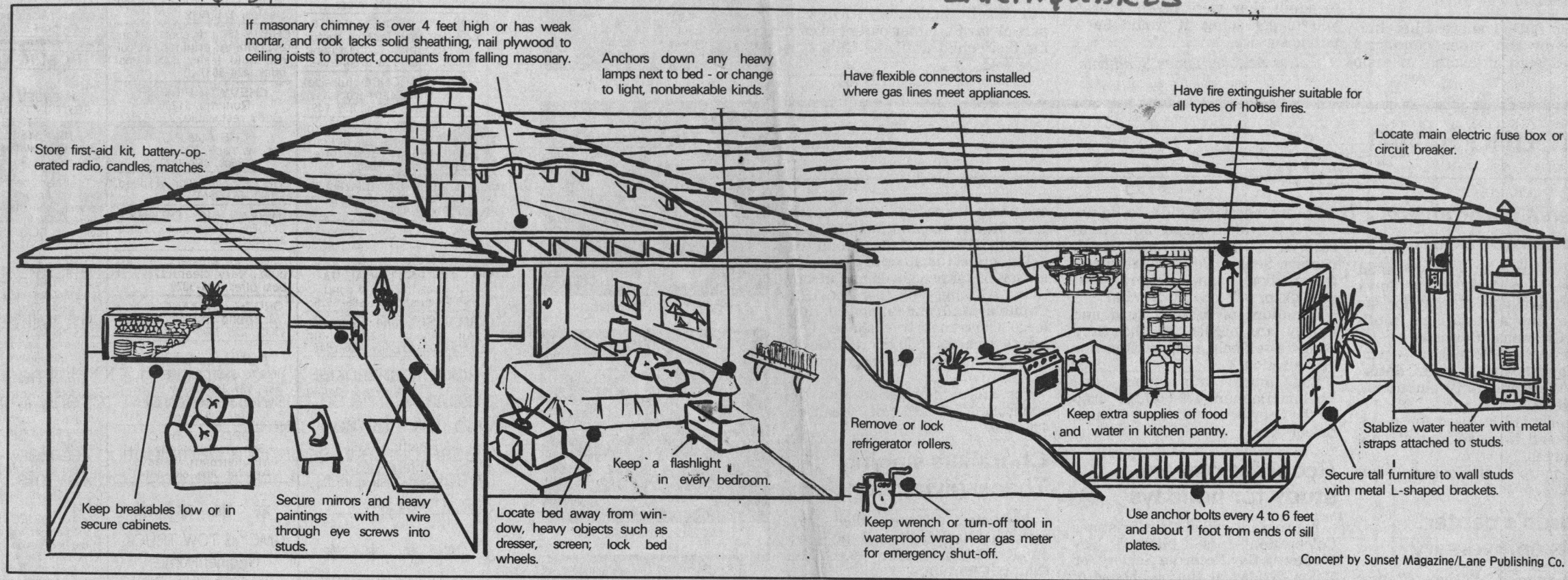


Great stress placed on quake preparedness

11-16-89

EARTHQUAKES



Concept by Sunset Magazine/Lane Publishing Co.

Here are some of the interior hazards homeowners should check for earthquake safety in order to make residences more quake-resistant.

By DAVE BROCKMANN
Sentinel staff writer

SEISMOLOGISTS and geologists have much to learn about earthquakes, but in the last 18 years we've learned a great deal about preparedness.

The 6.6-magnitude San Fernando Valley temblor in 1971 provided new information on performances of houses. In a matter of 15 seconds in 1983, the 6.5 Coalinga quake jolted many older wood-frame houses off their foundation, and newer homes lost chimneys and masonry veneer. After the 1987 Whittier Narrows 5.9 earthquake, the City of Los Angeles' Earthquake Division launched a study to improve the performance of un-

reinforced buildings.

And, today, we're witnessing the billions of dollars of damage in Santa Cruz County from the 7.1 earthquake on Oct. 17.

Findings over the years have re-emphasized the importance of earthquake preparedness by homeowners. There's no dodging reality. Earthquake risk is widespread in the West's seismically active zones, and for homeowners, it is prudent to be aware of safety measures that can be taken in order to prevent damage, particularly to older structures.

