

Published by the California Seismic Safety Commission

Commercial Property Owner's Guide to Earthquake Safety

2022 EDITION



State of California
Gavin Newsom
Governor

SSC No. 22-01

The Commercial Property Owner's Guide to Earthquake Safety* was developed and published by the California Seismic Safety Commission. It is distributed under the provisions of the Library Distribution Act and Government Code Section 11096.

*Copyright 2022 by the California Seismic Safety Commission.
All rights reserved.*

Legislation

This guide has been developed and adopted by the California Seismic Safety Commission as required by Business and Professions Code Section 10147.

California Seismic Safety Commission

2945 Ramco St. #195
West Sacramento, CA 95691

Download an online copy at
http://ssc.ca.gov/forms_pubs

*Cover photo: Building damaged by the 1994 Northridge earthquake,
U.S. Geological Survey*

*Disclaimer: The effects, descriptions, recommendations and suggestions included in this Guide are intended to improve general earthquake preparedness; however, they do not guarantee the safety of an individual or a structure. The California Seismic Safety Commission is responsible for the content of this Guide. The State of California, the California Seismic Safety Commission, and all contributors to this document assume no liability for any injury, death, property damage, loss of revenue, or any other damages incurred by any person as a result of an earthquake. For specific recommendations regarding your commercial property, consult a professional for guidance.

Effective September 1, 2022, the 2022 edition of the *Commercial Property Owner's Guide to Earthquake Safety* replaces the 2006 edition.



Introduction

EARTHQUAKES ARE INEVITABLE IN CALIFORNIA.

They can occur at any time and without warning. They can be extremely destructive and even deadly.

As a current or future owner of commercial property*, you should be aware of the risks—potentially considerable and catastrophic—that earthquakes pose to your property and its contents and to the safety of its occupants.

THIS GUIDE contains information that could help you prevent injuries, save lives, and avoid costly property damage from earthquakes. It provides information on:

- The most common earthquake-related hazards that could damage commercial property
- How to identify and then fix potential structural and non-structural risks
- How to find more information on earthquake safety

If you sell commercial property, this Guide also will help you meet certain requirements under California law.

There are no guarantees of safety during earthquakes, but properly constructed and strengthened buildings are less likely to collapse or be damaged during earthquakes. The California Seismic Safety Commission advises you to act on the suggestions outlined in this Guide and make yourself, others, and your property safer.

* In this Guide, "Commercial property" refers to both commercial buildings and residential buildings with five or more dwelling units.

USING THIS GUIDE	PAGE
Selling or Buying Commercial Property.....	4
Earthquake Hazards in California	6
Commercial Property Earthquake Risks & the Disclosure Report	13
Tips for a Successful Retrofit.....	26
Financial Resources	30
Earthquake Safety Tips.....	32
Other Information.....	35

\$55+
BILLION

Earthquake
related losses in
California since
1971

\$21+
BILLION

Estimated
commercial/
industrial direct
and indirect
losses in the
1994 Northridge
earthquake

Selling or Buying Commercial Property: Requirements & Recommendations

SELLING COMMERCIAL PROPERTY

If you are selling a building built before 1975 that has precast (tilt-up) concrete or masonry walls (reinforced or unreinforced) and wood-framed floors or roofs, California law* requires you to:

- Properly strap the water heater(s).
- Give the buyer a copy of this Guide "as soon as practical before the transfer" (Government Code, sections 8893.2 and 8875.6).

If you sell your property through a real estate broker or agent, it is recommended that you give the agent, as soon as practical, the completed "Commercial Property Earthquake Risk Disclosure Report" (see page 13). The agent then can give the booklet and disclosure report to the buyer.

Keep a copy of all documentation signed by the buyer as evidence that you complied with the requirements.

Under the law, you are NOT required to:

- Remove siding, drywall, or plaster to complete the disclosure report.
- Hire someone to evaluate your building or to complete the disclosure report. You may seek the help of a certified commercial property inspector or a licensed contractor, architect, or engineer.
- Mitigate the risks before selling your property; however, making the improvements could increase your property's value.

*A summary of the relevant California laws related to seismic safety is included at the end of this Guide (pages 36–37).



BUYING COMMERCIAL PROPERTY

Before you agree to buy commercial property, you should consider the following:

- Have a certified commercial property inspector, licensed building contractor, engineer, or architect inspect the property and give an opinion on existing earthquake risks and the estimated cost to strengthen the building.
- Check the location of the property to determine if it is in an Alquist-Priolo Earthquake Fault Zone or an area susceptible to landslides, liquefaction, or tsunamis. A licensed geotechnical engineer and/or engineering geologist can help you answer these questions and check the stability of the foundation and the ground under the building.
- Check with the local building department to determine if local ordinances require seismic retrofits for your type of building.
- Negotiate the cost of any proposed repairs with the seller. Remember, the investment in strengthening a building will most likely be far less than the costs to repair a building following a major earthquake.

Property Tax Exclusion

Under California law (Revenue and Tax Code, Section 74.5), a property owner can implement seismic-strengthening measures without a property tax reassessment. To receive the exclusion, you must have the work approved by the local building department and file a claim form with your county tax assessor.

Earthquake Insurance

Typically, commercial property insurance does **not** include earthquake coverage. A property owner may purchase a separate earthquake policy. Information on earthquake insurance is on page 31.

Earthquake Hazards

KNOW YOUR PROPERTY'S RISKS

Earthquakes occur in California every day. As a commercial property owner, you should know if your property is in an area that is more prone to earthquakes or if the geology or soil conditions of your community present greater risk during an earthquake. The more you know, the better you are able to take appropriate precautions to protect yourself, others, and your property.

Requirements under the law: If you are selling your property, no matter its age, you must disclose to buyers information about natural hazards that can affect the property, including flood, fire, and earthquake hazards.

The most common earthquake-related natural hazards are **ground shaking, fault ruptures, landslides, liquefaction, and tsunamis**. In addition, earthquake damage to a dam can be a hazard to "downstream" properties.

Detailed hazard location maps and information are available through these online resources:

- California Department of Conservation:
www.conservation.ca.gov/cgs
- California Office of Emergency Services:
www.myhazards.caloes.ca.gov

Is your building near an active earthquake fault or an area prone to severe shaking?

See the maps on pages 10 & 11.

Earthquake Hazards



GROUND SHAKING



U.S. Geological Survey

In California, ground shaking causes 99% of earthquake property damage. Properties in areas near large active faults are more likely to feel severe shaking—and experience damage—than properties in other areas of the state.

