



UNDERWOOD PHOTO ARCHIVES/SUPERSTOCK

Prepare for the big one

The centennial of the 1906 San Francisco earthquake is a good time to make a disaster plan

The 100th anniversary of the 1906 San Francisco earthquake is putting seismic safety back in the news. Disaster will come again, as the 1989 Loma Prieta and 1994 Northridge quakes proved. For the Red Cross's Victoria Melvin, that's reason to make early preparations, learn to react safely during an earthquake, and know how to proceed afterward.

"People who endured Katrina were confused—and that happens during an emergency," says Melvin, who is an expert in disaster preparedness at the American Red Cross National Headquarters in Washington, D.C. "But that's why we encourage preparation so much."

Here's our guide—with help from the U.S. Geological Survey, the American Red Cross, and other agencies—for earthquake safety and emergency response.

Do you have a smart family plan?

Preparation is the key to riding out an earthquake. First, find out the earthquake potential for where you live. You can look at fault-zone maps and general soils maps at your city or county planning or engineer's office, or contact the U.S. Geological Survey (see page 9). Develop a family earthquake plan, then rehearse it, figuring out and practicing what each of you would do.

Before a quake strikes

- Learn about your child's school's earthquake plan through the PTA.
- Learn the earthquake safety plan at your place of business.
- Take a first-aid class.
- Visit www.redcross.org and enter your zip code in the designated box to find your local Red Cross chapter. Write down its address and phone number to keep in your emergency kit.
- Find out contact information for your state and local emergency services (check front pages of your local phone book). Visit their websites.
- Identify secure duck-and-cover spots in your home, such as under sturdy tables and desks.
- Choose a safe place outside your home where family members can meet after the shaking stops. "It's very important that people meet where they say they're going to or others will assume they are still in the building. That can be a tragic mistake," Melvin says.

According to the USGS, there is a 62% likelihood that a major quake will hit the Bay Area in the next 25 years

- Establish an out-of-state contact, and make sure family members know to call that person as soon as possible after an earthquake.
- Make a list of important phone numbers, post the list near your telephone, and place copies in wallets and backpacks. Include the number for the office of emergency services in your area. Update the list frequently.
- Practice your disaster plan with your family and post a copy of it in your home. Discuss the important information with babysitters, house sitters, and neighbors.

Talk to your kids

Dedicate time now to prepare your children for an earthquake. Involve them in developing your disaster plan, preparing disaster supplies kits (ask them what game or toy they want to include), and practicing "drop, cover, and hold on."

Part of a good disaster plan is setting up a neighborhood watch

Get to know your neighbors: Residents next door or across the street may be the best and most immediate help during a crisis. One way to get neighbors talking to each other is to organize an annual block party with games for the kids, and finish it with a brief meeting to discuss neighborhood concerns. This a good time to create a disaster plan—find out who may need special help and who has special skills.

Make sure everyone knows where the nearest fire and police stations are and how to shut off the gas if a leak is detected. You can set up a neighborhood watch program through your local police department. NERT (Neighborhood Emergency Response Teams) and CERT (Community Emergency Response Teams) are two organizations that offer emergency response training through local fire departments. (Check out S.F. NERT at www.sfgov.org/site/sfnert_index.asp?id=3139)

What should be in your disaster kit?



The disaster kit for your home should contain emergency supplies for use in the hours and days following a quake, when major services and resources will not be available. “We used to plan for about three days of food and water,” says the American Red Cross’s Victoria Melvin. “Now we’re saying four to seven days, or even longer. It could take a long time for the Red Cross to get supplies to communities in need.”

The Southern California Earthquake Center and the U.S. Geological Survey two kinds of kits:

Personal disaster kit

Keep your kit in the car or at your business. Use a backpack or other small bag that’s easy to carry, and include:

- Medications and medical consent forms for dependents
- First-aid kit and handbook
- Spare eyeglasses and personal hygiene supplies
- Bottled water
- Whistle (to alert rescuers to your location)
- Emergency cash
- List of emergency contact phone numbers

- Snack foods high in calories

- Emergency lighting—light sticks and/or a working flashlight with extra batteries and light bulbs (hand-powered flashlights are also available)

- Comfort items, such as games, crayons, writing materials, and teddy bears

Household disaster kit

For water, food, and other essential supplies. Use a watertight container—such as a plastic garbage can—and store in an easily accessible location, preferably outdoors (not in your garage). It should hold at least a 4- to 5-day supply of the following items:

- Drinking water (minimum one gallon per person per day)
- First-aid supplies, medications, and essential hygiene items, such as soap, toothpaste, and toilet paper

- Emergency lighting—light sticks and/or a working flashlight with extra batteries and light bulbs (hand-powered flashlights are also available)

- A hand-cranked or battery-operated radio (and spare batteries)

- Canned and packaged foods and cooking utensils, including a manual can opener

- Items to protect you from the elements, such as warm clothing, sturdy shoes, extra socks, blankets, and perhaps even a tent

- Heavy-duty plastic bags for waste and other uses, such as for tarps or rain ponchos

- Work gloves and protective goggles

- Pet food and pet restraints

- Copies of vital documents, such as personal identification and insurance policies

NOTE: Replace perishable items like water, food, medications, and batteries on a yearly basis.