It's no wonder that county and city building departments recommend homeowners make seismic safety improvements when they consider the age of most of the

housing. In the city of Santa Cruz, 35 per cent of the homes were built prior to 1939, and 48 per cent were constructed prior to 1970 using building codes less strict than those required today. The county statistics are a little better, with 51 per cent built between 1940 and 1970, with 21 per cent constructed prior to 1939.

Some of the measures recommended by the experts are inexpensive and take minutes to implement; others require larger outlays and much more time.

To learn how to make your home more earthquake resistant, a wealth of material is available. One of the best is Sunset magazine's eight-page, illustrated how-to article titled "Getting ready for a

big quake" (March, 1982). A pamphlet, designed by former City of Santa Cruz Chief Building Inspector Dave Steeves, points out some of the danger areas in your home and what corrective measures to take. "Seismic Retrofits," authored by Dave Benaroya Helfant, managing officer of Bay Area Structural, Inc., general engineering and general building contractors in Berkeley, provides some excellent advice on ways to beef up older homes in earthquake-prone areas.

According to Helfant, houses consist of four kinds of structural elements: horizontal members, such as joists, which support and transfer the weight of the building and the contents on the walls; vertical

members, such as walls and columns, which transfer the weight downward; the foundation, which supports the weight of the house and transfers it to the ground; and all points of connection between the wood members, between wood and concrete, and between concrete and concrete.

HERE ARE some potential damage guidelines and corrective measures provided in the City of Santa Cruz pamphlet:

• MUD SILL FOUNDATIONS: Due to age and wood-to-earth contact, the wood has lost its structural value and is unable to support the imposed loads bearing on it; thus, the structural support is lost, causing the structure to settle and

perhaps overturn.

Corrective measures: The prudent thing is to install a new foundation. This is costly, but will prolong the life of the structure.

• UNREINFORCED MASONRY AND RUBBLE FOUNDATION: This type of foundation is subject to failure due to displacement of masonry units. The mortar has deteriorated and has no adhesive value and thus the foundation is relying on dead weight to hold it in place.

Corrective measures: If the foundation is sound, leave it in place and provide other restraints. If the foundation is in poor condition, it should be replaced.

Please see **RETROFIT** —'D4

Retrofit/ Each reinforcement adds to a building's longevity

Continued from Page D1

• FOUNDATION ANCHOR BOLTS: If the structure is not fastened to any kind of foundation system, the structure can shift off the foundation.

Corrective measures: If the foundation is sound, homes can be secured to the foundation with drop-in anchor bolts. Once the hole has been drilled by the rotary hammer through the mudsill and into the concrete, a bolt is inserted.

• CRIPPLE WALL LATERAL BRACING: This is one of the most hazardous elements of the structure. In most cases, the cripple wall is a short wall framed with 2-by-4's with horizontal exterior siding

nailed to the framing. This system has no lateral value and is very unstable. It is unlikely in these cases that any diagonal bracing had been installed tying the interior posts to the exterior walls.

Corrective measures: Plywood sheathing can be installed on the interior of the cripple wall at each corner and every 25 linear feet of wall.

• WALL AND INTERIOR BRACING: Common practice prior to 1935 was to install some sort of bracing at the corners of the structures. This was accomplished by cutting in blocking to form a diagonal brace. Unfortunately, this was only done to provide alignment and keep the building plumb. No thought was given to the need for lateral support.

