



## HOT TOPICS & INSURANCE ISSUES

### Earthquakes: Risk and Insurance Issues

#### THE TOPIC

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An earthquake is a sudden and rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. This shaking can sometimes trigger landslides, avalanches, flash floods, fires, and tsunamis. Unlike other natural disasters such as hurricanes, there are no specific seasons for earthquakes.

In the United States about 5,000 quakes can be felt each year. Since 1900, earthquakes have occurred in 39 states and caused damage in all 50. One of the worst catastrophes in U.S. history, the San Francisco Earthquake of 1906, caused direct quake losses of about \$24 million and fire losses of about \$500 million, according to the National Geophysical Data Center. That would be about \$10 billion in 2002 dollars, a small portion of the potential cost of damage from a similar earthquake today.

The Northridge earthquake, which struck Southern California on January 17, 1994, was the most costly quake in U.S. history, causing an estimated \$20 billion in total property damage including \$12.5 billion in insured losses.



#### KEY FACTS

- Earthquakes in the United States are not covered under standard homeowners or business insurance policies. Coverage is usually available for earthquake damage in the form of an endorsement to a home or business insurance policy. Cars and other vehicles are covered for earthquake damage under the *comprehensive* part of the auto insurance policy.
- The potential cost of earthquakes has been growing because of increasing urban development in seismically active areas and the vulnerability of older buildings, which may not have been built or upgraded to current building codes.
- The California Earthquake Authority is the world's leading residential earthquake insurer with about 750,000 policies in force as of early 2003 and 15 participating insurers.

#### CURRENT DEVELOPMENTS

**Major Earthquakes in 2002/2003:** Two major earthquakes occurred in the first half of 2003. In May, Algeria experienced a massive 7.1 magnitude quake that killed at least 1,092 people and injured at least 6,782 and in January, a magnitude 7.8 earthquake hit the west central area of Mexico, killing at least 19 people but causing little damage, even close to the epicenter, approximately 300 miles west of Mexico City.

According to sigma, a research journal published by the reinsurance company, Swiss Re, there were 16 major earthquakes that killed 2,801 worldwide in 2002, although no earthquakes were among top 20 insured losses of that year. The strongest quake occurred on November 3, 2002, in a sparsely populated area in the interior of Alaska. The 7.9 magnitude quake was centered approximately 90 miles south of Fairbanks. There were no injuries but highways and roads in the area were damaged and the Trans Alaska Pipeline had to be shut down. On October 31 an earthquake jolted the small agricultural town of

San Giuliano di Puglia in southern Italy, killing at least 18 and trapping over 50 children in a collapsed school. The 5.4 magnitude earthquake, the strongest to hit Italy since 1997, left thousands homeless.

**New Prediction Techniques:** New computer software that can detect the initial vibrations of an earthquake and sound an alarm before the more destructive shaking occurs is undergoing trials in Southern California. Although the alarm would be sounded not more than 10 seconds before the quake begins, the system could give students enough time to seek immediate shelter under their desks, air traffic controllers the chance to prevent planes from landing, and traffic controllers the opportunity to lower barriers to bridges and overpasses. The Southern California Earthquake Center estimates that it would cost \$200 million to build such a network in California.

In August 2002 scientists in California conducted an unprecedented experiment to determine whether it is possible to predict earthquakes. The researchers drilled over a mile into the San Andreas fault in order to place dozens of instruments into an area where small earthquakes are frequent. Since the type of drilling involved in the experiment is very expensive, there has not been much research into underground advance signals of impending earthquakes.

**Earthquake Coverage:** In the first half of 2003 the California Earthquake Authority (CEA), the world's leading residential earthquake insurer, had about 750,000 policies in force in the state, down from 840,000 a year before, and private insurers had another 400,000. The percentage seems to rise and fall depending on how long ago the last damaging quake occurred. In 1996, the year the state legislature created the CEA, about 30 percent of state homeowners purchased the coverage. Today the number has plummeted to about 15 percent. Some homeowners, particularly those with little equity in their homes, are forgoing earthquake insurance, because of the high costs of premiums.