How can you protect your home now?

Strengthening your house's structure will take time, but you can immediately make the interior safer in the event of an earthquake by protecting your possessions and protecting yourself *from* your possessions. Take a walk with your family through your house and play "spot the hazard." Most rooms are full of them. In an earthquake, falling objects are the prime danger; that's how most people are hurt.

Getting started

Identify and list the risks first. Then begin by correcting the most glaring hazards and work your way down. Do the same with your possessions, first safeguarding what you value most. Place breakables in secured spaces, and keep caustic chemicals in secure cabinets at floor level.

Affix bookcases, armoires, and entertainment centers to the wall. Then you can worry about securing objects you store in them. Objects on tables and open shelves tend to slide or "walk" during earthquake shaking. Barriers will keep them from falling off; putties, tapes, and other adhesives will keep items from moving at all. Restrain all electronic gear by either fastening it directly or tethering it to secured shelves or desktops.

Things that hang from the ceiling need to be secured to joists or beams. Hang heavy art or mirrors on double hooks, and pad the backs to minimize damage. Ideally, hooks should be driven into studs.

The kitchen

Make sure cabinets latch securely. You can retrofit cabinets with heavy spring-loaded hasp or touch latches, or replace the pulls with latches or catches that lock to the cabinet frame. Don't count on magnetic catches; they often shake free. "Built-in" appliances—stoves, dishwashers, microwave ovens—aren't necessarily secured to surrounding cabinets; many simply rest on a trim strip, held only by gravity. Check to see how yours are secured. Also make sure all gas appliances have flexible connectors.

Bedrooms

Statistically, you're most likely to be in your bedroom when a quake hits. Make sure nothing can fall onto any beds or crib in the house. Remove or block casters. Keep beds away from windows, and use window coverings to deflect flying glass. Security film will strengthen glass and keep windows from shattering into the room.



Cabinet doors. Install child-safety latches on all cabinet doors to prevent contents from falling out.



Hanging objects. Affix to walls with "closed hooks." Display only unframed art or textiles above beds or places where people sit.



Home electronics. Secure computers, televisions, stereo equipment, and microwaves with flexible straps with buckles (for easy removal).



Tall furniture. Bookcases, armoires, and entertainment centers tend to be top-heavy. Secure to wall studs with L-brackets.

What about larger renovations?

Most of us live in single-story wood-frame houses. Lightweight and flexible (up to a point), they're the safest type of structures in which to ride out an earthquake.

The key is to make sure your house behaves as one continuous unit and that during a quake it won't flex to the point of breaking the supports or their connections. The building must be able to absorb and evenly distribute the lateral forces; there shouldn't be a weak point that can fail.

Foundation basics

Slab foundations can be good—particularly on soft soil, fill, or other inferior ground where the slab can bridge gaps. In areas of “seismicity,” the best approach is to have well over the amount of embedded steel reinforcement that the code requires.

With poured-concrete foundations, first check the “health” of the concrete. Be somewhat wary of hybrid foundations that have an abrupt change in style or materials. If your foundation appears strange, or if you have any question about it, get advice from an engineer.

If a foundation in a pre-1935 house is soft or crumbly, immediately consult an engineer. An engineer should also check any foundation made of brick, unreinforced concrete block, or wood; these have consistently failed in past quakes. Don't rule out the necessity of wholesale replacement of the foundation.

Crawl space is critical: it's the likely weak link

All the walls in a house help absorb and dissipate the energy of a quake, but in houses not built on a slab, there's often only a perimeter wall—and perhaps an occasional short column on its own footing—between the first floor and the foundation.

Stiffening this perimeter “cripple wall” and bolting it to the foundation are the two key steps you can take to increase your house's chances of making it through a quake. These are also the most expensive and technically and physically difficult steps. They are best left to professionals.

Bolting down your house

The board between the house and the foundation is called the mudsill. If bolts don't affix this sill to the foundation, even a moderate quake can cause your house to slip off its foundation. Houses built prior to



1940 weren't required to have sill bolts, and even some later houses don't have them. Several styles of retrofit bolts are available. All are forced into holes drilled through the sill and foundation with a rotary hammer.

Stiffening the crawl space walls

Even bolted, a mudsill is of little use if the studs that it rests on are simply nailed into place. Cripple walls can easily buckle if not laterally braced. On these walls in some houses, you'll find reinforcing 1-by-4s or 1-by-6s, or steel-strap bracing. Don't count on either; their main purpose was to keep the house square during construction.