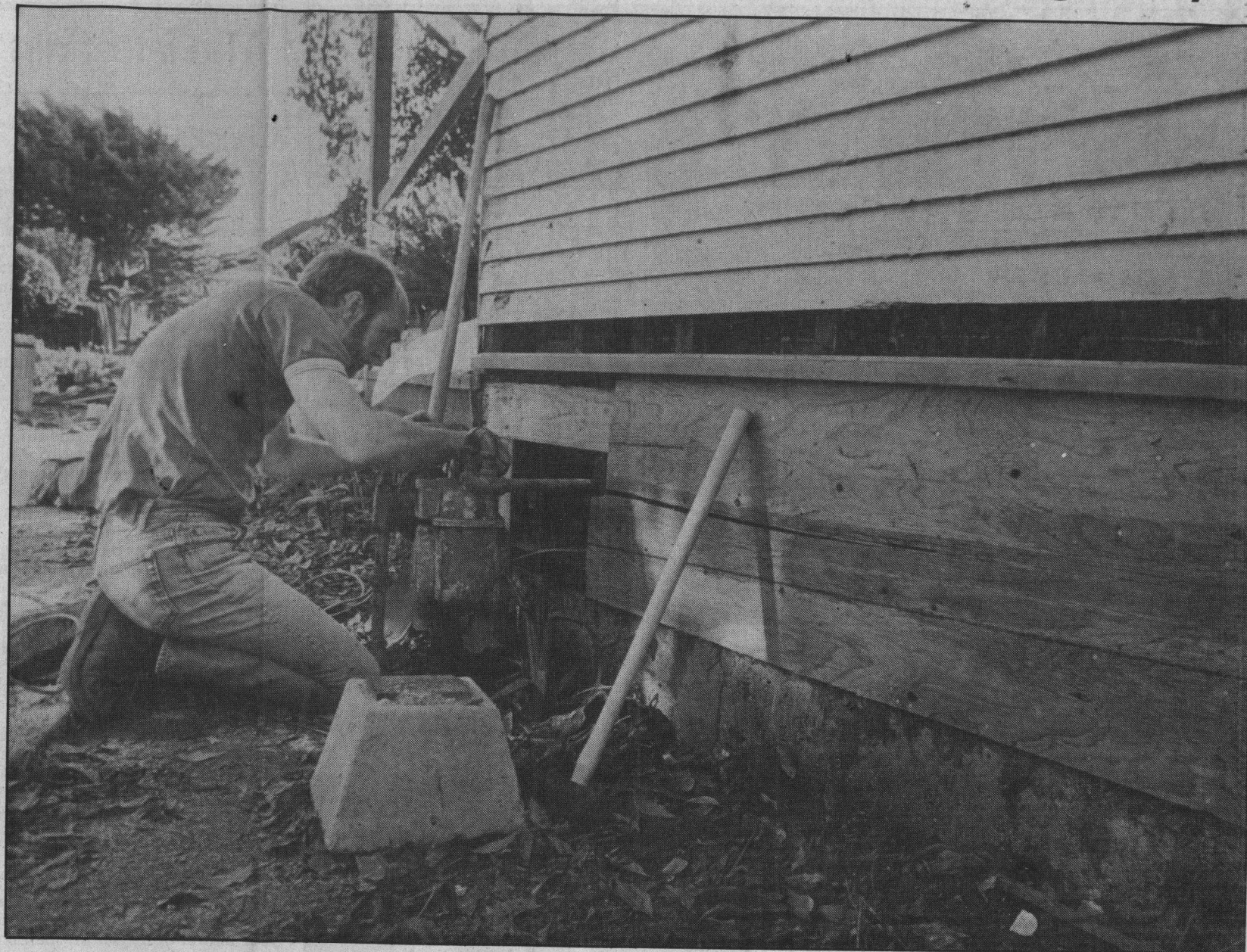
Corrective measures: Lateral bracing can be obtained by installing plywood or sheetrock in corners, hallways, stairways, closets and other locations. Be sure shear panels are nailed correctly.

• ROOF BRACING: In most older structures, little or no bracing or collar ties were provided to prevent the movement of the roof structure. The roof structure can move in a different plane than the main structure and, if no lateral bracing is provided, the roof can separate from the main structure and collapse.

Corrective measures: You can install diagonal bracing, purlins, collar ties and vertical supports in the attic.

• MASONRY CHIMNEYS: Prior to 1935, the common practice was to lay-up a single course of brick using a lime mortar and back-plaster the flue. No flue liners were used or reinforcement. The results of this type of installation may be that the mortar joints and lining have deteriorated from heat and weather to a point where the mortar has no adhesive value. The only thing holding this mass of brick together is dead weight. The result: failure of the chimney, loose bricks fall, large sections of the chimney can fall through the roof and ceilings.

Corrective measures: First, and foremost, is an inspection by a



Dan Coyro/Sentinel

Repair work on Center Street home involves checking the gas service line and strengthening the foundation.

licensed masonry contractor or chimney sweep. The county has issued procedures for repair of unreinforced as well as reinforced chimney damage. Unreinforced chimneys and fireplaces in the city of Santa Cruz should be taken down.