FAULT RUPTURE



Ross W. Boulanger

A strong earthquake can cause two sides of a fault to suddenly slide by one another. Even a relatively minor fault rupture can cause foundation and structural damage requiring expensive repairs.

Earthquake Hazards

LANDSLIDE



Siang Tan, CGS

Earthquake shaking can be strong enough to cause soil and rock on a hillside to slide down the slope. A landslide can rip apart buildings at the top of the slope and also crush buildings at the bottom of the slope.

LIQUEFACTION



C.E. Meyer, U.S. Geological Survey

Strong ground shaking can cause liquefaction—excess pore water pressure that reduces the soil's ability to support structures. Liquefaction can cause structures to tilt or collapse.

Earthquake Hazards



TSUNAMI



National Oceanographic and
Atmospheric Administration, 1964

California's coastal areas are prone to damage from tsunami—a series of large ocean waves caused by an underwater earthquake or landslide. Tsunami waves can travel a great distance and cause flooding or wash away structures in low-lying areas along the shore, in and along harbors, and along the banks of rivers. Tsunamis generated by the 1964 Alaskan earthquake (magnitude 9.2) and the 2011 Japan earthquake (magnitude 9.0) caused property damage and loss of life in California.

**Is your
building at risk
of a tsunami?**

Check with your
County's office of
emergency services.

DAM FAILURE



E. V. Leyendecker,
U.S. Geological
Survey, 1971

A very strong earthquake could damage a dam, resulting in sudden and devastating flooding of nearby buildings. The 1971 San Fernando earthquake damaged the Lower San Fernando Dam, which sits less than half-mile above the neighborhoods of the San Fernando Valley in southern California. The risk of an aftershock forced the three-day evacuation of an 11-square-mile area.

**Is your building
near a dam?**

Check with your
County's office of
emergency services
for a dam inundation
map, which shows the
location of major dams
and areas that could
flood in the event of a
dam failure.

BETTER SAFE THAN SORRY

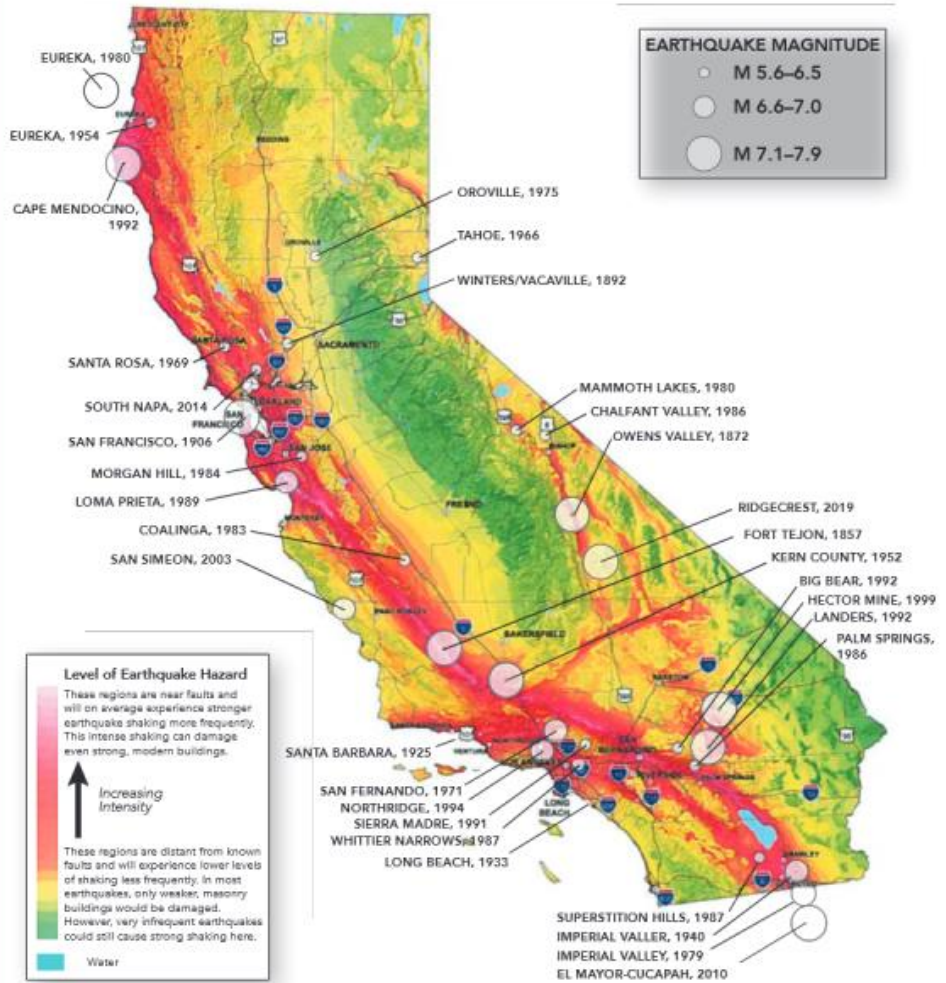
If your property is in a low-lying coastal area or an area near a dam (dam inundation zone), know where to evacuate to higher ground and be prepared to evacuate immediately after an earthquake.

Earthquake Shaking Potential for California

This map shows the relative intensity of ground shaking in California from anticipated future earthquakes and significant earthquakes that have occurred since the Great 1857 magnitude 7.9 Fort Tejon earthquake. Although the greatest hazard is in areas of highest intensity as shown on the map, no region is immune from potential earthquake damage.