The basic CEA policy includes a deductible that is 15 percent of the home's replacement cost, rather than the standard dollar amount in homeowners insurance policies. The policy covers only the house (other structures such as garages, pools, etc. are not covered). Personal possessions are covered up to \$5,000 and "loss of use" expenses, the additional cost of living elsewhere while home repairs are made, are covered up to \$1,500. Recognizing that some people want more comprehensive coverage, the CEA now offers a 10 percent deductible, insurance for other structures, personal items coverage up to \$25,000 and \$10,000 in "loss of use" coverage. Premiums vary widely among the 19 rating territories, based on the type of house, its age, the nature of the soil, and proximity to known fault lines. The average cost statewide is \$500, but it can exceed \$3,000 a year. The CEA currently has reserves of \$7 billion. Because of high deductibles, this amount is considered enough to cover two earthquakes as severe as the 1994 Northridge quake, which caused an estimated \$12.5 billion in insured losses.

According to A.M. Best Co. Inc., direct premiums written for earthquake coverage in California totaled \$543.1 million in 2001. The state accounted for 48.1 percent of the total U.S. earthquake premiums of \$1.13 billion. Following California are Washington, Missouri, Oregon, Tennessee and Illinois. These are the only states with a market share greater than 2 percent. In Missouri, according to an analysis by the state department of insurance, 59 percent of homeowners in areas near the New Madrid fault and 42 percent statewide bought quake coverage in 2002. The high percentage may be explained that by the fact that coverage in the state is relatively inexpensive (38 cents per \$1,000 of coverage statewide and 76 cents per \$1,000 in high-risk areas). The most recent survey of insurers in Washington State, which dates to almost 10 years ago, showed that about 20 to 25 percent of homeowners had earthquake coverage.

The New York Department of Insurance reports that in 2002 insurers collected \$17.7 million in earthquake coverage premiums and incurred \$2.6 million in direct losses. Although New York State accounted for only about 1 percent of earthquake direct premiums written in 2001, the market grew 57 percent over the five years beginning in 1997, according to the National Association of Insurance Commissioners (NAIC). Several small earthquakes have been recorded in New York State over the past few years.

**Loss Mitigation Programs in California:** Under a pilot loss mitigation program to help make thousands of California homes more resistant to earthquake damage, the CEA spent 5 percent, or \$5 million, of its investment income on safety programs that included a list of recommended seismic retrofit contractors, home inspections, and subsidized bank loans for retrofitting homes. The CEA is now focusing its efforts on consumer education.

**State Court Decisions:** In March 2003, the 9th Circuit Court of Appeals ruled that a California law that allowed homeowners to refile claims for losses in the 1994 Northridge earthquake is constitutional. Allstate had challenged the law, which went into effect in January, 2000. It gave homeowners until December 31, 2001 to reopen previously filed Northridge earthquake claims or file claims for damage discovered after the normal one-year deadline for filing claims had expired. Although most homeowners were satisfied with the way their claims were handled after the quake, for the few that believed they were inadequately compensated, this law provided them with the opportunity to have a court review the facts of the loss and make a determination as to the appropriate property settlement. It is too soon to calculate the financial impact of the law on insurers. On April 29, 2002 the U.S. Supreme Court declined to hear an insurance industry challenge to the law.

**Studies:** The first national study of earthquake risk in the United States was released by the Federal Emergency Management Agency (FEMA) in September 2000. The study estimated that over time earthquake losses in the United States could average \$4.4 billion dollars a year. This estimate includes only capital losses, such as repairing or replacing buildings, contents and inventory (\$3.49 billion), and loss of income, including business interruption, rental income and wage losses (\$0.93 billion). It does not cover damage and losses to critical facilities, transportation and utility lines or indirect economic losses.

The \$4.4 billion estimate of probable annual earthquake losses is close to the losses from floods and hurricanes. Flood losses averaged \$5.2 billion annually during the period 1989 to 1998, according to the National Weather Service. The National Climatic Data Center estimates \$5.4 billion in annual hurricane losses for the same period.

