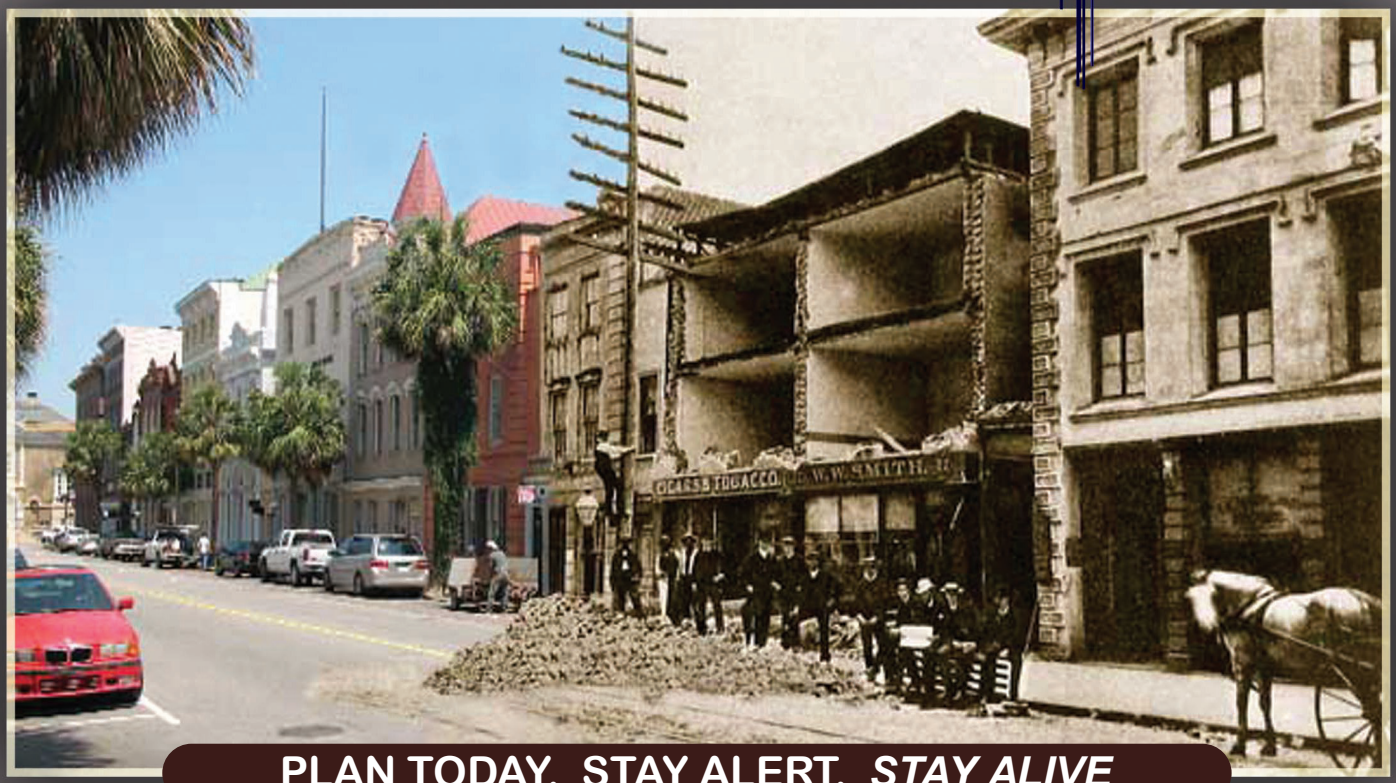
South Carolina Earthquake GUIDE



PLAN TODAY. STAY ALERT. *STAY ALIVE*

INSIDE...

Earthquakes in South Carolina
August 31, 1886
Preparing for an Earthquake
Home Hazard Hunt
And More . . .

An Earthquake Resource Compiled by the S.C. Emergency Management Division

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Why are there EARTHQUAKES in South Carolina?