\$3+
BILLION
PER YEAR

Expected
long-term
average
earthquake
damage in
California



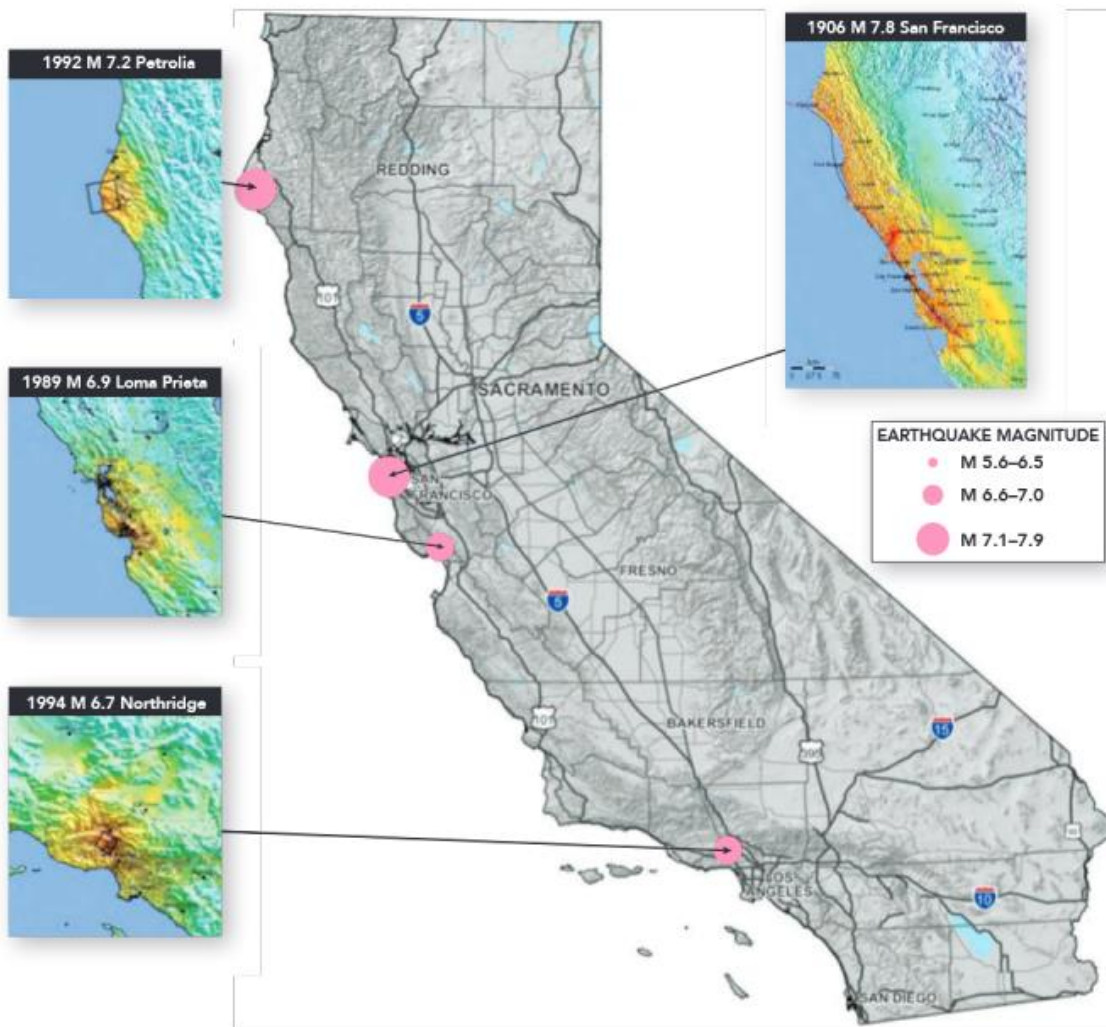
Source: California Geological Survey and U.S. Geological Survey

PAGE 10



Significant Historical Earthquakes and Their ShakeMaps

The ShakeMaps (insets) show areas of moderate-to-heavy ground shaking in four historical earthquakes.



ShakeMap Explanation

INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING	NOT FELT	WEAK	LIGHT	MODERATE	STRONG	VERY STRONG	SEVERE	VIOLENT	EXTREME
POTENTIAL DAMAGE	NONE	NONE	NONE	VERY LIGHT	LIGHT	MODERATE	MOD/HEAVY	HEAVY	VERY HEAVY

Source: USGS

Commercial Property Earthquake Risks & the Disclosure Report

IN THIS SECTION PAGE

Completing the Commercial Earthquake Risk Disclosure Report.....	13
Identifying and Disclosing Earthquake Risks.....	14
Water Heaters	14
Wall Anchorage.....	15
Unreinforced Masonry Walls	16
Pre-1980 Concrete Buildings	18
Steel-Frame Buildings	19
"Soft"-Story or Open-Front Design	20
Exterior Cladding & Signage	21
Other Structural & Non-Structural Risks	22

You are not required to remove siding, drywall, or plaster or to hire an inspector to determine the answer to a question. Also, you are not required to fix or retrofit your property before you sell.

Earthquakes in California can occur at any time and without warning. To prevent injuries and avoid costly property damage, property owners should determine the potential for earthquake risks and then retrofit or upgrade these conditions. If not corrected, these risks can lead to:

- Severe property damage (foundation, floors, walls, windows)
- Broken utilities, leading to fire, water damage, and spread of toxins
- Personal injuries
- Loss of business contents and business interruption

Under State law, a seller of commercial property must give the buyer a copy of this Guide "as soon as practical before the transfer" if the property was built before 1975 and has precast (tilt-up) concrete or masonry walls (reinforced or unreinforced) and wood-frame floors or roof.

A seller also should provide a Commercial Property Earthquake Risk Disclosure Report (page 13) for a building with any of the following*: Precast (tilt-up) concrete or reinforced masonry walls and wood-frame floors or roof (pre-1975); unreinforced masonry; concrete buildings (pre-1980); "soft"- or weak-story (open) design; steel-frame construction (pre-1995). (See pages 15–20.)

To complete the report, answer each question to the best of your knowledge. For questions 1–7, use "Yes" if the building is protected from the risk imposed by earthquakes; use "No" if the building—or a portion of the building—is at risk.

* The Seismic Safety Commission believes property owners of buildings of types that have historically proven hazardous in earthquakes have a duty to inform foreseeable victims. (The Right to Know: Disclosure of Seismic Hazards in Buildings, CSSC 92-03, 1992)

Commercial Property Earthquake Risk Disclosure Report

(2022 Edition)

Name Mark Chaves, Steve Oliveira APN 235-12-009
 Street Address 1170 N 5th Street Year Built 1957
 City San Jose County Santa Clara Zip Code 95112

Answer these questions to the best of your knowledge. If any of questions 1-7 are answered "No," or if either question 8 or 9 is answered "Yes," your property is likely to have an elevated/disclosable earthquake risk. If you do not have actual knowledge as to whether these risks exist, answer "Don't Know." Questions answered "Don't Know" may indicate a need for further evaluation. If your property does not have the feature, answer "Doesn't Apply." If you corrected one or more of these risks, describe the work on a separate page. The page numbers in the right-hand column indicate where in this guide you can find information on each of these features.

