Retrofitting Works!

You don't have to sit back and wait for the next earthquake to destroy your home.

In 1989, at the corner of Center and Elm Streets in downtown Santa Cruz, architect Michael O'Hearn unwittingly created a laboratory for the study of seismic retrofit design. On that corner at 214 and 210 Elm Street, were two identical Victorian style homes. The twin homes were built by the same builder, with identical materials and constructions techniques. When O'Hearn bought them in 1984, he started retrofitting #210. Unfortunately, he had not yet retrofitted #214 before the Loma Prieta earthquake hit on October 17, 1989.

The home at 214 Elm St "came apart in four sections", O'Hearn said. However, the home at 210 with its plywood shear panels and bolted foundation suffered only minor damage. "This one we had retrofitted (#210) costs us $5,000 to repair. The other one (#214) cost us $260,000 to repair. The whole building had to be jacked up, repaired, and slid back on a new foundation."

-Based on an article prepared by APA – The Engineered Wood Association © 1997

Additional Information Sources

Association of Bay Area Governments
ABAG offers a number of earthquake publications which can be obtained from ABAG at 101 Eighth St, Oakland or by calling 510/464-7900. Information is also available at http://quake.abag.ca.gov. You can read and print out:

1. Maps showing predicted severity of shaking by fault and by city. Click on **Earthquake Shaking**.
2. Lists of contractors who have taken our training to do seismic retrofitting work, a list of home inspectors that we have trained and a list of structural engineers with retrofit experience. Click on **Residents**.
3. Standard ways to fix both structural and non-structural problems, including strapping water heaters and bracing bookshelves. Click on **Residents**.
4. Sources of money to help pay for retrofitting homes. Click on **Residents**.

United States Geological Survey
USGS offers a variety of publications, including *Putting Down Roots in Earthquake Country*. This handbook provides information about the threat posed by earthquakes in the San Francisco Bay region and explains how you can prepare for, survive, and recover from these inevitable events. The handbook can be viewed online at http://pubs.usgs.gov/gip/2005/15/ or you can request a free hard copy by calling (650) 329-4668.

California Seismic Safety Commission
The Commission has a general guide on how to identify typical earthquake weaknesses in your home. Home sellers are required by state law to disclose these weaknesses to home buyers. To obtain a copy of *The Homeowners Guide to Earthquake Safety (2005)*, contact your realtor, local board of realtors, or the Commission at 1755 Creekside Oaks Drive, Suite 11, Sacramento, CA 95833, or phone 916/263-5506. It is also available online at http://www.seismic.ca.gov/hog.html.

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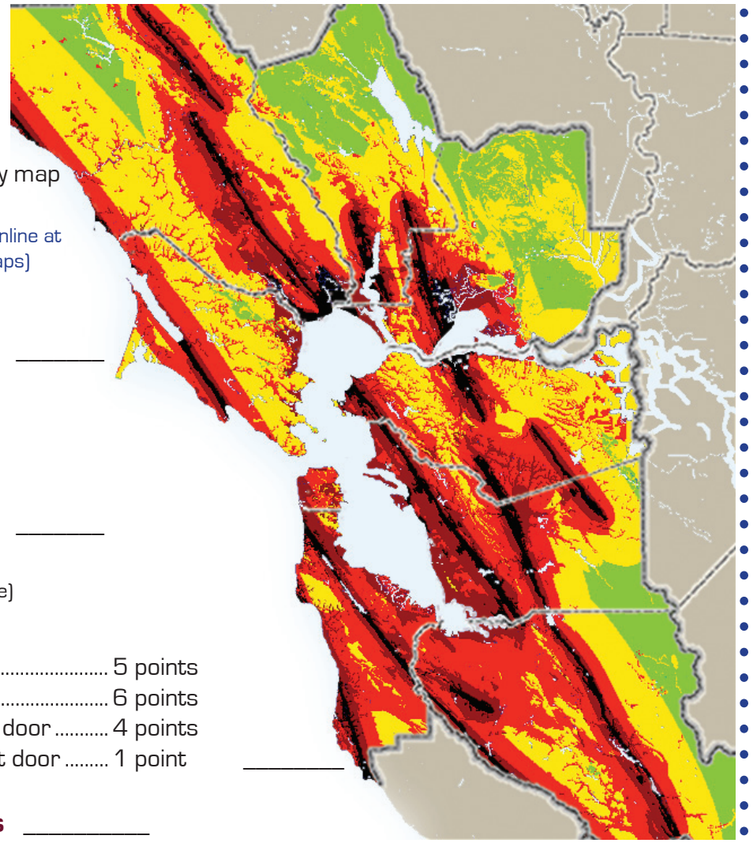
Association of Bay Area Governments

Stand Up To Quakes
Get Your Home in Shape!

