of Existing Buildings, provides a tool to evaluate a building's potential to provide for occupant safety. Beyond safety, tools such as the U.S. Resiliency Council Earthquake Building Performance Rating System can be used to provide valuable insights into repair costs and time to regain functional recovery after an earthquake.

Follow all applicable building codes, including permitting requirements, when contracting for earthquake retrofitting activities. If your business is looking for a new building or lease, ask the current owner which building code was following for construction. Determining whether the construction followed a modern building code can help you determine if it has the latest earthquake-resistant construction techniques and materials. Check Inspect2Protect.org to identify the building codes where you do business and learn about effective earthquake-strengthening improvements for older structures.

The **STRUCTURE Action Plan** is not all-inclusive. It will, however, introduce you to some of the most common mitigation opportunities. Complete one or more retrofits to become eligible for recognition as a **QuakeSmart – STRUCTURE Member.**

STRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Concrete Tilt-Up Construction without Anchored Roof or Floor System	Anchored roof and floor systems to walls			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Unreinforced or Under-Reinforced Concrete Construction	Reinforced concrete construction			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Improperly welded steel frame connections	Reinforced welded steel frame connections			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Unreinforced Soft Story Construction	Reinforced soft story construction			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Unreinforced Masonry Construction	Reinforced masonry construction and anchored roof and floor systems to walls			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Unreinforced or Unanchored Brick or Masonry Elements in Building or Façade	Reinforced or anchored brick or masonry elements in building structure or façade			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Unreinforced Cripple Walls	Reinforced and anchored cripple walls			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

2. DEVELOP AND EXECUTE AN ACTION PLAN - STRUCTURE OVERVIEW

STRUCTURAL RISKS	MITIGATION SOLUTION	QUANTITY	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
POTENTIAL DIY OR REPAIR PERSON ACTIVITIES				
Walls or Wood Frame Structure Not Anchored to Foundation	Anchored walls or wood-frame structure to the foundation			❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

Use the Cost Estimation Worksheet to determine the approximate costs of mitigation.

MULTIFAMILY AND COMMERCIAL BUILDINGS						
WHAT TO LOOK FOR	Inspect the exterior of the structure and look for signs that it has shifted off its foundation.	Look for damage or significant cracks to the building, including walls, ceilings, light fixtures, and the roof.	Check for signs of earthquake damage like cracks in the walls that appear in a stair step pattern or radiating cracks around doors and windows.	Look for large cracks in the foundation, basement, chimney mortar, or any walls.	Walk around the building and note if you feel soft spots in the floor.	Open and close all windows and doors to ensure none are jammed, blocked or difficult to move.
WHAT TO ASK YOUR LANDLORD	Ask if older properties have been retrofitted and reinforced. If the answer is yes, ask for details on retrofit methods.	Are drill holes in the wall to secure bookcases and other furniture permitted?	Is there a rental payment forgiveness policy if an earthquake makes my home uninhabitable?	When was the last time the roof was replaced?	Has an earthquake ever impacted this property?	When was the structure built? What building code was used?
MITIGATION SOLUTION	Secure bookcases and other tall furniture with flexible straps and buckles.	Install flexible gas connections on appliances like water heaters.	Purchase renters earthquake insurance.	Secure lamps, vases, collectibles, and pottery with Velcro earthquake putty.		

STRUCTURE – ACTION PLAN

Use the **STRUCTURE Action Plan** to identify preparedness and mitigation actions.

MITIGATION SOLUTIONS	MITIGATION RESOURCES
Concrete Tilt-Up Construction without Anchored Roof or Floor System Concrete tilt-up buildings are reinforced concrete structures with exterior concrete walls constructed flat on the ground and then tilted "up" into position, often including warehouses or other industrial facilities. The seismic vulnerability of this type of construction is the potential for the roof or floor and wall connection to fail and the wall panels to fall away from the building or the roof to fall away from the wall, resulting in roof or floor collapse. Retain a registered design professional to anchor the roof and floor systems to the walls to help address this type of vulnerability. Credit: FEMA 	Association of Bay Area Governments Resilience Program. Guide to Earthquake Vulnerable Commercial Building Types
Unreinforced or Under-Reinforced Concrete Construction Retain a professional to reinforce concrete construction. Credit: FEMA 	ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings FEMA P-2006, Example Application Guide for ASCE 41 FEMA 454, Designing for Earthquakes: A Manual for Architects
Improperly welded steel frame connections Reinforce welded steel frame connections. Retain a professional to reinforce concrete construction. Credit: FEMA 	Association of Bay Area Governments Resilience Program. Guide to Earthquake Vulnerable Commercial Building Types FEMA P-547, Techniques for the Seismic Rehabilitation of Existing Buildings