	Yes	No	Doesn't Apply	Don't Know	See Page
1. Are water heater(s) braced, strapped, or anchored to resist falling during an earthquake?					14
2. If the building has precast (tilt-up) concrete or masonry walls (reinforced or unreinforced) with wood-frame floors or roof: Are walls adequately anchored to floors and roofs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15
3. If building walls are of unreinforced masonry:					
a. Are these walls and parapets strengthened?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16
b. If load-bearing walls have not been strengthened, and the building is in Seismic Zone 4: Have warning signs been posted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17
4. If the building is a pre-1980 concrete building: Do walls or columns have adequate steel reinforcement?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18
5. If the building is a pre-1995 building with steel-moment framing: Has it been inspected for fractures in welds in or near steel connections?					19
6. If the building has a soft- or weak-story or open-front design: Has it been adequately strengthened?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20
7. Is exterior cladding and signage adequately anchored?					21
A "Yes" answer on Questions 8 and/or 9 could indicate that the property is in a location prone to earthquake damage. More information is available at www.conservation.ca.gov/cgs/geohazards/eq-zapp .					
8. Is the building in an Alquist-Priolo Earthquake Fault Zone (an area prone to fault rupture)?					6
9. Is the building in a Seismic Hazard Zone (zone identified as susceptible to liquefaction or landslides)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6

As seller of the property described herein, I have answered the questions above to the best of my knowledge in an effort to disclose fully any potential earthquake risks it may have.

EXECUTED BY

Seller Mark Chaves Seller Steve Oliveira Date _____

I acknowledge receipt of this Disclosure Report, completed and signed by the seller. I understand that if the seller has answered "No" to one or more questions 1-7 or "Yes" to question 8 or 9, or if the seller has indicated a lack of knowledge, there may be one or more earthquake risks that could impact this property.

Buyer _____ Buyer _____ Date _____

Earthquake Risk Disclosure Report Item 1



During an earthquake, an unbraced water heater can topple, which can start a fire or lead to major water damage.

Is your building's water heater braced?

If your building's water heater is not properly braced, or if it has rigid rather than flexible pipes, the water heater may move or topple during an earthquake. This movement can break gas or water lines, resulting in fire, water damage, or release of toxic gas.

Under California law, you are required to brace your building's water heater(s) whenever you install a new water heater or if you sell the building.

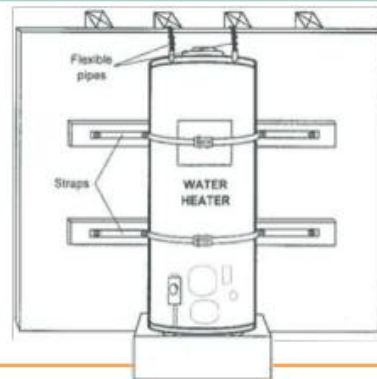
How to Check for Proper Water Heater Bracing

1. Look for two sets of straps that wrap around the water heater and securely bolt the water heater to the wall and wall studs (see diagram).
2. Make sure water and gas pipes are flexible.

Tankless Water Heater?

For a tankless water heater, be sure it is securely attached to the wall and that its pipes are installed according to the manufacturer's instructions.

PROPER WATER HEATER BRACING



WANT TO RETROFIT?

Find out more on pages 26-29.

Earthquake Risk Disclosure Report Item 2



Are walls adequately anchored to floors and roofs?

During an earthquake, the various parts of a building may move in different directions. If the connections (anchorage) between concrete or masonry walls (reinforced or unreinforced), wood floors, and roof are weak, walls can pull away during earthquake shaking, causing all or a portion of the building to collapse.

How to Check for Wall Anchorage

Buildings with the following characteristics are more likely to have poor wall anchorage:

- Buildings constructed before the mid-1970s with precast (tilt-up) concrete or masonry walls (reinforced or unreinforced)
- In some buildings built between 1975 and 1995 and prior to adoption of the post-Northridge earthquake standards

You most likely will need to hire a professional engineer or architect to determine the condition of wall anchorage.



Reid Middleton, Inc.

The concrete tilt-up walls of this "big box" warehouse store separated from the steel truss roof during an earthquake.



WANT TO RETROFIT?

Find out more on pages 26-29.

Earthquake Risk Disclosure Report Items 3a and 3b

Are unreinforced masonry walls and parapets strengthened?

If your building has walls of unreinforced masonry—hollow clay tiles, stone, concrete blocks, or adobe—the mortar holding together the masonry may be brittle and not strong enough to withstand earthquake shaking. As a result, during an earthquake:

- Walls or an entire building could collapse
- Masonry can break away and fall to the ground or on adjacent buildings
- Roofs, floors, and parapets (tops of walls that extend above roofs) can fall

In addition, an adjacent unreinforced masonry building can present a risk to your building and its occupants.



Earthquake shaking caused the unreinforced brick parapet and façade of this building to collapse, killing people on the ground.

*C.E. Meyer,
U.S. Geological Survey*



WANT TO RETROFIT?

Find out more on pages 26–29.

Earthquake Risk Disclosure Report Items 3a and 3b



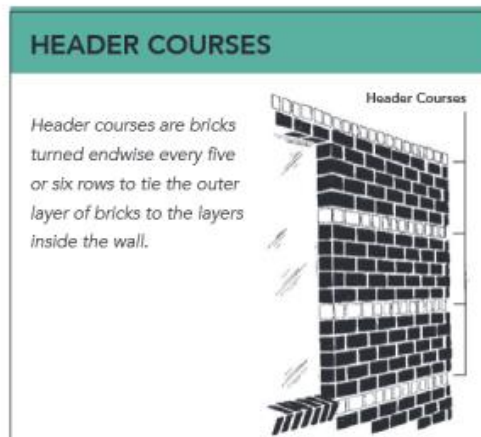
How to Check for Structural Reinforcement

Most pre-1940 buildings have unreinforced masonry construction. To assess these older buildings, examine the composition of the exterior walls and look for evidence of structural reinforcement or retrofitting, such as steel plates and anchor bolts (see photo).



Fred Turner, SE

- The use of “header courses” is often a sign of unreinforced masonry.
- Unbraced parapets have no visible steel members connecting the top or side of the parapet to the roof.
- If you do not know what to look for, consult a licensed engineer or architect.



Are you required to post warning signs?

If your building is in an area where a damaging earthquake is most likely to happen (Seismic Zone 4)—and if your building has load-bearing walls of unreinforced masonry—you may be required to post earthquake-risk warning signs for the public.

Properly posting these warning signs is important for the safety of the public. In addition, failure to post required signage will delay your building's eligibility to receive state assistance for earthquake repairs if eligible (see Disclosing Masonry Weaknesses on page 36).