Up to 160,000 households will be unable to sleep in their own homes following the next big earthquake in the Bay Area because they will be so badly damaged. **Will yours be one of them?**

Take the Quiz:

Is your home tough enough to stand up in a quake?



1. What color does the shaking intensity map (right) show for your neighborhood?
   (You can also search a more detailed map online at http://gis.abag.ca.gov/website/shaking.maps)
   - Red, dark red or black.....7 points
   - Yellow .....5 points
   - Green or blue.....3 points _____
2. When was your home built?
   - Before 1960.....5 points
   - 1961-1978.....3 points
   - 1979 – present.....1 point _____
3. How tall is it? (select the most appropriate)

   2 or more stories with living area above garage..... 5 points
   Split-level or on a hill or gentle slope..... 6 points
   1 story, 3 or more steps to the front door ..... 4 points
   1 story, less than 3 steps to the front door ..... 1 point _____

Total points _____

To take this quiz online or to take the quiz for apartment buildings, condos, and mobile homes, visit our website at http://quake.abag.ca.gov/residents/homequiz/.

If your home earned 13 or more points, it probably needs to be made stronger to keep you and your family safer, unless it has been strengthened in the last few years.

Scientists now predict that a large earthquake in the Bay Area is about twice as likely to happen as not happen in the next 30 years. Are you betting your home's value and your safety on odds like that?

It's usually easy and not very expensive to strengthen your home. Retrofitting will give you piece of mind that you should be able to live in your home after an earthquake – and have minimal damage to repair.

Go to http://quake.abag.ca.gov for more information and more detailed shaking maps.

Look inside for more information
The seven steps for strengthening
Frequently asked questions
Retrofitting success stories
and more....

Seven Steps for Strengthening

Follow these seven steps to a safer, more earthquake-resistant home or apartment building.

Step 1 Take the quiz on the first page of this booklet.

If your home earned 13 or more points, it probably needs to be made stronger to keep you and your family safer, unless it has been evaluated or retrofitted in the last few years. The threat of earthquake damage to your home is based on its specific design, quality of construction, and state of repair, as well as its particular location, when it was built, and its type of construction.

Step 2 Get bids and a detailed proposal with plans from at least three contractors.

The contractors should show exactly what is going to be done, referencing appropriate building codes. Ask each for two professional references (such as engineers or architects) and for two homeowner references. You can find a list of retrofit contractors and engineers online at quake.abag.ca.gov/residents/retrofitprof.

Step 3 Call the references for all three contractors.

Ask the professional references these questions -

- Have you ever worked with this contractor to retrofit a home?
- Is this contractor competent to perform a retrofit? (tell them about your home)

Ask the homeowner references these questions -

- Did this contractor do your work in a timely manner?
- Would you recommend this contractor?

Step 4 Ensure that the proposed retrofit meets or exceeds available minimum standards.

If your home is only one or two stories tall and has a crawl space under the floor (that is, is not on a concrete slab), you can probably use the standard plan set. This plan set is a tool to help homeowners know what needs to be done. The plan set is available online at http://quake.abag.ca.gov/residents/planset/ . You can use the plan set to get bids from contractors, or, if experienced, you can do the work yourself.

Cities have a policy of not recommending individual contractors. However, consider calling your building department to see if you can take the proposed plans from the three contractors to that office. Some city and county building departments will review the plans and discuss with you which designs are consistent with the commonly used retrofitting guidelines.

Step 5 Select a contractor.

With information from professional and homeowner references and possible building department comments, you can select the contractor best able to do the job. If your retrofit was designed by an engineer he or she may have a contractor in mind for the job. Ask him about possible contractors to implement the plans.

Step 6 Make sure that the contractor gets a building permit from the city or county and, at the end of the job, has the permit signed off by the city or county inspector.