2. DEVELOP AND EXECUTE AN ACTION PLAN - STRUCTURE

MITIGATION SOLUTIONS	MITIGATION RESOURCES
Weak-Story Construction Soft-story construction occurs when the stiffness of one story is substantially less than that of the stories above. Weak-story construction occurs when walls or frames providing lateral resistance on one story are weaker than those in adjacent stories.  Retain a professional to reinforce soft- or weak-story construction. Credit: FEMA	FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories International Code Council. International Existing Building Code
Unreinforced Masonry Construction Unreinforced masonry is a structural element of masonry construction without sufficient steel reinforcement. The other seismic vulnerability of this type of construction is the potential for the roof or floor and wall connection to fail and the wall to fall away from the building or the roof or floor to fall away from the wall, resulting in roof or floor collapse Retain a professional to reinforce masonry construction and to anchor the roof and floor systems to the walls to help address these types of vulnerability.	FEMA 232, Homebuilders' Guide to Earthquake Resistant Design and Construction FEMA P-774, Unreinforced Masonry Buildings, and Earthquakes: Developing Successful Risk Reduction Programs ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings FEMA P-2006, Example Application Guide for ASCE/SEI 41
Unreinforced or Unanchored Brick or Masonry Elements in Building or Façade Retain a professional to reinforce or anchor brick or masonry elements in building structures or façades. Credit: FEMA 	FEMA P-1000, Volume 2C: Plan set for Masonry Chimneys FEMA 232, Homebuilders' Guide to Earthquake Resistant Design and Construction BIA Technical Note 28A, Adding Brick Veneer to Existing Construction

MITIGATION SOLUTIONS	MITIGATION RESOURCES
Unreinforced Cripple Walls Cripple walls are short frame walls extending from the foundation to the bottom of the first floor, often enclosing a crawl space or serving as walls for a basement or stepped foundation. Cripple walls should be reinforced to withstand the side-to-side motion of an earthquake. Solutions may include nailing plywood to the entire wood frame of the cripple walls.  Some building departments have prescriptive plan sets to assist owners with mitigation of seismic risk, such as wood frame homes with cripple walls. Check with your local building department. Credit: FEMA	International Code Council. International Existing Building Code. FEMA P-1100, Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings FEMA 232, Homebuilders' Guide to Earthquake Resistant Design and Construction
Walls or Wood Frame Structure Not Anchored to Foundation Retain a professional to anchor walls or wood frame structures to the foundation.  Credit: California Earthquake Authority	International Code Council. International Existing Building Code FEMA P-1100, Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings FEMA 232, Homebuilders' Guide to Earthquake Resistant Design and Construction

2. DEVELOP AND EXECUTE AN ACTION PLAN - STRUCTURE

Typical options for various types of building retrofits to address earthquake vulnerabilities include:

- International Existing Building Code
- ASCE 41-17, adopted by the building code. See also FEMA P-2006, Example Application Guide for ASCE/SEI 41
- FEMA P-58, Seismic Performance Assessment of Buildings

For a comprehensive list of FEMA building design earthquake publications, see Building Science – Earthquake Publications.

Use the Cost Estimation Worksheet to determine the approximate costs of mitigation.

FUNCTIONAL RECOVERY

Functional recovery design can increase earthquake resilience beyond safety to building durability. FEMA defines functional recovery as a building that is ready to support most of its pre-earthquake uses in addition to reoccupancy. For example, a house can provide shelter but also meet basic safety codes and can be legally lived in during repair and cleanup. Learn more about functional recovery at FEMA P-2090, Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time.

STRUCTURE - NOTES

STRUCTURE - NOTES (continued)

SURROUNDINGS

SURROUNDINGS include everything outside your building's walls that may cause damage, disrupt your business or organization operations, or create conditions that prevent employees and customers from entering or leaving your workplace. Examples include a neighboring business' unreinforced brick building, large trees, a nearby river, a gas station, railroad tracks, or hazardous materials storage sites.

The **SURROUNDINGS Action Plan** offers earthquake mitigation activities to identify and address hazards to your organization from these external risks. However, as the risks are outside your walls, they may be beyond your control. In this instance, contingency planning, communication, and coordination are essential to minimize negative impacts. As with the other sections, the Action Plan is not all-inclusive. By reviewing your applicable risks, organizations will be eligible for recognition as a **QuakeSmart – SURROUNDINGS Member**.