Earthquakes are probably the most frightening naturally occurring hazard encountered. Why? Earthquakes typically occur with little or no warning. There is no escape from an earthquake! While South Carolina is usually not known for earthquakes, ten to thirty earthquakes are recorded annually and two to five earthquakes are felt each year. These earthquakes tend to be less than magnitude 3.0 on the magnitude scale and cause little damage.

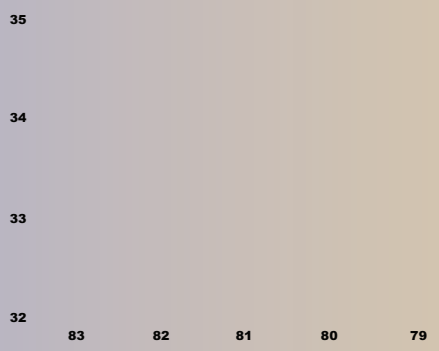
Earthquake Causes:

An earthquake is the violent shaking of the earth caused by a sudden movement of rock beneath its surface.

Plate Tectonics:

Although earthquakes can occur anywhere on earth, the majority of earthquakes worldwide occur at plate boundaries. These earthquakes are known as interplate earthquakes. In contrast, South Carolina is located within the interior of the North American plate, far from any plate boundary. Earthquakes occuring within a plate are intraplate earthquakes. Little is known as to why intraplate earthquakes occur. The most widely accepted model is that several geologically old fault systems of varying orientation within the subsurface are being reactivated while being subjected to stress. This stress buildup may be due to the Plate Tectonic Theory. For hundreds of millions of years, the forces of continental drift have reshaped the Earth. Continental drift is based on the concept that the continents bumped into, and slid over and under each other and at some later time broke apart. Today, most people accept the theory that the Earth's crust is on the move.

S.C. Earthquakes from 1698 to Present



South Carolina's Fault System:

Most of South Carolina's earthquakes occur in the Coastal Plain where the underlying rocks are very faulted or broken from the break-up of the plates. These cracks in the deep rocks mean that this area of the plate is weak. If pressure is exerted on the edge of the plate, some of these faults/breaks will allow the rocks to move. Faults in South Carolina have been mapped and estimated. Fault rupture is not the only cause of earthquakes. Small earthquakes may also occur near dams from water pressure and near the Appalachian Mountains.

Intensity from the 1886 Earthquake

Threat Level for South Carolina

Currently, there is no reliable method for predicting the time, place, and size of an earthquake. Several areas of South Carolina regularly experience earthquakes and have experienced strong earthquakes in the past. Approximately 70% of all earthquakes in the state occur in the Coastal Plain with most clustered around three areas of the State: Ravenel-Adams Run-Hollywood, Middleton-Place-Summerville, and Bowman. There is a consensus among seismologists that where earthquakes have occurred before, they can again.

The two most significant historical earthquakes in South Carolina were the 1886 Charleston earthquake and the 1913 Union County earthquake. The August 31, 1886 earthquake which struck in the Summerville/Charleston area is the largest event to have occurred in the southeastern U.S. and the most destructive, killing 60 people. In 1913, Union County experienced an earthquake that by today's standards would probably be measured as a M 5.5 on the Richter scale based on the level of damage reported. Not much is known about the cause of the Union County earthquake because of the lack of technology at the time.

Destruction Based on Intensity

10	Complete destruction
5/6	Cracks in walls, windows would be broken
4	Things would be thrown off shelves
2	If lying down, vibrations might be felt

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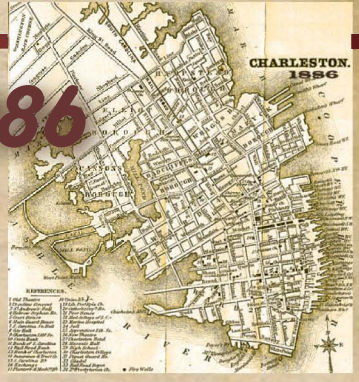
Charleston Earthquake of 1886



On August 31, 1886, Charleston, South Carolina, experienced the most damaging earthquake in the eastern United States. The initial shock lasted nearly one minute. The earthquake had a magnitude of 7.3 (Johnson, 1996) and was felt over 2.5 million square miles, from Cuba to New York, and Bermuda to the Mississippi River. Structural damage extended several hundreds of miles to cities in Alabama, Ohio, and Kentucky. At the time of the earthquake, many of the residents of Charleston thought it was a calamity that struck the entire world. Many residents were surprised when they discovered it was principally their area where the majority of severe damage occurred.