• PORCHES AND ATTACHMENTS: It is amazing to see very ornate porches and add-ons where a qualified craftsman has spent painstaking hours on ornamentation but has completely overlooked proper attachment to the main structure and the provision of any lateral bracing.

Corrective measures: Refasten ledgers to main structure with lag screws; use framing clips on joist or rafter connection to ledger in

at the top and bottom to prevent movement. Tall objects, such as bookcases, can be restrained by using L-shaped brackets fastened to the top or back of the object and to a wall or ceiling member to prevent movement.

• UTILITY SHUT-OFFS: A great percentage of residents do not know where utility services are located or how to shut them off. If utilities — gas and electricity — are not shut off, damages can occur by fire, explosion or electrocution.

There are some other household considerations for families. Every residence should have an emergency plan and every family member be knowledgeable of this plan.

Things to do — order of importance

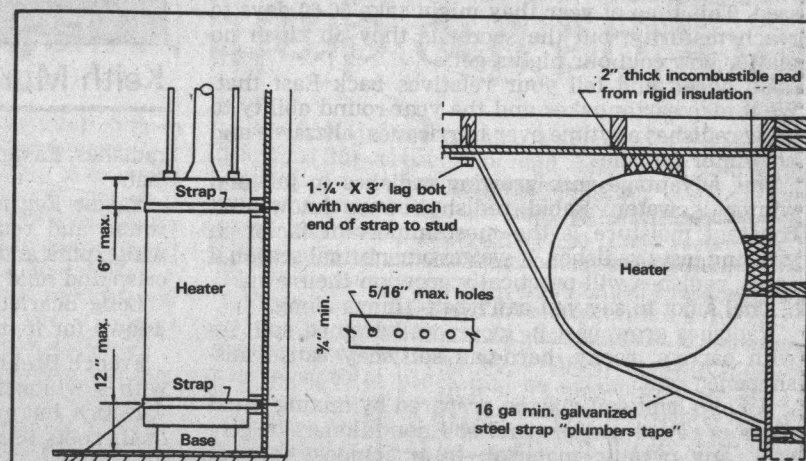
1. Adequate foundation.
2. Sills anchored to foundation.
3. Lateral bracing of cripple walls.
4. Lateral bracing of interior under-pinning.
5. Stabilize unreinforced masonry chimney.
6. Adequate interior shear walls.
7. Adequate shear wall at garage door.
8. Adequate lateral bracing of porches, decks and other attachments.
9. Restraints on hot water heater, furnace and appliances.
10. Secure tall furniture.
11. Restraints on cabinet doors and drawers.
12. Provide emergency tools and instructions outlining an emergency plan.

Source: City of Santa Cruz

RETROFITTING DEFINITIONS

1. **Anchor bolts** — Threaded bolts that are imbedded in a concrete foundation used to fasten the wood foundation sill to the foundation.
2. **Brace** — A diagonal member used to brace corners, walls and vertical members in order to prevent lateral movement.
3. **Cinch anchor** — A threaded bolt and sleeve assembly that can be inserted in a drilled hole in a concrete or masonry foundation to secure the sill to the foundation (if none are cast into the foundation).
4. **Cripple wall** — A low vertical wall under 6 feet in height used

ANCHORAGE FOR WATER HEATER



2. **Brace** — A diagonal member used to brace corners, walls and vertical members in order to prevent lateral movement.
3. **Cinch anchor** — A threaded bolt and sleeve assembly that can be inserted in a drilled hole in a concrete or masonry foundation to secure the sill to the foundation (if none are cast into the foundation).
4. **Cripple wall** — A low vertical wall under 6 feet in height used between the foundation and the first floor. Also used to level off a stepped foundation or to obtain under floor clearance.
5. **Dead load** — Total weight of structural elements of a building.
6. **Diaphragm** — Plywood laid in a staggered pattern and nailed to the framing members in conformance to a nailing schedule.
7. **Gas, electrical service** — The meter location at which point the utility service enters the structure.
8. **Force** — Energy imposed in a lateral or vertical direction during an earthquake.
9. **Girder** — Horizontal member used to support floor system.
10. **Lateral** — A term used to describe a horizontal direction.
11. **Live load** — Combined load of occupants and non-structural contents of a structure.
12. **Ledger** — Horizontal member fastened to wall system used to support joists and rafters.
13. **Mud sill** — Timbers laid on the ground, used to support a structure in lieu of a masonry or concrete foundation system.
14. **Shear walls** — An assembly comprised of wood framing members covered with diagonal solid sheathing or plywood nailed in conformance to a nailing schedule.
15. **Seismic restraints** — Materials and methods used to prevent the movement, separation and overturn of structural elements and non-fixed articles.