WATCH VIDEO

2. DEVELOP AND EXECUTE AN ACTION PLAN - SURROUNDINGS OVERVIEW

A CASE STUDY: LOMA PRIETA EARTHQUAKE

The Loma Prieta earthquake showed how dangerous unreinforced masonry buildings can be to adjacent buildings and pedestrians because of falling debris. It revealed the risks of "adjacency hazards" like debris or building components falling from one building and damaging another, as well as buildings causing direct damage to another building.

Source: Practical Lessons from the Loma Prieta Earthquake. National Research Council.

SURROUNDINGS RISKS	SURROUNDINGS RECOMMENDATION	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Nearby vulnerable buildings and their attachments (e.g., parapets, overhangs, or signs close to your building)	Asked building owners or the jurisdiction about the age and construction of buildings and documented any potential vulnerabilities in your **Business Continuity Plan**		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
High-risk businesses nearby (e.g., gas station, dry cleaners, chemicals, or manufacturing)	Surveyed neighborhood for businesses that regularly manage hazardous waste and documented in your **Business Continuity Plan**		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Retaining walls or landscaping (e.g., trees) that can collapse, fall on your building, or block entrances or exits	Asked neighboring building owners to brace retaining walls or mitigate landscape risks as needed		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Rivers, waterways, levees, or floodwalls that can overtop or flood your area and/or cut off access	Contacted local emergency management for historical flood data, reviewed FEMA Ready Floods resources, and considered flood insurance depending on your flood risk Documented findings in your **Business Continuity Plan**		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

SURROUNDINGS RISKS	SURROUNDINGS RECOMMENDATION	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Highway or railroad tracks nearby (e.g., accidents or hazardous material spills)	Surveyed the neighborhood for nearby highways or railroad tracks to determine the potential for accidents, hazardous material spills, and interruptions to transportation and access during an earthquake Documented findings in your **Business Continuity Plan**		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable
Number of points of access in and out of your building or facilities	Considered current access points in and out of your business/ organization and determined if there are potential sources of obstructions or alternate access points in the case of an emergency Checked to ensure your building is compliant with your local jurisdiction's building code Looked to see whether any landscaping or other items outside of the building could block entrance or exit to the building Documented findings in your **Business Continuity Plan**		❑ Yes ❑ Picture Taken of Solution ❑ No ❑ Not Applicable

SURROUNDINGS ACTION PLAN

Use the **SURROUNDINGS Action Plan** to identify preparedness and mitigation actions.

SURROUNDINGS RISKS	PREPAREDNESS RECOMMENDATION	PREPAREDNESS RESOURCES
Nearby vulnerable buildings and their attachments (e.g., parapets, overhangs, or signs close to your building)	Ask building owners or the jurisdiction about the age and construction of buildings and document any potential vulnerabilities into your **Business Continuity Plan.**	Share resources with neighbors, including the **QuakeSmart** Toolkit's **SYSTEMS** and **STRUCTURE** sections. FEMA 454, Designing for Earthquakes: A Manual for Architects FEMA P-774, Unreinforced Masonry Buildings, and Earthquakes: Developing Successful Risk Reduction Programs
High-risk businesses nearby (e.g., gas station, dry cleaners, chemicals, or manufacturing)	Survey neighborhood for businesses that regularly manage hazardous waste and document in your **Business Continuity Plan.**	Share resources with neighbors including the **QuakeSmart** Toolkit's **SPACE** section. Managing Your Hazardous Waste: A Guide for Small Businesses. EPA.
Retaining walls or landscaping (e.g., trees) that can collapse, fall on your building, or block entrances or exits	Asked neighboring building owners to brace retaining walls or mitigate landscape risks as needed.	Share resources with neighbors including the **QuakeSmart** Toolkit's **SYSTEMS** section on freestanding walls/fences.
Rivers, waterways, levees, or floodwalls that can overtop or flood your area and/or cut off access	Contact local emergency management for historical flood data, review FEMA Ready Floods resources, and consider flood insurance depending on your flood risk. Document findings in your **Business Continuity Plan.**	FEMA Ready. Floods. FloodSmart. Why Buy Flood Insurance.