Geologically, Charleston lies in one of the most seismically active areas in the Eastern United States. The seismicity in the Coastal Plain of South Carolina clusters around the cities of Summerville and Bowman, SC, known as the Middleton Place - Summerville Seismic Zone (MPSSZ). The MPSSZ seismicity appears to be occurring in two steeply dipping faults. The first fault is the deeper, northeast-trending Woodstock Fault and the second is the shallower, northwest-trending Ashley River Fault. Recent seismic activity (November 2002; M=4.2 & 3.5) has also included an earthquake in the Atlantic Ocean off the coast of South Carolina.

Currently the MPSSZ experiences between 10 to 15 magnitude 3 or less events every year. Large events, like the 1886 earthquake, have been recorded in the oral history of the area (~1600 and 13-1400's AD). Additionally, paleoseismic investigations have shown evidence for several pre-historic, liquefaction-inducing earthquakes in coastal South Carolina in the last 6000 years. If the present is the key to the past, and the past is an analog for the future, then the Charleston region can expect to experience another 1886 magnitude event in the future. (South Carolina Earthquake Education and Preparedness, College of Charleston.)

An EARTHQUAKE Today

Results of a scientific study commissioned by the South Carolina Emergency Management Division indicate that an earthquake today of similar intensity (7.3) and location to the one in 1886 could have the following results:

- An estimated 45,000 casualties, of which approximately 9,000 (about 20 percent) would be major injuries requiring hospitalization; fatalities would number about 900. A daytime event would cause the highest number of casualties.
- Nearly 70,000 households, or about 200,000 people, would be displaced, with an estimated 60,000 people requiring short-term shelter.
- Total economic losses from damage to buildings, direct business interruption losses, and damage to transportation and utility systems would exceed $20 billion. Direct economic losses due to building damages (without the business interruption losses) are estimated to exceed $14 billion. Transportation and utility systems' direct economic losses would exceed $1 billion.
- About $10.9 billion in economic losses would occur in the tri-county area of Charleston, Berkeley, and Dorchester. The building damages alone would cause more than $4.2 billion in losses due to direct business interruption in the state. Loss estimates include rental income, business income, wages, and relocation expenses.
- More than 250 fires would burn, primarily in the tri-county area. The lack of operational firefighting equipment and water due to the earthquake would be a major concern.
- About 80 percent of urban households in the affected tri-county area would be deprived of water. It would take weeks, if not months, to restore the water systems to normal operation.
- Hospitals would likely suffer significant building damage that could result in up to 30 hospitals out of the 108 (about 30 percent) being nonfunctional. More than 220 schools and more than 160 fire stations would have significant damage. In addition, extensive damage is expected to the large inventory of re-locatable school buildings.
- Close to 800 bridges would be damaged beyond use, thus hampering recovery efforts.
- About 63 electric power facilities (51 substations out of 380, and 12 power plants out of 53) would suffer at least moderate damage; about 300,000 households would be without power.
- More than 36 million tons of debris would be generated.