Plywood shear paneling is necessary to stiffen the cripple walls against damaging deformation. It's best to sheathe the whole wall, but at a minimum, for cripple walls less than 4 feet tall, engineers recommend that you add 8 linear feet of plywood in each direction at every

interior corner of the crawl space. Double the run to 16 feet for two-story houses.

Also in the arsenal: hold-downs and structural steel angles

Where shear sheathing falls short of being twice as long as it is tall, reinforce the studs with hold-downs. These anchors bolt into the foundation and into corner posts or other supporting columns that immediately benefit from the additional bracing.

Professional help

If you need professional retrofitting help, be cautious in the selection process. All it takes to designate yourself a seismic retrofitter is a contractor's license. Find an experienced contractor who specializes in this kind of work, and ask for affiliations and references. You can call your state license board to see if any complaints have been filed against any contractor you're considering.

Other spots needing shear strengthening

Many buildings that failed in San Francisco's Marina District during the 1989 quake were "soft story" buildings—wide-open ground floors (usually garages) supporting multiple stories above. If you have living space over your garage, make sure the wall surrounding the garage door—as well as the back wall of the garage—is sheathed with 1/2-inch plywood, nailed as cripple walls are, provided there's plenty of space on both sides of the door. Use hold-downs to anchor the posts supporting the garage's header

beam. For extreme loads (several stories), you may need a fabricated steel frame surrounding the garage opening.

When the walls aren't wood

Unreinforced masonry walls are extremely dangerous—and are increasingly rare in houses in earthquake territory. If you want to improve such walls (especially recommended if your house was built before 1930), consult a structural engineer.

Homeowner's insurance generally does *not* cover earthquake damage. To be protected you may need a separate earthquake insurance policy.

These days, brick or other masonry is more commonly used as veneer. If inadequately tied to supporting walls, the veneer will consistently topple, although this isn't likely to cause structural damage. You can easily check the inside of a masonry wall to see if the stuff is veneer or not, but knowing how well it's tied to its supporting frame is another matter. Private building inspectors or a structural engineer can determine that for you.

Another thing to check (besides looking for major cracks) is the condition of the mortar. If you can scrape it off easily between bricks,

it's likely to fail during a quake; see an engineer.

Other key connections

In general, make sure all connection points you can gain access to (plates between stories, ceiling plates to rafters, and so on) are tied together well. You can find a metal connector for every conceivable joint—from simple L- and T-straps for any exposed columns or girders, to threaded-rod hold-downs for floor-to-floor tension connections.

Also make sure all gas and plumbing lines and vent pipes are supported at least every 4 feet; strap them to floor joists or to walls. Pay particular attention to peripheral, nonstructural connections, making sure everything is well anchored.

The roof

Keep your roof in good shape, particularly if it's tile or some other heavy material. If you're reroofing, consider the weight of the roof. A clay tile roof on a 1,500-square-foot house weighs tons more than a composition or wood roof. During reroofing is also an excellent time to add solid plywood shear panels over the rafters. This solid sheathing—now required in many applications anyway—will also provide protection for your roof if the chimney falls (most snap at the roof line).

Bracing

If you have skip-sheathing on your roof and a brick chimney, at least brace the roof around the chimney. You can feed sheets of plywood up into the attic (ripped to fit through the access hatch) and screw them to the joists around the chimney—



Failed masonry. Before this chimney collapsed, it first snapped at the roof line.

Steel frame. Braced chimney has a collar to hold it together and braces to keep it from coming down.

don't nail or you'll knock plaster off old ceilings or pop nails in newer ones. Lay down plywood from the chimney to a distance 1½ times its height (measure from the joist to the top).

A masonry chimney

The farther a chimney rises above the roof line, the farther—and consequently harder—it can fall. At 5 feet above, if it collapses, it can come through the roof (the likelihood increases as the slope of the roof decreases).

If the chimney poses a major threat, take it down; if the risk is minimal, leave it alone. The older your house, the greater a liability your masonry chimney is. As with any masonry, you should check the mortar for deterioration.

Only recent codes require internal and external bracing adequate

to keep most chimneys intact during a quake. Some masonry chimneys can be made safer with bracing and strapping, but realize that your fireplace and its chimney are probably the heaviest things in your house. If it falls, an improperly strapped chimney could bring the wall down with it.

Check with local building inspectors; rules about reinforcing chimneys are based on zones of seismic vulnerability and vary widely.

The water heater

It's your most unstable appliance. Make sure it's secured to the wall with loops of plumber's tape (tape should wrap entirely around the heater, then be bolted to the studs on two sides). Or use ready-made brackets or some other positive supports. If you have a zero-clearance water heater that sits out from

the wall, brace it from behind with 2-by-4s so it won't bang against the wall. If the wall is concrete, install heavy eye screws in lead anchors, then run light steel cable through the eye screws and around the heater. Make sure the gas line in and the water lines in and out connect with at least a foot of flexible line.