SURROUNDINGS RISKS	PREPAREDNESS RECOMMENDATION	PREPAREDNESS RESOURCES
Highway or railroad tracks nearby (e.g., accidents, hazardous material spills)	Survey neighborhood for nearby highways or railroad tracks, for awareness of the potential for accidents, hazardous material spills, and interruptions to transportation and access during an earthquake. Document findings in your **Business Continuity Plan.**	Share resources with neighbors, including the **QuakeSmart** Toolkit's **SYSTEMS** and **STRUCTURE** sections. FEMA 454, Designing for Earthquakes: A Manual for Architects FEMA P-774, Unreinforced Masonry Buildings, and Earthquakes: Developing Successful Risk Reduction Programs
Number of points of access in and out of your building or facilities	Consider current access points in and out of your business/ organization and determine if there are potential sources of obstructions or alternate access points in the case of an emergency. Building codes typically require functioning entrance and exit locations in buildings. Check to ensure your building is compliant with your local jurisdiction's building code. You can visit Inspect2Protect.org to learn more about the building code in effect in your area; and contact your building department for additional building code information. Look to see whether any landscaping or other items outside of the building could block entrance or exit to the building. Document findings in your **Business Continuity Plan.**	Share resources with neighbors including the **QuakeSmart** Toolkit's **SPACE** section. Managing Your Hazardous Waste: A Guide for Small Businesses. EPA.

SURROUNDINGS - NOTES

SERVICE

SERVICE includes opportunities for your organization to engage, support, and give back to your community following an event by asking, “What kind of help can we provide after a disaster?” You and your employees could deliver free ice, help prepare meals, remove debris from homes, or help staff a local volunteer agency.

If you are interested in serving, consider including a **SERVICE** component in your **Business Continuity Plan**. Get started by contacting your local emergency management officials or your community’s Voluntary Organizations Active in Disaster (VOAD) chapter to identify training opportunities. You can also join a Community Emergency Response Team (CERT), serve as a business representative in your local Business Emergency Operations Center (BEOC), or offer first aid training for employees at your worksite.

By performing all applicable activities in **SERVICE** and the applicable preparedness and mitigation actions in **STAFF, SPACE, SYSTEMS, STRUCTURE**, and **SURROUNDINGS**, businesses and organizations will be eligible for recognition as a **QuakeSmart – SERVICE Member**.

WATCH VIDEO

2. DEVELOP AND EXECUTE AN ACTION PLAN - SERVICE OVERVIEW

A CASE STUDY: LOMA PRIETA EARTHQUAKE

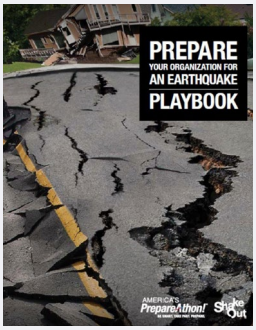
The Loma Prieta earthquake illustrated how damaging earthquakes can worsen pre-existing social problems, including homelessness, housing deficiencies, and budget shortfalls. Adequate training for volunteers in advance of earthquakes can help effective and safe response actions.

Source: Practical Lessons from the Loma Prieta Earthquake. National Research Council.

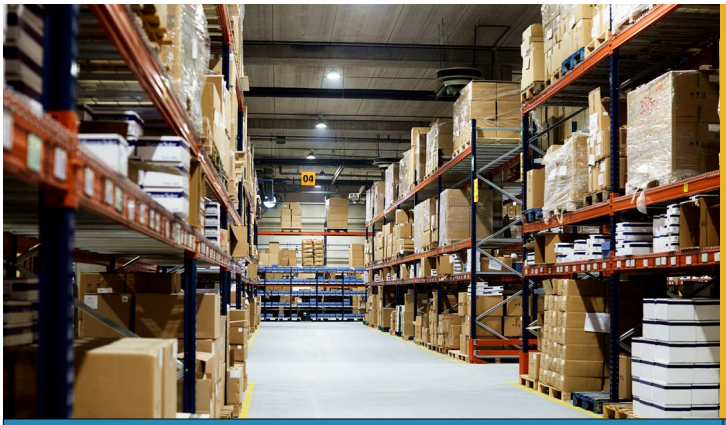
SERVICE ACTION	SERVICE SOLUTION	ASSIGNED TO	ACCOMPLISHED & COMPLETION DATE
Contacted your local emergency management office	These activities are written in your **Business Continuity Plan.**		❑ Yes ❑ No ❑ Not Applicable
Considered purchasing a generator or other power source to serve as a community charging station	These activities are written in your **Business Continuity Plan** to cover recovery actions. Make sure the generator or other equipment is properly braced (see **SYSTEMS**).		❑ Yes ❑ No ❑ Not Applicable
Identified ways to engage and participate in your community	These activities are written into your **Business Continuity Plan.**		❑ Yes ❑ No ❑ Not Applicable

SERVICE

Use the **SERVICE Action Plan** to identify preparedness and mitigation actions.