The report also points out that the potential cost of earthquakes has been growing because of increasing urban development in seismically active areas and the vulnerability of older buildings, which may not have been built or upgraded to current building codes. According to the study, 84 percent of the nation's annual losses are expected to occur in California, Oregon and Washington, with California accounting for the lion's share. Other areas at risk include the central United States, within the New Madrid Seismic zone, which includes parts of Illinois, Kentucky, Tennessee, Missouri, and Arkansas, and the Charleston, South Carolina area. In addition to California metropolitan areas, cities ranked among the top 40 high-loss potential urban areas include Seattle, Portland, New York City, Salt Lake City, and St. Louis.

The study pointed out the need for increased recognition of metropolitan areas with "low seismic hazard" but "high seismic risk," such as New York City and Boston, which have high concentrations of buildings and an infrastructure that was built without taking into account seismic codes. Although the likelihood of catastrophic quakes occurring in these areas is statistically low, the potential cost is very high. In addition, because of the perception of low risk, neither the public nor the private sector has developed earthquake preparedness programs that teach people how to protect against earthquake damage and injury.

## **BACKGROUND**

**Insurance Coverage for Earthquakes in the United States:** Standard homeowners, renters and business insurance policies do not cover damage from earthquakes. Coverage is available either in the form of an endorsement or as a separate policy for homeowners, renters and small business owners. Large businesses can sometimes have earthquake coverage added to a commercial insurance policy by paying an additional premium. Unlike flood insurance, earthquake coverage is available from private insurance companies rather than from the government—except in California, where homeowners can also get coverage from the California Earthquake Authority (CEA).

Earthquake insurance provides protection from the shaking and cracking that can destroy buildings and personal possessions. Coverage for other kinds of damage that may result from earthquakes, such as fire and water damage due to burst gas and water pipes, is provided by standard home and business insurance policies. Cars and other vehicles are covered for earthquake damage by comprehensive insurance which also provides protection against flood and hurricane damage as well as theft.

**Deductibles and Costs:** Earthquake insurance carries a deductible, generally in the form of a percentage rather than a dollar amount. Deductibles can range anywhere from 2 percent to 20 percent of the replacement value of the structure. This means that if it cost \$100,000 to rebuild a home and there was 2

percent deductible, the consumer would be responsible for the first \$2,000 dollars. Insurers in states like Washington, Nevada and Utah, with higher than average risk of earthquakes, often set minimum deductibles at around 10 percent. In most cases, consumers can get higher deductibles to save money on earthquake premiums.

Premiums also differ widely by location, insurer and the type of structure that is covered. Generally, older buildings cost more to insure than new ones. Wood frame structures generally benefit from lower rates than brick buildings because they tend to withstand quake stresses better. Regions are graded on a scale of 1 to 5 for likelihood of quakes, and this may be reflected in insurance rates offered in those areas. The cost of earthquake insurance is calculated on "per \$1,000 basis." For instance, a frame house in the Pacific Northwest might cost between one to three dollars per \$1,000 worth of coverage, while it may cost less than fifty cents per \$1,000 on the East coast.

A brick home would cost approximately \$3 to \$15 dollars per \$1,000 in the Pacific Northwest, while it would cost between 60 to 90 cents in New York. Earthquake insurance is available from most insurance companies in most states.

**Coverage Crisis in California:** California law requires homeowners insurance companies to offer earthquake coverage to their homeowners insurance policyholders. Homeowners can decide to purchase it, purchase a policy from another insurer, or decline it altogether.

In January, 1994 the Northridge earthquake, a magnitude 6.8 quake (see section on Earthquake Measurement), struck Southern California, causing an estimated \$12.5 billion in insured losses, according to the Insurance Services Office, Inc. (ISO).

The insurance industry ended up paying out more in claims for this quake than it had collected in earthquake premiums over the preceding 30 years. While no insurer became insolvent, some came very close. To recover their financial strength and to be better prepared for the next earthquake, most insurers began to limit their exposure to earthquakes by writing fewer new homeowners insurance policies. In addition, most insurers filed for both rate increases and increases in deductibles from the 10 percent that was current then to 15 percent or higher. This triggered a crisis that by mid-1996 threatened the vitality of the state's housing market and stalled the state's recovery from recession.