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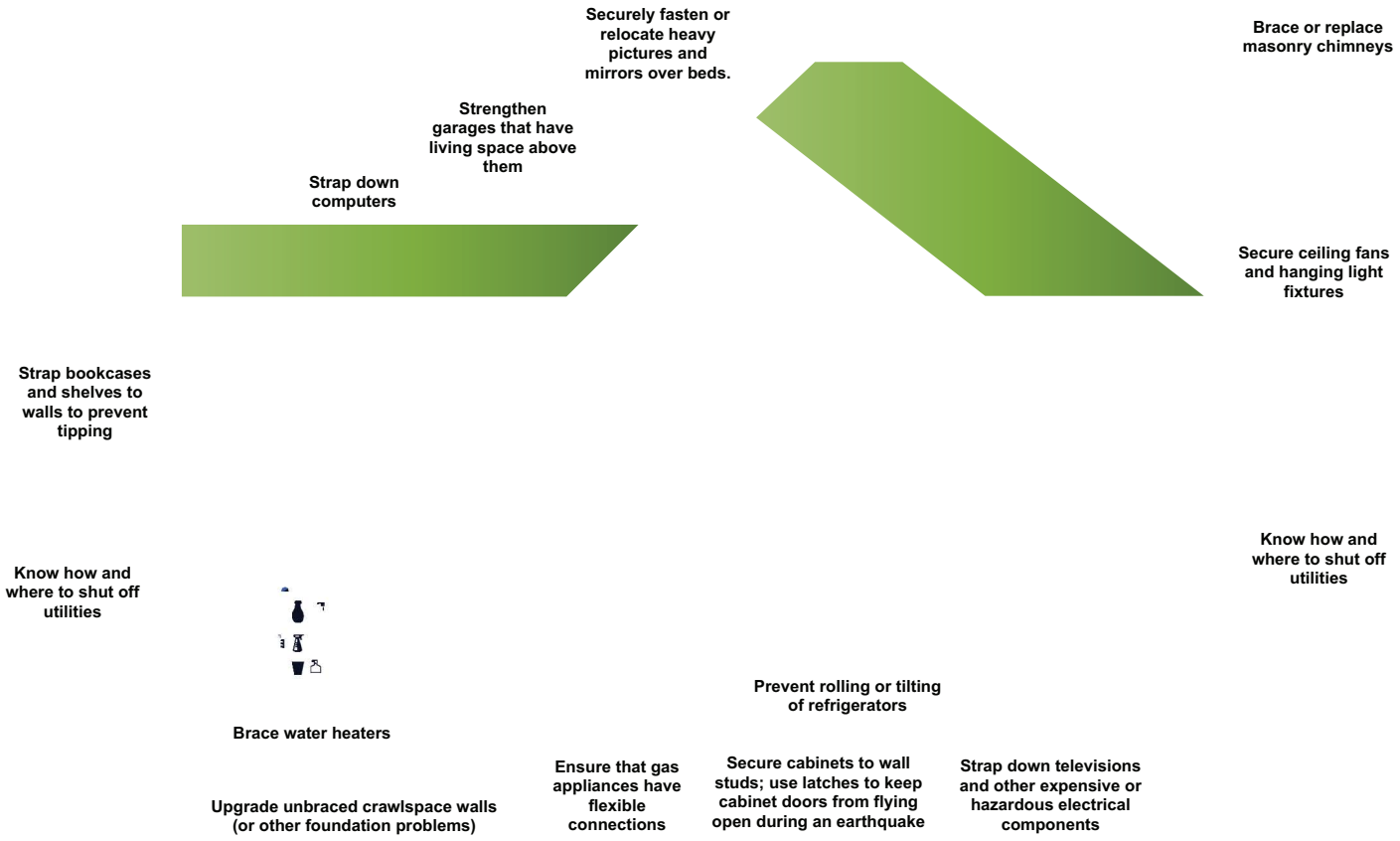
Earthquake Home Hazard Hunt

Recommendations for reducing earthquake hazards in your home



CITIZENS with SPECIAL NEEDS

Citizens with disabilities and special needs should understand the importance of being prepared for the effects of an earthquake. Unlike some disasters, normally there is no time for evacuation and citizens should shelter-in-place. Planning ahead is the key. Identifying potential hazards ahead of time can reduce the dangers of serious injury or loss of life.

Talk to neighbors, family or caregivers about how to protect your home and belongings from earthquake damage. Check for hazards in your home. Repairing deep plaster cracks in ceilings and foundations and anchoring overhead lighting will help reduce the impact of an earthquake.

Make sure that you have your supplies kit and that it is maintained. Some of the supplies that you should have in your kit include batteries for hearing aids, flashlights and similar devices, extra oxygen tanks, electrical backups for medical equipment, emergency food and water including provisions for special dietary requirements and an emergency supply of your medications.