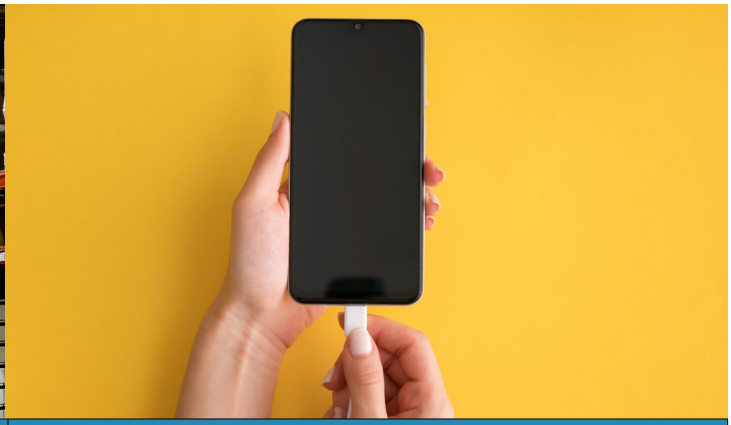
PREPAREDNESS ACTION	PREPAREDNESS SOLUTION	PREPAREDNESS RESOURCES
Contact Your Local Emergency Management Office	Contact your local emergency management office to identify programs and resources for planning, mitigation, preparedness, training, education, and drills in your area. Contact your local emergency management office during your disaster planning to provide historical information on hazards and disasters in your area. Use this information to determine how you can provide service(s) to the community before and after a disaster. Include decisions in your **Business Continuity Plan.**	FEMA
Engage and Participate with Your Community	In addition to preparing your organization, it is important to understand your local and tribal community emergency plans and how to work with other organizations in your community or tribe. Opportunities to participate in whole community planning include: Learn about public-private partnerships and opportunities to engage in addressing the readiness of the community against earthquakes and other disasters. Participate with local or tribal organizations that make your community a safer and more prepared place to live and do business, such as your local Citizen Corps Council, hazard mitigation planning team, or local and tribal Community Emergency Response Team (CERT). Citizen Corps Councils include representatives from all sectors of the community. This whole community membership helps to ensure the community perspective is reflected in local emergency management practices.	 Community Emergency Response Team. FEMA Ready

2. DEVELOP AND EXECUTE AN ACTION PLAN - SERVICE



RELIEF KITS

If your organization is open after the disaster, you could become a distributor or storage warehouse for Disaster Relief Kits. Providing a place for the supplies to be stored locally allows volunteer organizations to distribute them throughout affected areas readily.



CHARGING STATION

If your organization has electricity after the disaster, you could become a volunteer charging station. You could provide a safe, secure place for emergency responders, volunteers, and community members to charge their cell phones, power wheelchairs, and battery-powered tools.

FOOD PREPARATION

If your organization has the capability to prepare or serve meals, you could support food distribution. Providing a clean kitchen for emergency responders, volunteers, or community members to prepare or receive meals following a disaster is essential for rebuilding the community.

VOLUNTEER

Contact your local emergency manager and determine where volunteer opportunities exist in the community. You and your employees could prepare meals, sort debris, or work at a local office of a volunteer organization. For additional ideas, visit National Voluntary Organizations Active in Disaster.

SERVICE - NOTES

3. BE RECOGNIZED AND INSPIRE OTHERS

Now that you have taken steps to prepare and mitigate your business or organization, you can be recognized as a **QuakeSmart Business** or **QuakeSmart Organization**. Gain recognition for your accomplishment of protecting customers and employees by completing the **QuakeSmart** application and submitting with the checklists completed from **Step 2: Develop and Execute an Action Plan**.

You will receive a **QuakeSmart** recognition certificate and web badge to let your customers and staff know that you are a **QuakeSmart** business or organization. You may also request a custom news release that you may use to let your community know that you have taken action to prepare.