**California Earthquake Authority (CEA):** In 1996, the California Legislature established the CEA to make basic earthquake insurance both available to consumers and financially viable for insurers. The CEA is a privately funded, publicly managed organization. Insurers can participate in the CEA and offer CEA policies to their policyholders. Those who choose not to participate must offer their own earthquake coverage to their homeowners policyholders. The standard earthquake policy from the CEA is regarded as the industry's standard. It includes a 15 percent deductible and covers the home, but not additional structures such as swimming pools and garages. The policy has a \$5,000 limit on contents coverage and a limit of \$1,500 for additional living expenses.

By 2002, the CEA was the world's leading residential earthquake insurer with more than 840,000 policies in force, representing two-thirds of California's earthquake insurance market; claims-paying ability of \$7.3 billion; and more than 15 participating insurers. The CEA has contracts with 30 to 40 reinsurers. In the event that the CEA's funds were not sufficient, participating insurers would be assessed and policyholders would be surcharged.

According to A.M. Best Co., Inc, direct premiums written for earthquake coverage in California totaled \$543 million in 2001. California's earthquake premiums accounted for 48.2 percent of the total of \$1.1 billion for the United States. Prior to 1994, approximately 28 percent of Californians bought earthquake insurance; today only 17 percent of California homeowners have the coverage. (The percentage seems to rise and fall depending on how long ago the last damaging quake occurred.)

Consumers in California now have more choices when purchasing earthquake coverage than they did before Northridge. They can purchase it through the CEA, a homeowners insurer that offers its own earthquake policy, or through a company that offers a "stand alone" policy. Consumers who want more coverage can purchase a "wrap around" policy and for an additional premium, they can lower their

deductible to 10 percent, increase coverage for contents to \$100,000 and increase additional living expenses to \$15,000.

**What Are Earthquakes and Where Do They Occur?:** An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. For hundreds of millions of years, the forces of plate tectonics have shaped the earth as the huge plates that form the Earth's surface move slowly over, under, and past each other.

Sometimes the movement is gradual. At other times, the plates are locked together, unable to move. When the pressure building up grows strong enough, the plates break free causing the ground to shake and rupture along fault lines, or zones of weakness.

One of the most famous faults is the San Andreas Fault, which extends about 600 miles from the Gulf of California northwest along the California coast. The 1906 San Francisco earthquake was caused by movement of the San Andreas Fault.

Quakes can produce different kinds of shaking. Some, like the 6.8 magnitude (see section on Earthquake Measurement) Northridge quake, are thrust fault quakes, which cause violent up-and-down, rather than the more common side-to-side movement. Ground shaking from earthquakes can collapse buildings and bridges as well as trigger landslides, avalanches, floods, fires, and tsunamis. Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake.

According to the U.S. Geological Survey, there are more than three million earthquakes worldwide each year. While the vast majority of those are a magnitude 3.9 or lower, more than 900 earthquakes measure 5.0 or higher each year. About 81 percent of the world's largest earthquakes occur in the Circum-Pacific seismic belt. The area extends from Chile, northward along the western South American coast through Central America, Mexico, the west coast of the United States and the southern part of Alaska, through the Aleutian Islands to Japan, the Philippine Islands, New Guinea, the island groups of the Southwest Pacific and to New Zealand.

The most powerful earthquake on record occurred in Chile on May 22, 1960. The magnitude 9.5 quake caused \$550 million in damage, killed more than 2,000 people and injured more than 3,000. It also caused a tsunami, which caused additional destruction in Hawaii, Japan, the Philippines and the west coast of the United States.

**Earthquake Risk in the United States:** In the continental United States, earthquakes occur most frequently west of the Rocky Mountains. While the United States experiences only two percent of the world's earthquakes, some 90 percent of its population lives in seismically active areas. Statistics show that since 1900, earthquakes have occurred in 39 states and caused damage in all 50 states. More than 3,300 Americans have died in earthquakes during the last century.