In case family members are separated from one another during an earthquake, develop an emergency communications plan. Ask an out-of-state relative or friend to serve as the "family contact". Make sure everyone in the family knows the name, address and phone number of the contact and that they are to call the contact to let them know where they are if they cannot make contact directly with the family in the earthquake affected area.

Expect aftershocks. These secondary shockwaves are usually less violent than the main earthquake but can be strong enough to do additional damage to weakened structures. Additionally, you should be aware of possible tsunamis if you live in coastal areas.

Stay informed about what is happening and what public officials are asking citizens to do. Be prepared to follow their instructions.

If you know of friends, neighbors or families with disabilities or special needs, talk to them about their plans and ensure that they are safe in case of a natural or man-made disaster.

Don't be afraid to ask for help if you think you will need it. Having a plan and being ready are the keys to safety.

Additional information on preparedness is available at www.scemd.org or www.fema.gov

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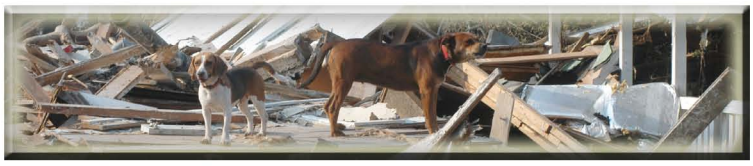

My Pet in an Earthquake

Before the Event

In an earthquake we may not have a warning, but you can prepare for your pets as you do for any other disaster:

- Maintain a list of locations and phone numbers of potential refuge sites: specialized pet shelters, boarding facilities, veterinary clinics, pet-friendly hotels, stables, or homes of friends and relatives. Share the list with family and neighbors.
- Choose and use an ID method for each animal. Examples include microchipping, ID tags on collar, and photos of you with your animal. This is extremely important if your animals become lost.
- Keep your animals' immunizations - especially rabies – current.
- Maintain animals' health records, proof of vaccinations, microchip numbers, and necessary prescriptions with your other important family papers.
- Maintain a disaster 'go kit' for each animal: means of confinement (cage or carrier large enough for them to stand and turn around in), leash, harness, bowls, 3-days of water and food, medications, specific care instructions, litterbox, clean-up supplies.
- Meet with or notify your county emergency manager if you wish them to be aware of special needs you may have, such as assistance with evacuation if you possess a guide dog or other service animal.

Immediate Aftermath

Damage from the quake may cause our familiar landscape to be unrecognizable. Our companion animals may be displaced from their homes. The immediate focus for emergency workers during this time will be human safety.

When circumstances allow, there will be personnel who are trained in animal emergencies integrated into the incident management structure to assist emergency workers and citizens with animal needs. These needs may include 'rescue' (capture and transport to safety), ID, treatment, temporary shelter and care, and reuniting with owners.

Public information about options for assistance with animals will be provided as soon as possible from the SC Emergency Management Division (SCEMD) by way of news briefings and telephone hotlines.

After the Earthquake

If your animals cannot be found, contact your veterinarian, animal care and control office, and/or county and state emergency managers who can provide you with search lists and databases of animals that have been found and sheltered during the event. When you and your animals return home, check to be sure your surroundings are clear of dangers such as downed power lines, debris, and displaced wild animals.

Other resources

Other resources include your veterinarian and animal care/humane organizations, and these web sites: www.clemson.edu/LPH (then go to Emergency Preparedness); www.scav.org; www.avma.org.

IMPORTANT WEB SITES

South Carolina Emergency Management Division
www.scemd.org

University of South Carolina Seismic Network
http://scsn.seis.sc.edu/

SC State Geologist's Office, SC Department of Natural Resources
http://www.dnr.sc.gov/geology/earthquake.htm

U.S. Geological Survey information on South Carolina
http://earthquake.usgs.gov/regional/states.php?region=South%20Carolina

South Caroliniana Library and the University of South Carolina
http://www.sc.edu/library/socar/about.html

Picture Collection of 1886 Charleston Earthquake
http://www.eas.slu.edu/Earthquake_Center/1886EQ/