RECOGNITION APPLICATION

Organization: _____

Owner/Manager: _____

Address: _____

Phone Number: _____

Email: _____

Organization Website URL: _____

QUAKESMART DESIGNATION LEVEL	
❑ QuakeSmart **STAFF**	Must complete Steps 1-5 **STAFF** preparedness activities for recognition
❑ QuakeSmart **SPACE**	Must complete all applicable **SPACE** mitigation activities for recognition
❑ QuakeSmart **SYSTEMS**	Must complete two potential DIY or repair person activities or one professional activity
❑ QuakeSmart **STRUCTURE**	Must complete one of the applicable **STRUCTURE** activities for recognition
❑ QuakeSmart **SURROUNDINGS**	Must complete all applicable **SURROUNDINGS** activities for recognition
❑ QuakeSmart **SERVICE**	Must complete all applicable **SERVICE** activities and **STAFF, SPACE, SYSTEMS, STRUCTURE**, and **SURROUNDINGS** for recognition

Please include your preparedness actions and mitigation checklists from **Step Two: Develop and Execute an Action Plan**.

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Resources

QuakeSmart Toolkit. FEMA Ready

Buyer's Guide to Resilient Homes. FLASH

Business Continuity Plan. FEMA Ready

Disaster Resistant Business (DRB) Toolkit

FEMA P-154, Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook

ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings

FEMA E-74, Reducing the Risks of Nonstructural Earthquake Damage

U.S. Resiliency Council Building Rating

7 Steps To A Disaster Resilient Workplace. Earthquake Country Alliance

Earthquake Country Alliance

ResilientWorkplace.org

Great ShakeOut

What Businesses Learned From The Nisqually Earthquake of February 28, 2001. CREW.

Practical Lessons from the Loma Prieta Earthquake. National Research Council.

National Voluntary Organizations Active in Disaster

FEMA P-909, Home and Business Earthquake Safety and Mitigation

FEMA P-530, Earthquake Safety at Home (March 2020)

How to Prepare for an Earthquake FEMA

FEMA P-1100, Volume 1: Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings

Brace and Bolt Grants. California Earthquake Authority

Fix the Bricks. Salt Lake City Emergency Management

Mitigation Assistance. U.S. Small Business Administration

Recommended Earthquake Safety Actions. Earthquake Country Alliance

How to Prepare for an Earthquake. FEMA

Prepare Your Organization for an Earthquake Playbook. FEMA

Crisis Communications Plan. FEMA Ready

Emergency Supply List. FEMA Ready

NOAA Weather Radio All Hazards

Emergency Alerts. FEMA Ready

Insurance Coverage Discussion Form. FEMA Ready

US Fire Administration

Managing Your Hazardous Waste: A Guide for Small Businesses. United States Environmental Protection Agency

Guide to Earthquake Vulnerable Commercial Building Types. Association of Bay Area Governments Resilience Program

International Existing Building Code. International Code Council

FEMA P-1100, Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings

FEMA 232, Homebuilders' Guide to Earthquake Resistant Design and Construction

FEMA P-2006, Example Application Guide for ASCE 41

FEMA 454, Designing for Earthquakes: A Manual for Architects

FEMA P-774, Unreinforced Masonry Buildings, and Earthquakes: Developing Successful Risk Reduction Programs

FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories

FEMA P-1000, Volume 2C: Plan set for Masonry Chimneys

BIA Technical Note 28A, Adding Brick Veneer to Existing Construction

FEMA P-547, Techniques for the Seismic Rehabilitation of Existing Buildings

FEMA. Building Science – Earthquake Publications

Floods. FEMA Ready

Why Buy Flood Insurance. FloodSmart

Inspect to Protect. www.inspecttoprotect.org

Search Your Location. FEMA

Community Emergency Response Team. FEMA Ready

APPENDIX

EARTHQUAKE MITIGATION COST ESTIMATES - SPACE

***Not actual costs! The numbers provided below are intended to be a range of "rough numbers" based on assumptions of typical buildings/equipment. Every situation is different. There are many variables such as the soil the building is sitting on, proximity to strong shaking, length of expected shaking, etc. An engineer will need to be consulted to ensure correct solutions for your needs. These costs do not include engineering or inspection costs.

Use these numbers as a starting point to help you determine where to mitigate first, second, etc., based on potential impacts to your business.