Earthquake Warning

This is an unreinforced masonry building

You may not be safe inside or near unreinforced masonry buildings during an earthquake.



WANT TO RETROFIT?

Find out more on pages 26–29.

Earthquake Risk Disclosure Report Item 4

Do you have a pre-1980 concrete building?

Pre-1980 structures with concrete walls or columns often lack adequate steel reinforcement. As a result, the walls or columns can be brittle, and, during a major earthquake, the walls or the entire building may collapse or be damaged beyond repair—and pose a great threat to life.

In 1971, three concrete hospital buildings collapsed following the San Fernando earthquake, killing 52 people.

How to Check for Adequate Steel Reinforcement

You should hire a structural or civil engineer to review your building's plans to determine the level of steel reinforcement and the need for additional confining reinforcement steel. This assessment is particularly important for buildings constructed before 1975 or for buildings with any of the following:

- Many large windows
- An irregular shape (not square or rectangular)
- A tall, open first floor



Concrete columns with inadequate confining reinforcement steel failed during the 1994 Northridge earthquake.

U.S. Geological Survey



WANT TO RETROFIT?

Find out more on pages 26–29.

Earthquake Risk Disclosure Report Item 5



Has an older steel-frame building been inspected?

Pre-1995 steel-moment-frame buildings and pre-1982 steel-braced-frame buildings often require retrofit.*

Earthquake shaking can cause fractures (cracks) or buckling in steel framing, which can severely damage a building's structural integrity and cause a building to partially collapse.

These fractures can occur in welds and steel elements in or near steel beam-to-column connections, and also in column base plates in pre-1995 steel-moment-frame buildings. In buildings constructed before 1982, slender or thin-walled diagonal steel braces can buckle prematurely.

How to Check for Weld Fractures or Thin-Walled Braces

Fractures in steel-frame construction are often small and hard to detect because they may be covered by exterior facades, interior walls, ceilings, or fireproofing. You should hire a structural or civil engineer to assess the condition of steel framing, particularly if the building has been exposed to strong ground shaking and you have found:

- Cracked finishes around columns and beams
- Cracked or out-of-plumb partitions or door frames
- Damaged ceilings or broken glass

You may also want to obtain a qualified assessment if you are concerned about the potential for such damage.

Earthquake shaking followed by tsunami damaged both the steel-moment framing and the steel-braced framing of this building.



Dimitrios Lignos and EERI

* A steel moment-frame is an assembly of beams and columns, rigidly joined together to resist both vertical and lateral forces, while a steel braced frame resists lateral forces with diagonal braces.



WANT TO RETROFIT?

Find out more on pages 26–29.

Earthquake Risk Disclosure Report Item 6

Is a “soft”- or weak-story building adequately strengthened?

Older wood-framed buildings—particularly apartments—are described as having a “soft-” or weak-story problem when the first (ground-level) floor has either carport-style parking or commercial space that has large windows and few solid walls.

These types of buildings are prone to collapse if ground floor walls and columns are not strong enough to hold up the building during earthquake shaking.

How to Check for Strengthening

To check the structural condition of a soft- or weak-story building, you should consult a qualified engineer or architect.



U.S. Geological Survey

Earthquake shaking caused these apartment buildings to collapse on their ground-level carports.



WANT TO RETROFIT?

Find out more on pages 26–29.

PAGE 20

Earthquake Risk Disclosure Report Item 7



Is exterior cladding and signage adequately anchored?

A building's exterior cladding can sustain damage and even fall off if the cladding does not allow the building to flex when the ground shakes.

This type of structural risk is particularly problematic for buildings that have:

- Heavy precast concrete cladding with weak steel connections
- Cladding units with gaps or joints not large enough or in the right places to accommodate building movement

Inadequate anchoring of exterior signage can also become a hazard during an earthquake.

How to Check for Adequate Anchoring

Consult with a qualified engineer or architect to assess a building's exterior cladding and signage.



U.S. Geological Survey

The cladding (siding) of this office building—as well as the structure—were damaged during an earthquake.



WANT TO RETROFIT?

Find out more on pages 26–29.

Other Structural and Non-Structural Risks

Other Structural and Non-Structural Risks

Your commercial property also may have other structural or non-structural issues that could result in serious property damage or injuries during an earthquake. Although these risks are not included on the Disclosure Report, they should be considered if you are a property owner or potential buyer.

UNUSUAL OR IRREGULAR BUILDING DESIGN

A building with a design that is anything other than a box with four walls, floors, and a roof can be more vulnerable to earthquake damage than simple buildings. Design features such as the following can make a building vulnerable:

- Long horizontal spans
- Open, multi-story interior spaces (e.g., lobbies, auditoriums)
- Unique building shape (e.g., L-shape)
- Vertical step-backs or over-hangs at upper floors

Consult a qualified engineer or architect to evaluate the condition of a building.



C. Scawthorn



WANT TO RETROFIT?

Find out more on pages 26–29.

Other Structural and Non-Structural Risks



OTHER COMMON PROPERTY VULNERABILITIES

If your building has any of these features or types of contents, you should consider a detailed assessment for earthquake vulnerability. If necessary, the issues should be mitigated to prevent costly building damage, injuries or interruption to business.

- **Heavy roof:** Buildings with heavy roofs (e.g., clay, tile, or slate) will shake more in an earthquake than buildings with lighter-weight roofs. These heavier materials are also more likely to fall and injure people or objects below.
- **Over-sized windows:** The larger the window (e.g., retail stores), the more likely it will break in an earthquake. This is a particular problem when windows are surrounded with only a small amount of supporting wall framing.
- **Unattached or unbraced building equipment (mechanical, electrical, plumbing [MEP]):** If improperly braced, essential building equipment such as air conditioners, water or propane tanks, and boilers can topple or slide in an earthquake. Unbraced gas, electrical, water supply, or waste lines can break and cause fire or flood damage.
- **Unbraced ceiling or wall systems:** Unbraced or improperly braced ceiling systems, heavy light fixtures, wall partitions, and duct vents can shake loose during an earthquake and injure people or damage building contents.
- **Stairs, balconies, overhangs:** If these features are not braced or attached properly, they can collapse in an earthquake and, potentially, prevent people from evacuating the building.
- **Unreinforced masonry chimney:** Unreinforced brick or stone chimneys often collapse in earthquakes.



U.S. Geological Survey



WANT TO RETROFIT?

Find out more on pages 26–29.