Source: City of Santa Cruz

proper attachment to the structure and the provision of any lateral bracing.

Corrective measures: Refasten ledgers to main structure with lag screws; use framing clips on joist or rafter connection to ledger; install diagonal bracing at post and girder connections; use plywood roof sheathing to form a diaphragm; remove any deteriorated material and replace with sound material; caulk vertical and horizontal areas where they join the main structure to prevent weather intrusion; use metal straps and shapes to provide positive connections of framing members.

• **HOT WATER HEATERS AND APPLIANCES:** Only in recent years has there been concern with dangers of movement of heavy equipment and appliances. A hot water heater can fly across a room if it is not restrained, severing gas lines and water lines, causing damage and possibly injury. The same results can occur with furnaces, kitchen ranges, washers, dryers and refrigerators.

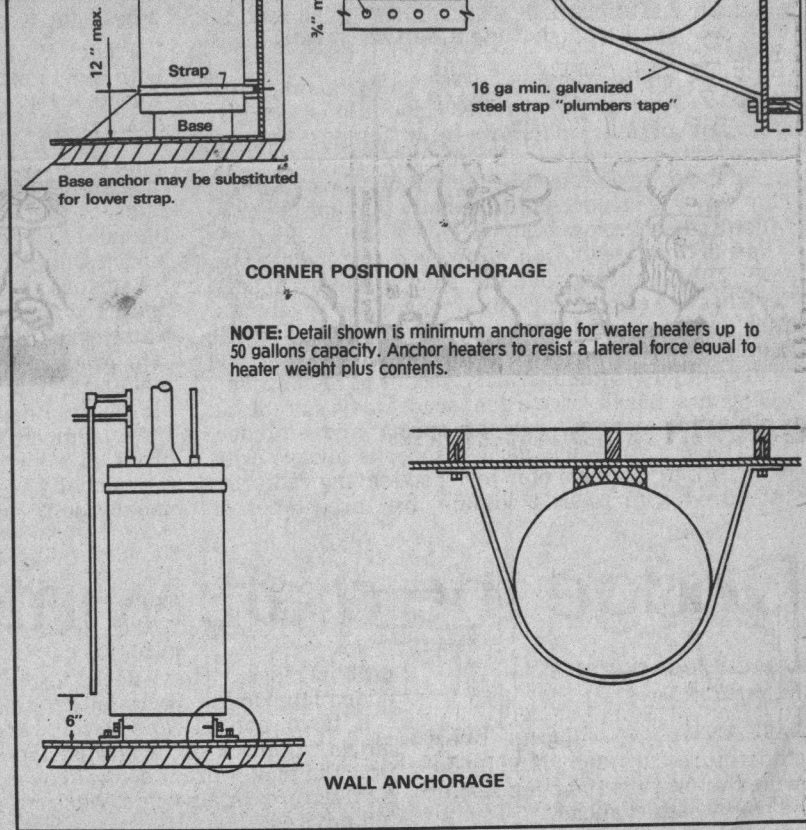
Corrective measures: Hot water heaters can be restrained by the use of strapping or plumber's tape

There are many other household considerations for families. Every residence should have an emergency plan and every family member be knowledgeable of this plan.

The plan should consider:

- Evacuation plan of the building.
- Several flashlights and lanterns.
- Battery-operated AM-FM radio.
- Food and water supply for three days for all occupants and pets.
- First-aid kit including medication for those who require regular medication.
- List of occupants and location of work or school.
- Copy of school or work emergency plan.
- List of safe buildings that would be used as emergency shelters.

Copies of "Earthquake Preparedness" are available at the City of Santa Cruz Building Department counter, 809 Center St. The County of Santa Cruz Planning Department has "Earthquake Damage Repair Information" available at the Government Center, 701 Ocean St.



Source: City of Santa Cruz