Item to be secured	How to secure item	Number of items	Average Cost per Item	Cost/item Ranges	Total
Computers	Strap or Velcro® monitor/laptop to desk, latch desktop computer to desk.		$10	$9 - $11	
TVs	Strap or Velcro® TV to table or entertainment center.		$27	$27.00	
Top-heavy furniture and appliances	Attach to wall studs with "L" brackets or flexible earthquake-strap products.		$7.50	$6 - $9	
Tall shelving	Attach to wall studs with "L" brackets or flexible earthquake-strap products.		$7.50	$6 - $9	
Library shelving or stacks	Once furniture is braced, install lip guards or other product to prevent shelving items from falling.	Engineering needed		Estimated $300 - $600 per shelf	
Tall file cabinets	Secure to wall studs, install positive catch latches in non-locking drawers.		$35.00	$25 - 45 per cabinet	
Drawers and cabinets	Install drawer latches.		$5.00	$4 - $6	
Compressed gas cylinders	Attach to wall with chains or braces.	Engineering needed		$800 - $1,500	
Containers of hazardous materials	Secure. Solutions vary depending on type of containers and where housed - but not secured is very high impact to lives and property.		$55.00	$10 - $100	
Fragile Artwork - Large	Secure hanging art and pictures to wall studs with screws and use closed hooks. Secure other items to table-surfaces with quake putty or similar products.		$8.00	$5 - $11	
Fragile Artwork - Medium	Secure hanging art and pictures to wall studs with screws and use closed hooks. Secure other items to table-surfaces with quake putty or similar products.		$8.00	$5 - $11	
Fragile Artwork - Small	Secure hanging art and pictures to wall studs with screws and use closed hooks. Secure other items to table-surfaces with quake putty or similar products.		$6	$6	
Free-standing half-height partitions	Follow manufacturers guidelines for installation using acceptable configurations with good connections between panels. Bracing panels to ceiling or floor may be required.	Engineering needed: 2 brackets and anchors		$6 - $9	

EARTHQUAKE MITIGATION COST ESTIMATES - SYSTEMS

***Not actual costs! The numbers provided below are intended to be a range of "rough numbers" based on assumptions of typical buildings/equipment. Every situation is different. There are many variables such as the soil the building is sitting on, proximity to strong shaking, length of expected shaking, etc. An engineer will need to be consulted to ensure correct solutions for your needs. These costs do not include engineering or inspection costs.

Use these numbers as a starting point to help you determine where to mitigate first, second, etc. based on potential impacts to your business.

Item to be secured	How to secure item	Number of items	Average Cost per Item	Cost/item Ranges	Total	Notes
DIY Items						
Suspended Space Heater	Secure to building structure and reinforce connections to fuel lines and other piping. Consult local codes.		$900.00	$600 - 1200 per unit		Cost will vary depending on how they are anchored. Must have an engineer to determine proper solution.
Air Compressor	For equipment on vibration isolators, install snubbers or bumpers, otherwise anchor to structure.		$850.00	$500 - $1,200 per unit		Due to vibrations, need to get engineer to determine solution and a fabricator to create.
Built-in Wall Partitions	Connect to structure above ceiling and add reinforcement if made of heavy materials or supporting shelves.		$35	$35 per every 8 feet of wall		Need an engineer to determine how to brace top of wall to ceiling or roof structure.
Propane/Fuel Tank	Consult with an engineer to inspect and determine recommendation.		$550.00	$300 - $800 per tank		Need to get engineer to determine solution and a fabricator to create.
Water Heater	Secure with heavy, metal-gauge strapping 1½ times around tank and bolt into wall studs. Water/ gas connection should be flexible.		$25	Standard water heater: $25; Larger water heater: $200		
Windows	Install protective film, especially where broken glass would cause the most injuries or damage.		$160	$160 per roll of 36"x25' (depending on number of windows to cover)		Prices vary depending on distributor and if larger roll is needed for larger windows. Price does not include installation, or if installing yourself, the cost for cleaners and tools (eg. squeegee, knife).