South Carolina Earthquake Education and Preparedness Program
http://www.cofc.edu/~scearthquakes/scientists/overview.html

South Carolina Insurance News Service
www.scinsnews.com

Emergency and disaster preparedness for children
http://www.ready.gov/kids/

Citizen Corps emergency and disaster preparedness information for adults
http://www.citizencorps.gov/

Red Cross emergency and disaster preparedness information
http://www.redcross.org/

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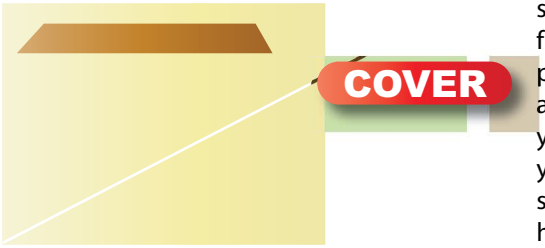
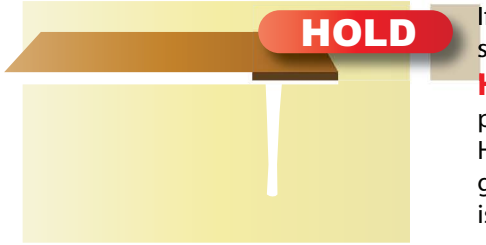
d move

DROP, COVER, HOLD

DROP down on the floor:



Take **COVER** under a sturdy desk, table or other furniture. If that is not possible, seek cover against an interior wall and protect your head and neck with your arms. Avoid danger spots near windows, hanging objects, mirrors, or tall furniture.



If you take cover under a sturdy piece of furniture, **HOLD** on to it and be prepared to move with it. Hold the position until the ground stops shaking and it is safe to move.

TIPS

HIGH-RISE BUILDING

OUTDOORS

SIDEWALK NEAR BUILDINGS

DRIVING

CROWDED STORE OR OTHER PUBLIC PLACE

STADIUM OR THEATER

EARTHQUAKE INSURANCE

- Most people don't buy earthquake insurance because they think it's too expensive and an earthquake will never happen to them. In South Carolina, the entire state is considered to have a moderate to high risk for earthquakes.
- An earthquake of the same magnitude as the 1886 earthquake would cost close to $40 billion in today's dollars (according to Applied Insurance Research).
- Most homeowner and rental insurance policies DO NOT cover damages caused by an earthquake, but coverage can be added to most policies as an "endorsement" for an additional cost.
- Even in earthquake prone areas, only 25-28% of homeowners have earthquake insurance. (Western Insurance Information Institute)
- Earthquake deductibles are set as percentages, i.e. 5% or 10% of the coverage amount rather than fixed dollar amounts. The earthquake deductibles apply separately from your basic homeowner's (and business) policy deductible.
- Following a damaging earthquake, South Carolinians could face loss of life, injury and property damage. Without earthquake insurance, you will have to pay for all losses to your home and possessions.

From the South Carolina Insurance News Service

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after SHOCK

Earthquakes have many effects that can be separated into two groups: primary and secondary.

Primary Effects are features that are always present in a severe earthquake.

- **The ground shakes**
- **Roads buckle**
- **Buildings collapse**
- **Electric lines and gas mains can snap**
- **Large areas of ground can shift position**
- **Large bodies of water can rise and fall**

Supplies Kit

Be self-sufficient for at least three days.

Have basic supplies on hand and make sure everyone in your family knows how to pull them together quickly.

This checklist can help you develop a supplies kit:

- *Non-perishable food*
- *Drinking water (two quarts per person per day)*
- *Flashlights, extra batteries, and bulbs*
- *Battery-powered AM/FM radio or hand crank radio and NOAA weather radio with extra batteries*
- *First-aid kit and manual*
- *Matches in a waterproof container*
- *Non-electric can opener*
- *Essential medicines, including prescriptions*
- *Complete change of clothing including a long-sleeve shirt and long pants*
- *Sturdy shoes*
- *Masks to guard against dust*
- *Baby supplies*
- *Fire extinguisher*
- *Mess kits, paper cups, plates, utensils, and paper towels*
- *Important family documents*
- *Paper and pencil*
- *Toiletries*
- *Books, toys and games*
- *Pet food and extra water for your pet*

Aftershocks are earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the mainshock and within 1-2 rupture lengths distance from the mainshock. Aftershocks can continue over a period of weeks, months, or years. After the 1886 earthquake, 300 aftershocks were recorded in that area for a 2 ½ year period.