The building permit is your record of the completed work. As part of the permit process, the inspector will go out to the job site in various stages and verify that the work is being done correctly. A building inspector can only ensure that the retrofit plan you chose can be implemented, it is up to you to ensure that the retrofit plan is appropriate.

Step 7 Congratulations!

Invite your friends and neighbors over to help you celebrate a safer home! Being safer is a wonderful reason to celebrate!

Do You Know about Chimney Safety?

Tell your friends and family members to get away from chimneys and fireplaces during earthquakes!

Most chimneys tend to break at the roofline and fall away from the home. However, some chimneys can fall into the home, causing serious injury and death. You can put sheets of plywood above the ceiling framing to reduce the chance of bricks falling through a sheetrock ceiling. If you are more concerned, consider replacing your masonry chimney with a modern stud-framed one around a metal flue, not simply bracing or strapping it – braced chimneys typically will still fall when exposed to violent shaking. Learn more at http://quake.abag.ca.gov/residents/chimney/.

Did You Know?

The most common cause of injuries in an earthquake is your home's contents breaking or injuring you. Make sure to properly secure your water heater, cabinets, bookcases, mirrors and picture frames. Learn how at http://quake.abag.ca.gov/residents/contents/.

Frequently Asked Questions

What is retrofitting? I have read that some of the retrofits in the Bay Area have not been done properly. What should I check for?

Retrofitting for most single-family homes involves strengthening the walls of the crawl space under your home and making sure that it is attached to the foundation (with bolts or anchors) and to the floor framing above. While many homes continue to be retrofitted, we have become increasingly concerned about the quality of retrofits, including the workmanship and the work actually performed. Somewhere between 25% and 75% of currently retrofitted homes need additional work. Make sure that your contractor addresses **all** three of the following:

A retrofit that does not contain all three components is not adequate.

1. The mudsill-foundation connection - Adding bolts and washer plates will prevent the house from slipping off the foundation. While many houses have bolts, they are often not appropriately spaced and lack washer plates.
2. The cripple wall - Adding plywood panels on all four walls will prevent collapse of the outside wall of your crawl space. If your floor sits directly on the foundation, no plywood is needed.
3. The cripple wall-floor framing connection - Adding load-rated framing clips to attach the plywood shear walls or foundation to the floor framing above.

A qualified engineer or other design professional is usually needed to design a retrofit for larger, split-level homes with rooms above a garage, or homes on a hillside.

Can I do any of this work myself?

Yes, homeowners who have done other home improvements can do it themselves. If you plan to do the work yourself, you need to take a training class. Two classes are open to all Bay Area residents: The Building Education Center in Berkeley 510/525-7610 • City of San Leandro Building Department 510/577-3405

How do I find an experienced contractor?

Use a list of contractors with retrofit training, such as ABAG's website at http://quake.abag.ca.gov/residents/retrofitprof/. Then follow the Seven Steps for Strengthening.

Will I need to hire an engineer or other design professional?

Sometimes you need to hire a design professional, such as an engineer or architect specializing in seismic retrofitting, particularly if your home is **more than one story** (even if the home is only a split level), has a bedroom or other living area over a garage, or is on a steep hillside. The engineer will charge $1,000 to $5,000, depending on the complexity of the job.

How do I select the engineer or design professional?

The engineer should be a licensed civil or structural engineer with experience in designing retrofits for homes. You can use the ABAG list of engineers that perform retrofit work http://quake.abag.ca.gov/residents/retrofitprof/. In addition, some architects may have the expertise to design a retrofit.

Do I need a building permit from the city or county?

Yes, permits are required by law. When you obtain a building permit, you also have some assurance that the work will be completed to the standard you specify. You really need that permit to protect your investment.

How much do permits cost?

Typically, cities and counties charge very little for retrofit permits. Some cities do not charge at all. A typical retrofit permit that does not require an engineer costs about $250. Call your city or county.

How much will the retrofit cost me?

Although costs vary, the typical home retrofit that does not require an engineer costs about $3,000 to $10,000.

How can I get the money to pay for this?

Home equity loans are available from banks. A five-year loan from a bank for $5,000 for 5 years at 9% will cost you about $104 a month. Homeowners with low fixed incomes may be able to get help in paying for the work from their city or county or from the California Department of Insurance. Some cities have financial assistance available to their residents for retrofitting. Learn more at http://quake.abag.ca.gov/residents/money/

Retrofit Work Costs Less Than Repairing This Damage