EARTHQUAKE MITIGATION COST ESTIMATES - SYSTEMS

Item to be secured	How to secure item	Number of items	Average Cost per Item	Cost/item Ranges	Total	Notes
Possible DIY or Handyman Items						
Suspended T-Bar Ceilings	Bolt grid to structure. Then, strengthen with diagonal hanger or bracing wires also anchored to structure.		$0.18	To rewire it: $.10 - $.25 per sq.ft.		
Suspended Light Fixtures	Connect to structure, not to suspended ceiling. Keep pendant lights from swinging by using diagonal wires or bracing to restrain movement.		$20.00	Should be hung with 4 wires from each corner: $15 - $25 each		If you anchor all the light fixtures, it helps strengthen the T-Bar ceilings.
Stairways	Should have a fixed connection to one floor and sliding connection to the other. If stair enclosures have brittle materials (unreinforced masonry), encapsulate or replace.		$22.50	$20 - $25 per sq.ft. to encapsulate stairwell (but must address rest of building first)		Need to protect side-to-side and platforms, themselves. Stairs are normally designed well, but when connecting to unreinforced side walls they will not hold up.
Piping	Secure to structures and add reinforcement at vulnerable spots (joints, bends) and between floors.		$85.00	(Depends on weight of pipe) For light pipe every 8ft $50 - $120 per brace		
HVAC Equipment and Ducts	Anchor to floor, and if on a vibration isolators then secure each machine to each other and the floor. Follow building codes.		$350.00	$200 - $500 per HVAC unit		Ducting costs will depend on duct work eg. flex duct vs. hard. Hard ducts: $20 per every 8 ft.
Automatic Fire Sprinkler - Piping	Brace to structure and reinforce connections (joints). Also, look for other equipment/hazards that may move and damage sprinkler system.		$150.00	Piping: $150 per every 50 feet (of 2-6 inch diameter pipes). Each head has to be braced a the termination of the line (will most likely to breach at intersection)		Longitudinal and vertical pipes and solutions vary.
Automatic Fire Sprinkler - Heads	Look for other equipment/ hazards that may move and damage sprinkler system.		$25.00	$25 per head		Heads are all different so costs will vary.

EARTHQUAKE MITIGATION COST ESTIMATES - SYSTEMS

Item to be secured	How to secure item	Number of items	Average Cost per Item	Cost/item Ranges	Total	Notes
Professional Services Required						
Roof Parapets	Brace parapets to roof using engineer recommendations that include flashing & weatherproofing.		$300.00	$300 per every 6 - 8 ft		Solution for concrete tilt up is not needed most of the time - but inspect to be sure.
Exterior Veneer	Attach to structure with anchors or adhere.		$3.50	$2 - $5 per sq.ft.		
Exterior Signs	Secure signage and canopies to structure and reinforce with vertical braces.		$550.00	$300 - $800 per sign		Most commercial signs are mounted for wind-loading but larger/heavier sign may need reinforcements.
Freestanding Walls or Fences	Reinforce		$30.00	$30 per sq.ft. for new concrete footing		Likely will need to enlarge existing footing (2 ft vs. 20 ft) and it needs to be footed on BOTH sides (as it abuts neighbors property).

EARTHQUAKE MITIGATION COST ESTIMATES - STRUCTURE

***Not actual costs! The numbers provided below are intended to be a range of "rough numbers" based on assumptions of typical buildings/equipment. Every situation is different. There are many variables such as the soil the building is sitting on, proximity to strong shaking, length of expected shaking, etc. An engineer will need to be consulted to ensure correct solutions for your needs. These costs do not include engineering or inspection costs.

Use these numbers as a starting point to help you determine where to mitigate first, second, etc. based on potential impacts to your business.

Item to be secured	How to secure item	Number of items	Cost per Item	Sq.Ft. Ranges	Cost/item Ranges	Total	Notes
Masonry Construction	Consult with an engineer to inspect and determine recommendation.		$12.50	1,000 - 10,000 sq.ft. 10,000 - 50,000 sq.ft. 50,000 - 100,000 sq.ft (or larger)	$7 - $50 (per sq.ft.) $5 - $12.50 (per sq.ft.) $2.60 - $6.50 (per sq.ft.)		
Non-Ductile Concrete Construction	Consult with an engineer to inspect and determine recommendation.		$15				
Wall-to-Foundation Connection	Consult with an engineer to inspect and determine recommendation.		$45				Includes installation of an angle iron connecting wall to floor.
Concrete Tilt-up Construction with Partially-Anchored Roof System	Consult with an engineer to inspect and determine recommendation.		$3.50	1,000 - 10,000 sq.ft. 10,000 - 50,000 sq.ft. 50,000 - 100,000 sq.ft (or larger)	$3.50 - $10 (per sq.ft) $2.50 (per sq.ft.) $1.30 (per sq.ft)		
Soft Story Construction	Consult with an engineer to inspect and determine recommendation.		$6,000		$5,000 - $7,000 per parking space for tuck under parking		This is the range for "tuck under parking" soft story. Other soft story retrofit is too broad to provide a range. Have an engineer inspect.
Brick Elements in Building Structure or Façade	Consult with an engineer to inspect and determine recommendation.		$3.50		$2 - $5 per sq.ft.		
Cripple Walls	Consult with an engineer to inspect and determine recommendation.		$3,500		For crawl space area to bolt frame to foundation and reinforce cripple walls: $2000 - $5000; for sheer walling anchors & drywalling: $10 - $12 per sq ft.		

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