In general, the larger the mainshock, the larger and more numerous the aftershocks, and the longer they will continue.

Secondary effects are other disasters caused by the ground movement of earthquakes. Most of the damage done by earthquakes is due to secondary effects that can occur over very large regions, causing wide-spread damage.

Landslides

These occur in hilly/mountainous regions. The damage caused can range from blocked roads to possibly huge property damage and many deaths.

Soil Liquefaction

This happens when the movement caused by an earthquake forces water to seep into the material beneath a building. This causes saturated granular material to lose its strength and briefly change into a liquid from a solid. This forces the foundations of structures to become very unstable and sink into the ground.

Fires

Earthquakes can easily cause fires. Ground movements can lead to gas and fuel leaks in pipes, cutting of electrical cables, etc. The destruction of water pipes makes it harder to fight such fires should they occur. The Earthquake of 1906 in San Francisco ruptured the main water supply, and as a result, there was extensive fire damage.

WHEN THE EARTHQUAKE IS OVER

When the earthquake is over, you need to review what has occurred.

To do this you should:

- Check on the status of your family's physical health and the safety of your home.
- You will probably be on your own for three days or more if roads or bridges are damaged and/or blocked. Be prepared to take care of your family until help arrives.
- Take one step at a time and pay attention to the mental health of your family.

After you've recovered:

- Restock your Supplies Kit.
- Review and update your personal emergency plan.
- Get trained and volunteer so you can help others in your community.

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Epicenter
The point on the Earth's surface above the point at depth in the Earth's crust where an earthquake begins.

Fault
A fracture or crack along which two blocks of rock slide past one another. This movement may occur rapidly, in the form of an earthquake, or slowly, in the form of creep.

Seismologists
Scientists who study earthquakes and their causes and results.

Seismogram
The record made by a seismograph.

Seismographs
Instruments that make an automatic record of the time, duration, direction, and intensity of earthquakes.

Theory of Plate Tectonics
States that the earth's crust is divided into a number of relatively rigid plates that collide with, separate from, and translate past one another at their boundaries, this disruption commonly results in earthquakes.

Modified Mercalli Intensity (MMI) Scale -
The Modified Mercalli Intensity Scale is commonly used in the United States by seismologists seeking information on the severity of earthquake effects.

Micro	(I) Not felt except by a very few people under especially favorable conditions.
Minor	(II) Felt only by a few people at rest, especially on upper floors of buildings.
	(III) Felt quite noticeably by people indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck may be felt. Duration estimated.
Light	(IV) Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sounds. Vibrations felt are similar to a heavy truck striking a building.
	(V) Felt by nearly everyone; many awakened; some dishes, windows broken and unstable objects overturned; pendulum clocks may stop.
Moderate	(VI) Felt by all, many frightened; some heavy furniture movement; a few instances of fallen plaster; damage slight.
	(VII) Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
Strong	(VIII) Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse; damage great in poorly built structures. Chimneys, factory stacks, columns, monuments, walls may fall, heavy furniture overturned.
	(IX) Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; damage great in substantial buildings, with partial collapse; buildings shifted off foundations.
Major to Great	(X) Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; rails bent.
	(XI) Few, if any, (masonry) structures remain standing; bridges destroyed; rails bent greatly.
	(XII) Damage total; lines of sight and level are distorted; objects thrown into the air.

This Earthquake Guide was compiled and produced by the South Carolina Emergency Management Division as a public service in coordination with state, federal, local and volunteer agencies including the South Carolina Earthquake Education and Preparedness Program, the South Carolina Insurance News Service, the Federal Emergency Management Agency, Hispanic Outreach of S.C., and others.

www.scemd.org

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