Other Structural and Non-Structural Risks

- **Signs, marquees, canopies:** Signs and other exterior features must be braced to ensure they will not fall and cause injuries or property damage. Check periodically to make sure connections are secure.
- **Shelves, storage and building contents:** An earthquake can cause shelves, storage systems, furniture, and their contents to shift and fall, injuring people and damaging property.
- **Heavy business equipment:** IT equipment or shop equipment may be severely damaged in an earthquake. A business may lose vital records and cause costly business interruption. Appliances with flammable gas and ignitable liquid can cause a fire following earthquake.



Reid Middleton, Inc



WANT TO RETROFIT?

Find out more on pages 26–29.

Other Structural and Non-Structural Risks



FIRE FOLLOWING EARTHQUAKE

A building may survive an earthquake but sustain significant post-earthquake damage from a fire. A fire following earthquake can become an extremely large and devastating event in urban settings that are more densely populated and have neighborhoods with wood-frame buildings. In addition, broken water mains may reduce the amount of water available to fight these post-earthquake fires.

Although fire following an earthquake has many possible causes, the most common fires are those resulting from:

- Natural gas leaks
- Electrical system malfunctions
- Interactions involving hazardous chemicals or flammable liquids

How to Reduce the Fire Risk

The most practical way to minimize the likelihood of fire following earthquakes is to prevent the release of flammable gas and ignitable liquid from building equipment and pipelines.

- Ensure that all natural gas appliances (water heaters, dryers, stoves, ovens, furnaces) are securely anchored to floors or walls and have flexible pipe connections.
- Correct deficiencies that could result in electrical arcing near combustible material.
- Install automatic gas shut-off systems and/or ensure that key personnel at the building site have both the access and tools (wrench) to shut off the gas after an earthquake.



SF Fire Department



WANT TO RETROFIT?

Find out more on pages 26–29.



Tips for a Successful Retrofit

MAKE A PLAN: DEFINE THE SCOPE OF WORK AND HOW TO ACCOMPLISH THE PROJECT

The first step in an earthquake retrofit or upgrade is to ensure that you, as the property owner, understand the work that will be required for the retrofit project and the required building and performance standards. You should not rush into repairs, no matter how badly they are needed, or hire the first contractor you meet with.

Define Scope of Work

Defining the scope of a retrofit or upgrade project is a critical first step. Additional resources are listed on page 35.

Reminders:

- For any retrofit project, be sure to consult with your local building department for advice on the State's requirements, local building codes and standards.
- To determine the best solution for a retrofit, you may want to consult a licensed engineer or architect or a general contractor that specializes in this type of work. (See page 29 for additional information on securing expert advice).
- You or your architect/engineer/contractor will need to obtain a building permit from your local building department.
- When evaluating the cost of a retrofit, remember to consider both the economic value of the work and the value to your "peace of mind."



Water Heater Bracing

Under California law, you are required to brace the water heater when you install a new water heater and when you sell your property.

You can brace a water heater yourself using a strap kit, available from a local hardware store. Or, you can hire a plumber or handyperson to do the work. The diagram on page 14 illustrates proper water heater bracing.

As an added safety precaution, consider having a licensed plumber replace any rigid pipes with flexible pipes, which will better withstand shaking during an earthquake.

Simple Mitigation Projects: Bracing of Nonstructural Components

In several recent U.S. earthquakes, the majority of property damage has been nonstructural in nature, and the loss of life and property could have been prevented with proper bracing of nonstructural components.

The publication *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide (FEMA E-74)* is a good resource for learning about and then mitigating the risks of various nonstructural building components—and allows building and business owners to undertake some seismic bracing without the need to hire an engineer, architect, or contractor.

Other resources for simple mitigation projects include the following:

- *Nonstructural Earthquake Hazards in California Schools* (DSA, CSSC, OES, 2011)
- *Installing Seismic Restraints for Mechanical, Electrical, and Duct and Pipe* (FEMA 412, 413, and 414, 2002, 2004)
- *Seismic Considerations for Steel Storage Racks* (FEMA 450, 2003)

More Complicated Retrofit Projects

By their nature, some earthquake retrofit projects are more complicated and will require the expertise of a licensed engineer or architect and/or a general contractor who specializes in this type of work. Be sure the expert consults relevant local ordinances and the latest industry guidelines and standards.

- **Inadequate wall anchorage:** To strengthen wall anchorage may require new anchorage and continuous ties across the roof. Work can be done inside above the ceiling or on the roof, at relatively low cost. Engineering information is in the *California Existing Building Code, Appendix A, Chapter A2*.

- **Unreinforced masonry walls and parapets:** In most cases, retrofitting unreinforced masonry walls requires 1) better connecting the walls to the roof and floors and 2) installing steel frames or reinforced concrete. In some cases, large steel plates must be attached with anchor bolts through the masonry (see photo on page 17). Engineering information is in the *California Existing Building Code, Appendix A, Chapter A1*.
- **Non-ductile concrete walls and columns:** To mitigate this issue, new walls or bracing can be added and columns can be wrapped with confining material.
- **Steel-frame buildings:** For repair and retrofit techniques and recommended guidelines check these resources: FEMA (*FEMA 350 to 353*), the American Institute of Steel Construction (*AISC 341 Seismic Provisions and AISC 358*) and the International Code Council (ICC) (see "Additional Resources" on page 35). Local ordinances may also apply.
- **Soft-story multi-unit residential buildings:** Soft, weak, or open-front stories can be strengthened to prevent collapse.
- **Unreinforced masonry chimney:** Strengthening or bracing a chimney can be expensive. Retrofit options include:
 - Adding plywood panels either above ceiling joists or, when re-roofing, on roof framing
 - Removing or replacing all or a portion of the chimney with lighter-weight material (e.g., using a metal flue for the upper portion of a chimney) (see *FEMA P-1100, Volume 2C*)
- **Historical buildings:** Your project also may need to comply with the *California Historical Building Code*.

Keep Your Retrofit Documents

Once your project is complete, remember to keep all plans, permits, and other project records so you can provide them to a future buyer.



Select a Licensed Architect, Engineer and/or Contractor

A critical step is to find and hire the right professional. Be sure you:

- Discuss project with at least two or, ideally, more licensed professionals.
- Obtain written proposals. Do not accept verbal promises. Be sure to compare the proposals to ensure the scope of work in each (project description) meets your needs and are similar. Examine all terms (e.g., price, project plan and timeframe, use of subcontractors). Consider each professional's experience with earthquake retrofitting. The lowest-priced bid may not be the best bid.
- Ask for and then check with references.
- Before finalizing a contract, verify that your preferred professional's state license is current and that he/she is locally licensed.