Historically, the most violent earthquakes have occurred in the central United States. The largest earthquake in the continental United States was along the New Madrid Fault in Missouri, where a 3-month long series of quakes in 1811-1812 included three quakes larger than a magnitude of 8. The state with the most major earthquakes is Alaska, but the one with the most damaging earthquakes is California.

The largest earthquake in the United States was a magnitude 9.2 quake that struck Alaska on March 28, 1964. The earthquake and ensuing tsunami caused more than \$500 million in property losses, according to the National Geophysical Data Center.

The most costly earthquake in the United States was the Northridge, California, earthquake of January 17, 1994, with insured losses estimated at \$12.5 billion, according to ISO.

**Earthquake Risk in the Western United States:** Although the entire Northwest of the United States is at high risk of earthquakes, nine of the most costly earthquakes in the last century occurred in California. According to the U.S. Geological Survey, there is a 70 percent probability that an earthquake of magnitude 6.7 or larger will strike the San Francisco Bay area over the next 30 years. The San Francisco earthquake

in 1906 measured 8.3 on the Richter scale and caused direct quake losses of about \$24 million, as well as fire losses of about \$500 million, according to the National Geophysical Data Center. Beside the 1994 Northridge quake, large, recent quakes in California include the 7.6 magnitude Landers quake in 1992 that caused \$92 million dollars of insured losses, the 6.9 magnitude Eureka quake in 1992 that resulted in \$66 million dollars of insured losses, and the 7.0 Loma Prieta quake in 1989 that resulted in more than \$7 billion in insured losses, 62 deaths and 3,757 injuries.

**Earthquake Risk in the Central United States:** The New Madrid Fault zone lies within the central Mississippi valley extending from northeastern Arkansas through southeastern Missouri, western Tennessee, Kentucky and southern Illinois. The last major earthquake, magnitude 8, occurred there in 1812. But scientists warn that this was not a freak occurrence and estimate the probability of a magnitude 6 to 7 earthquake within the next 50 years at more than 90 percent. Earthquakes in Central and Eastern United States affect much larger areas than earthquakes of similar magnitude in the West. For example, the San Francisco earthquake of 1906 was felt 350 miles away, whereas the New Madrid earthquake of December 1811 rang church bells in Boston, Massachusetts, 1,000 miles away.

**Earthquake Risk in the Eastern United States:** The largest earthquake in the East was a 7.5 temblor that struck Charleston, South Carolina, in 1886, killing over 60 people. While the risk of an earthquake in the Northeast is not nearly as high as in the West, the region is seismically active. A 6.0 earthquake struck Boston in 1755 and a 5.8 earthquake struck the northern part of New York State in 1944. Near New York City, there have been two 5.0 to 5.3 earthquakes, one in 1737 and the other in 1884. Experts say an earthquake of between 6.5 and 7.5 is possible in the Northeast, but estimate that it may occur "in the order of thousands of years."

Applied Insurance Research, a catastrophe modeling firm, points out that large numbers of buildings in both Boston and New York City were built long before the introduction of seismic building codes. Many of the older structures in the two cities are made of unreinforced masonry, the most vulnerable to earthquake damage. Worse, much of Boston is built on artificial fill, which can amplify seismic waves by as much as a factor of three. New York is less vulnerable, being largely built on bedrock.

**Earthquake Measurement:** The size and magnitude of an earthquake is measured in several different ways. The *Richter Scale* measures the size of earthquake waves. It was developed by Charles Richter in the 1930s and is a logarithmic measurement of the amount of energy released by an earthquake, see below. The *Mercalli Intensity Scale* evaluates the intensity of a quake according to observed severity at specific locations. It rates the intensity on a Roman numeral scale that ranges from I to XII. Today, seismologists are using the *Moment Magnitude Scale*, which measures the size of the earthquake's fault, and how much of the earth slips at the time of the quake. A number of readings are taken, averaged and then adjusted to generate numbers similar to the *Richter Scale*. This allows the magnitude of earthquakes measured on these new scales to be compared with earthquakes recorded earlier. According to the *Moment Magnitude Scale*, the severity of an earthquake is categorized as the following:

5.0 - Small  
 5.0 – 6.0 Moderate  
 6.0 – 7.0 Large  
 7.0 - 7.8 Major  
 7.8 - Great

An increase of one unit of magnitude, for example, from a 4.0 to a 5.0 quake, is a 10-fold increase in wave amplitude on a seismogram, or about a 30-fold increase in energy released. Thus, the difference between a 4.0 and a 6.0 magnitude quake would be a release of energy 900 times (30 times 30) as great as a 4.0 magnitude quake since the magnitude is a logarithmic value.