What should you do during a quake?

The Red Cross's Victoria Melvin has a disaster mantra: "Everyone should be prepared [for an earthquake] in the moment, in every room, for every location they frequent." This includes identifying safe locations in each space to use during a quake—such as under sturdy tables and desks—as well as possible hazards. Also make sure your earthquake kit can support you for more than a few days.

Speed of movement can be your best weapon against the dangers of an earthquake. "Most injuries occur when people try to leave a building or get across a room," says Melvin. "And in just that moment, something falls on them." Knowing in advance where you'll seek shelter is key in the race against time. Here's what you need to do:

- Drop, cover, and hold on when you feel an earthquake starting. Quickly get under a sturdy table or desk and hang on to it or sit in a hallway with your back against one wall and your feet against the other.
- Don't run outside or to the window to watch the earthquake.
- Avoid glass or anything that might fall on you.
- Don't rush to aid others during the shaking.
- Don't try to restrain a pet during the shaking.
- Don't try to catch falling objects.
- If you're in bed, it's probably

best to stay there. Hold on, and protect your head with a pillow. To avoid injury from any broken glass on the floor, keep slippers or shoes (and a flashlight) close to your bed.

- If you are outside, get to open space away from buildings and power lines.
- If driving, you should pull over away from bridges, overpasses, tall buildings, and power lines.
- In some regions, tsunamis caused by earthquakes may flood the area minutes or hours after a quake. If you are near the shore and hear a tsunami warning, feel a quake, and/or notice that the water is receding from the shore, immediately seek higher ground. Do not return to the shore until an "all clear" has been given. See <http://pubs.usgs.gov/circ/c1187> for more on tsunamis.
- In a mountainous area be particularly aware of falling rocks and debris. ▶▶



Gas. Shut off gas at the meter only if you suspect a leak.



Water. If your water lines are broken, shut off water at the main valve at the street.



Electricity. Flip off breakers if you find fallen or loose wires or appliance damage, or if you smell burning insulation.

What to do following a quake

- Check for injuries. The manual in your first-aid kit gives emergency instructions.
- Check for hazardous conditions: fire, loose or fallen wires and utility lines, items falling from cabinets and closets, and broken windows or large cracks in walls. Stay away from brick chimneys and walls. Evacuate your home only if it is seriously damaged and poses a threat to your safety. Turn off gas only if you suspect a leak. And do not turn it back on yourself. Wait for the gas company to do it safely.
- Continue following through with your family's disaster plan.
- Retrieve emergency supplies.
- Anticipate aftershocks and reduce remaining hazards.
- Check on your neighbors once your situation is under control.

Resources

Related Web links

- American Red Cross, www.redcross.org or www.prepare.org
- Association of Bay Area Governments, <http://quake.abag.ca.gov>

Who to contact in the first week after an earthquake

- Your county office of emergency services (refer to front section of your local phone book)
- American Red Cross, www.redcross.org/services/disaster or 866/438-4636
- Governor's Office of Emergency Services (OES), www.oes.ca.gov
- Federal Emergency Management Agency (FEMA), www.fema.gov/about/process

Information on earthquake preparedness plans and disaster kits

- American Red Cross, www.redcross.org/services/disaster/beprepared or <http://redcrossshop.org>
- Pacific Gas and Electric Company, your local utility or www.pge.com/education_training

Learn more about preparing in your area

- Alaska:** Alaska Earthquake Information Center, www.aeic.alaska.edu or 907/474-7320
- British Columbia:** Provincial Emergency Program, www.pep.bc.ca
- Northern California:** U.S. Geological Survey, <http://quake.wr.usgs.gov> or 650/329-4085
- Southern California:** Southern California Earthquake Center, www.scec.org or 213/740-5843
- Colorado:** National Earthquake Information Center, www.earthquake.usgs.gov or 303/273-8500
- Hawaii:** State Civil Defense, www.scd.hawaii.gov or 808/733-4300
- Idaho:** Idaho Bureau of Homeland Security, www.bhs.idaho.gov
- Montana:** Disaster and Emergency Services, www.mt.gov/dma/des or 406/841-3911
- Nevada:** Nevada Seismological Laboratory, www.seismo.unr.edu
- Oregon:** Oregon Department of Geology and Mineral Industries, www.oregongeology.com/sub/earthquakes/earthquakehome.htm or 971/673-1555
- Utah:** Department of Public Safety, <http://des.utah.gov/earthquake> or 801/538-3400
- Washington:** Pacific Northwest Seismograph Network, www.pnsn.org/HAZARDS/welcome.html or 206/543-7010 ♦