You will find useful a number of publications from the Contractor's State License Board. Visit www.cslb.ca.gov.

- *What You Should Know before Hiring a Contractor:*
Provides information on how to find, hire and work with a contractor
- *Building Improvement Contracts: Putting the Pieces Together:*
Provides information on the legal requirements of contractors
- *After a Disaster, Don't Get Scammed:*
Provides general information on the contracting process

Avoid Contractor Payment Pitfalls

- For any project that costs \$500 or more, a licensed contractor must provide a written contract.
- Pay the contractor in installments as the work is completed.
 - Keep the down payment low. By law, a down payment on a building improvement contract cannot exceed 10% of the contract price or \$1,000, whichever is less.
 - Consider requiring the contractor to secure a completion bond.
 - Withhold at least 10% of the total contract price until the project is completed to your satisfaction.
 - Do not make the final payment until the local building department has signed off on the work and you have conducted a final review to make sure the work is complete and correct.



Financial Resources

Even in the most damaging earthquakes, federal or state assistance (funding) for the repair of commercial properties is **not** typically available. Commercial property owners are expected to have adequate insurance and financial reserves to cover losses (building, business interruption, and loss of income) and repairs. This reality emphasizes the need for commercial property owners to consider the cost-benefit of both seismic retrofits and earthquake insurance.

Financial Value of Retrofits

Properly retrofitted buildings are the only way to reduce the likelihood of significant property damage, devastating injuries, and/or financial losses from an earthquake. In addition, seismic retrofitting will likely reduce insurance premiums or increase the likelihood that your property is insurable.

Tax Credit Programs and Other Financial Assistance

For qualified owners of “at-risk property,” the State offers a five-year 30 percent tax credit program for qualified seismic-retrofit costs. The tax credit, which is awarded upon completion of a seismic retrofit, can be applied to personal income tax or corporate taxes.

California’s Revenue and Tax Code (Section 74.5) also allows property owners to implement seismic-strengthening measures without a property tax reassessment.

The California Capital Access Program (CalCAP) Seismic Safety Financing Program facilitates private financing for seismic retrofits to small businesses and residential property owners, including the owners of multi-unit residential properties and mobile homes. More information is on the California Treasurer website.

Local jurisdictions may also offer incentives for seismic retrofits. The local building department may be able to offer suggestions.

Consult an accountant for more information.



As a reminder: As part of the property sales process, lenders typically require a seismic assessment of the property and, depending on the outcome, a lender may require seismic retrofit or earthquake insurance for loan approval.

Earthquake Insurance

Without insurance, most commercial property owners will suffer significant financial loss from a major earthquake.

The cost of earthquake insurance is based on several factors, including property location, age, construction type, and condition as well as the deductible and replacement values. In California, typical earthquake deductibles average between 10 and 20 percent of replacement value.

A commercial property owner should consider his or her individual risk factors—including the potential costs of business interruption and loss of income—and then weigh the cost of earthquake insurance coverage against the benefits. The advice of a licensed civil or structural engineer or an architect can help determine the potential for damage, the expected cost of and time for repairs, and the potential for lost business income.

An alternative to traditional earthquake coverage is parametric insurance. Parametric insurance provides coverage against specific events rather than on actual loss damage. When a disaster such as an earthquake occurs, coverage is triggered by an objective measure of a hazard—such as earthquake magnitude—rather than based on loss adjustment. As a result, parametric policies can pay rapidly, disputes over payouts are greatly reduced, and payouts can be used flexibly for any post-disaster need.

Contact your insurance agent or broker to help you locate earthquake insurance products (traditional or parametric), pricing, and deductible options.

Small Business Disaster Loans and Other Resources

The U.S. Small Business Administration offers low-interest disaster loans; however, these loans have credit requirements.

The State offers a range of resiliency and disaster relief assistance programs and services for California businesses. For more information, visit the California Office of the Small Business Advocate website.

Earthquake Safety Tips

Precautions: During an Earthquake

If you are indoors: Drop, cover and hold on.

- Get under a sturdy desk or table and hang on to it OR move into a hallway OR get against an interior wall.
- Stay clear of windows, fireplaces, and heavy furniture or appliances.
- Get out of a kitchen or any area that has objects that can fall.
- Do not run downstairs or rush outside while the building is shaking. Debris may be falling and/or you might fall and sustain an injury.

If you are outdoors: Get into an open area. Move away from buildings, power lines, chimneys, and anything else that might fall.

If you are driving: Prepare to stop.

- Move as far out of traffic as possible.
- Do not stop on or under a bridge or overpass or under trees, light poles, power lines, or signs.
- Remain in your car until the shaking stops.
- After you resume driving, watch for cracks or bumps in the road and fallen objects.

If you are near a steep hillside:

Watch for landslides. Earthquakes can loosen rocks, trees, and other debris.

*MyShake is a free smartphone app that sends audio and visual earthquake warnings potentially seconds to tens of seconds before strong shaking begins depending how far you are from the epicenter. Part of the state's Earthquake Early Warning system, the tool is available for iPhone and Android devices. Get the app at the Apple and Google Play stores and learn more at www.earthquake.ca.gov.





COASTAL AREAS: SPECIAL TSUNAMI PRECAUTIONS

An earthquake or large landslide near the coast or beneath the ocean can cause a tsunami. A tsunami may occur without warning, and the first waves—which often are not the largest—may reach the coast within minutes after the initial earthquake. And, an earthquake may result in more than one set of waves; potentially deadly tsunami waves can continue to arrive for hours and at intervals of 10 minutes or more.

During the shaking: Drop, cover, and hold on. Watch for falling objects until the shaking stops.

After the shaking: Move (evacuate) immediately either to higher ground or inland away from the shore, and do so on foot, especially if you are not sure you can evacuate by vehicle. Note: Authorities may have no time to issue a warning. If you do not hear an evacuation announcement but you see a drop or rise in water level or you hear a loud noise coming from the water, move immediately and quickly away from the shore.

Stay away from the shore. Wait for an official “all clear” announcement before you return to the area.



Aftershocks may occur and you may need to continue to take precautions even after the initial earthquake.

Precautions: After an Earthquake

Check for Injuries

- If a person is bleeding, put direct pressure on the wound. Use clean gauze or cloth, if available.
- If a person is not breathing, immediately call 911. If you can, perform CPR.
- Seek medical help for other serious injuries.
- Do not attempt to move a person who is seriously injured unless there is an immediate danger of further injury.
- Cover injured persons with blankets to keep them warm.