**Legislation:** In 1977 the United States Congress enacted the Earthquake Hazards Reduction Act, in recognition of the fact that earthquakes pose the greatest potential threat of any single-event natural hazard confronting the nation. The Act directed the President to "establish and maintain an effective earthquake hazards reduction program."

Congress then created the National Earthquake Hazards Reduction Program, which gave lead

responsibility to the federal government to provide direction, coordination, research and other support to efforts aimed at earthquake hazard mitigation and preparedness. The Federal Emergency Management Agency (FEMA), the United States Geological Survey, the National Science Foundation, and the National Institute of Standards and Technology were assigned specific roles. Recommendations were included on the duties of state governments, local governments, private organizations and individuals.

**Loss Mitigation:** Although earthquakes cannot be prevented, science and engineering provide tools that can be used to reduce their damage. Science can now identify, with considerable accuracy, where earthquakes are likely to occur and what forces they will generate. Engineering can help provide design and construction techniques so that buildings and other structures can survive the tremendous forces of earthquakes.

To produce estimates of earthquake loss by geographic area, FEMA uses an earthquake loss estimation methodology called Hazards U.S. (HAZUS), developed in cooperation with the National Institute of Building Sciences. The loss estimation methodology is a software program that uses mathematical formulas and information about building stock, local geology and the location and size of potential earthquakes, economic data, and other information to estimate losses from a potential earthquake. HAZUS is capable of using two separate geographic information systems (MapInfo® and ArcView®) to map and display ground shaking, the pattern of building damage, and demographic information about a community. Once the location and size of a hypothetical earthquake is identified, HAZUS will estimate the violence of ground shaking, the number of buildings damaged, the number of casualties, the amount of damage to transportation systems, disruption to the electrical and water utilities, the number of people displaced from their homes, and the estimated cost of repairing projected damage and other effects.

In 1983, with funding support and in partnership with the FEMA, the states of Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee formed the Central United States Earthquake Consortium to improve public earthquake awareness and education. The consortium also coordinates multistate planning for earthquake preparedness, response, and recovery and encourages research in earthquake hazard reduction.

The CEA has developed a loss prevention program that could ultimately make thousands of California homes more resistant to earthquake damage. In the first phase of the program, the CEA spent 5 percent, or \$5 million, of its investment income on safety programs. They included a list of recommended seismic retrofit contractors, home inspections, and subsidized bank loans for retrofitting homes.

**THE TEN MOST COSTLY U.S. EARTHQUAKES**

(\$ millions)

Rank	Year	Location	Magnitude	Estimated property damage (1)	
				Dollars when occurred	In 2002 dollars (2)
1	1994	Northridge, CA	6.7	\$13 - 20,000	\$16 - 24,000
2	1989	San Francisco Bay area; Loma Prieta, CA	6.9	7,000	10,156
3	1971	San Fernando, CA	6.5	553	2,456
4	1964	Alaska and west coast of United States (tsunami damage from earthquake near Anchorage, Alaska)	9.2	500	2,902
5	1987	Southern California; primarily in Los Angeles – Pasadena – Whittier area	5.9	358	567
6	1992	Southern California; Landers – Joshua Tree – Big Bear	7.6	92	118
7	1992	Northern California Coast; Petrolia – Eureka	7.1	66	85

8	1952	Kern County, CA	7.5	60	407
9	1933	Long Beach, CA	6.3	40	554
10	1983	Central California; Coalinga	6.4	31	56
<p>(1) Includes insured and uninsured losses. (2) Adjusted to 2002 dollars by the Insurance Information Institute.</p> <p>Source: U.S. Department of the Interior, U.S. Geological Survey; Insurance Information Institute.</p>					

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