Check for Hazards

- **Fires:** If safe to do so, immediately extinguish a fire. Otherwise, call 911.
- **Gas leaks:** If you suspect a gas leak or smell natural gas (rotten eggs), shut off the main gas valve. **Note:** Once you turn off the gas, do not turn it back on yourself. Wait for the utility company to check for leaks and restore service.
- **Damaged electrical wiring:** Shut off power at the control box.
- **Downed or damaged utility lines:** Do not touch downed power lines or any objects in contact with them. Contact the local electric utility company.
- **Spills:** If you can do so safely, clean up any spilled medications or spills of other potentially harmful materials such as bleach, lye, or gasoline.
- **Downed or damaged chimneys:** Chimneys may be weakened and could topple during aftershocks. Do not use a fireplace with a damaged chimney; the damage could cause a fire or leak toxic fumes.
- **Broken glass:** To avoid injuries, be sure to wear sturdy shoes.
- **Fallen objects:** Look for objects that have fallen, being careful as you check closets and cupboards for objects that still might fall.

Other Information

The pages that follow provide additional information that property owners may find useful.

Additional Resources

A number of additional resources on earthquake safety for commercial property owners are available both from the California Seismic Safety Commission and the Federal Emergency Management Administration (FEMA).

IN THIS SECTION	PAGE
Additional Resources.....	35
Relevant State Seismic Safety Laws.....	36
Acknowledgements.....	38

- California Seismic Safety Commission:
www.ssc.ca.gov/forms_pubs/cog.html
- California Governor's Office of Emergency Services:
www.caloes.ca.gov
- California Building Standards Commission:
www.dgs.ca.gov/BSC/Codes
- California Earthquake Authority:
www.earthquakeauthority.com
- California Geological Survey:
www.consrv.ca.gov/cgs
- California Small Business Development Center:
www.californiasbdc.org
- Federal Emergency Management Administration:
www.fema.gov
- United States Geological Survey:
www.usgs.gov

Emergency Preparedness Resources

- American Red Cross:
www.redcross.org
- U.S. Department of Homeland Security:
www.ready.gov/earthquakes
- Earthquake Country Alliance:
www.earthquakecountry.org

Relevant State Seismic Safety Laws

The full wording of these laws is available at
<http://leginfo.legislature.ca.gov/faces/codes.xhtml>

Publishing the Guide (Business and Professions Code, Section 10147)

The California Seismic Safety Commission is required to develop, adopt, publish, and update the *Commercial Property Owner's Guide to Earthquake Safety*, containing information on geologic and seismic hazards, explanations of structural and nonstructural earthquake hazards, and recommendations for mitigating these hazards.

Delivering this Guide (Government Code, Sections 8893.2 and 8875.6)

Each seller of commercial property built before 1975 that has precast (tilt-up) concrete or masonry walls (reinforced or unreinforced) and wood-frame floors or roofs must give the buyer "as soon as practicable before the transfer" a copy of the *Commercial Property Owner's Guide to Earthquake Safety* and disclose certain earthquake deficiencies.

Disclosing Masonry Weaknesses (Government Code, Sections 8875.8 & 8875.9)

Local governments in Seismic Zone 4 (where a damaging earthquake is most likely to happen) must identify all unreinforced masonry buildings within their jurisdictions and establish programs to mitigate the risks of these buildings, including a process for notifying building owners of the risks (Government Code, Sections 8875, 8875.1 and 8875.2).

Building owners who receive such notices must post earthquake-risk warning signs on buildings that have load-bearing unreinforced masonry walls (Government Code, Sections 8875.8 and 8875.9).

A property owner has five years to comply with the local program requirements, after which the owner may not receive state assistance payments for earthquake repairs until after all other applicants have been paid (Government Code, Section 8875.7).

Note: Check with the local building department to determine if a building is subject to this requirement.



Water Heater Bracing (Health and Safety Code, Section 19211)

Water heaters must be anchored or strapped to resist falling during an earthquake. The seller must certify to the potential buyer that the water heater is properly braced.

Earthquake Faults (Public Resources Code, Section 2621 and following sections)

The Alquist-Priolo Earthquake Fault Zoning Act prohibits building for human occupancy astride active faults and requires sellers of commercial property to disclose to potential buyers if the property is located in a designated fault zone.

Landslide and Liquefaction (Public Resources Code, Section 2694 and following sections)

The Seismic Hazard Mapping Act requires the State to prepare maps of the zones in California most susceptible to landslide and liquefaction hazards during earthquakes and requires sellers to disclose to buyers if the property is in such a zone. The Disclosure Report can be used to meet the requirement.

Acknowledgments

California Seismic Safety Commission

Hon. Cindy Silva, Chair, Local Government
Fuad Sweiss, Vice Chair, Mechanical Engineer
Ida A. Clair, State Architect (Alternate: Diane Gould)
Hon. Ken Cooley, State Assembly (Alternate: Nestor Lopez)
Alegria De La Cruz, Social Services
Hon. Debra Garnes, Local Government
Mark Ghilarducci, Office of Emergency Services (Alternate: Lori Nezhura)
Joone Kim-Lopez, Public Utility
Mia Marvelli, Building Standards Commission
Dr. Kit Miyamoto, Structural Engineer
Hon. David Rabbitt, Local Government
Andrew (Andy) Tran, Insurance
Vincent Wells, Fire Protection

Commission Staff

Salina Valencia, Acting Executive Director
Tanya Black
Jia Wang-Connelly

The Commission appreciates the assistance of the following organizations and individuals in preparing this version and prior versions of the Guide:

American Red Cross	Randy Goodwin, City Architect/ Building Official, City of West Sacramento
Bob Anderson, SSC (ret.)	
Association of Bay Area Governments	Humboldt Earthquake Education Center
AT&T	International Code Council
Building Education Center	Richard McCarthy, SSC, Executive Director (ret.)
California Association of Realtors	National Geophysical Data Center
California Building Officials	Pacific Earthquake Engineering Research Center
California Council of the American Institute of Architects	San Diego Association of Governments
California Geological Survey	Southern California Association of Governments
California Department of Insurance	Southern California Gas Company/ SEMPRA
California Real Estate Inspection Association	Structural Engineers Association of California
California Governor's Office of Emergency Services	Fred Turner, SSC (ret.)
City of Los Angeles	United States Geological Survey
Collaborative for Disaster Mitigation	Ivan Wong, SSC Commissioner (fmr.)
Committee on Earthquake Safety Issues for Gas Systems	
Earthquake Engineering Research Institute	

