# Dwelling and Mobile Home Monetary Losses Due to the 1989 Loma Prieta, California, Earthquake with an Emphasis on Loss Estimation

U.S. GEOLOGICAL SURVEY BULLETIN 1939–B

Prepared in cooperation with the
State of California Department of Insurance

**COVER:** "***the cracks look like the stuff of nightmares. They snake through yards and across roadways .... [and] Summit Road from Highway 17 to Loma Prieta. The most impressive, three feet wide and seven feet deep, runs in front of John and Freda Tranbarger's house on Summit***". Photograph by Jim Gensheimer, October 24, 1989. Published November 30, 1989, in San Jose Mercury News and reproduced by permission. The photo, taken 7 days after the earthquake, shows water in the cracks due to the previous day's rainfall, thereby degrading the cracks.

Chapter B

# Dwelling and Mobile Home Monetary Losses Due to the 1989 Loma Prieta, California, Earthquake with an Emphasis on Loss Estimation

By KARL V. STEINBRUGGE and RICHARD J. ROTH, JR.

Prepared in cooperation with the
State of California Department of Insurance

U.S. GEOLOGICAL SURVEY BULLETIN 1939

ESTIMATION OF EARTHQUAKE LOSSES TO HOUSING IN CALIFORNIA

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

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# Dwelling and Mobile Home Monetary Losses Due to the 1989 Loma Prieta, California, Earthquake, with an Emphasis on Loss Estimation

*By* Karl V. Steinbrugge[1] *and* Richard J. Roth, Jr.[2]


### Abstract

Our overall objective is to improve the methodology of monetary loss estimation for wood frame dwellings and mobile homes by using earthquake insurance loss information based on specific data gathered after the Loma Prieta earthquake. Wherever applicable, it is intended to replace methodologies based on the Modified Mercalli scale. Loss data used were gathered by the California Department of Insurance and supplemented from other insurance sources. These data were compared and analyzed with similar information from all available California earthquakes.

Detailed loss data from the Loma Prieta earthquake were obtained from over 55,000 paid claims, which comprised all forms of insurance including those on dwellings. More detailed, supplementary information on 85,382 wood frame dwellings was obtained on loss (if any), construction variations, and many other components. Of these dwellings, 5,530 had paid losses in the study area, which includes nine counties in the San Francisco Bay area. Data are deliberately presented in considerable detail since they are difficult to obtain directly from our sources. Several are used by permission from proprietary sources or otherwise are not generally available. The strong and weak aspects of our data are pointed out.

Wood frame dwellings constructed prior to 1940 experienced average losses exceeding twice those of later construction. Post-1939 dwellings in the epicentral region suffered about 6 percent average building loss when not subjected to landsliding or located on stable but steeply sloping sites. Average building losses at 10 miles from the fault were small, and at 20 miles were negligible. Major exceptions were in structurally poor ground areas with liquefiable soils, where losses were magnified. A prime example was San Francisco's Marina District, which was 50 miles away.

Deductibles are normal in insurance policies, whether private or government. They are also sometimes found in one form or another in governmental grants. We developed loss over deductible equations which relate average homeowner loss—that is, the loss absorbed by the homeowner, beyond that covered by insurance. The equations are on an aggregate basis and not applicable to individual structures and are principally for computer use in broad loss estimation calculations.

When collapse did not occur, reported contents losses were about 20 to 25 percent of the reported building loss on the average, admitting wide variations in valuations and susceptibilities among building and contents.

Mobile homes (manufactured housing), when not earthquake braced, were prone to fall off their supports. Within 20 miles of the earthquake, about 15 percent of the approximately 2,500 fell from their supports. In sharp contrast, those braced to resist earthquake shaking had no known instances of falling.



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## WOOD FRAME DWELLINGS

### Introduction

On October 17, 1989, the 7.1 Richter magnitude Loma Prieta earthquake significantly damaged structures in northern California (fig. 1) from the Pacific coast beaches, east to include western Santa Clara County, north 50 miles to include San Francisco County, and south to include northern San Benito and northern Monterey Counties. The insurance industry paid out over a billion dollars to settle 56,667 claims (out of 112,513 claims reported) for all types of insurance coverages, from damage to structures and automobiles to life and medical coverages. The actual dollar loss was much greater than this, because about 70 percent of the private property was uninsured for earthquake damage, as well as practically all of the highway system and public buildings which sustained substantial damage. When the insured and uninsured private property damage is combined with the damage to public highways, bridges, and buildings, and combined with the economic losses, direct and indirect, the total loss from the Loma Prieta earthquake rises to about $10 billion.

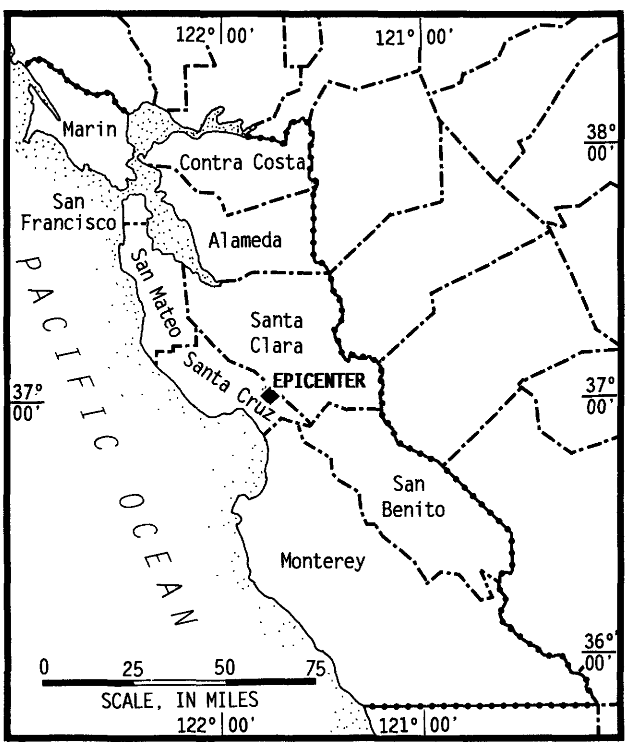



**Figure 1.** San Francisco Bay Area counties in the Loma Prieta earthquake study area, which is bounded by a solid line with dots.

Our data on monetary loss estimation for wood frame dwellings constitute one component of these losses for which substantial loss data are available. Our findings are intended as one basis to estimate monetary loss for earthquakes in areas where geophysical conditions are similar. Potential users include disaster response planners, both governmental and private, as well as financial entities such as insurance companies. Findings are also intended to be useful for legislative and policy planning as well as for the general public.

Quantifying monetary losses for postulated future earthquakes has relied heavily on isoseismal maps prepared after earthquakes, a method which we believe is overly judgmental for loss estimation purposes. Our approach, based on actual monetary loss experience, is compared with those based on intensities.

Numerical values found throughout the text and tables are usually much less precise than those given; actual values may vary within 50 percent of the given values. However, high precision is characteristic for values of exponential functions and also for small differences between large numbers. Distances are normally expressed in miles as well as kilometers to accommodate the nonscientific reader.

### Characteristics of the Earthquake

The earthquake's origin time was 5:04:15 p.m. (PDT) on October 17, 1989. Seismic data for it differ slightly among authorities, but the variations are insignificant for our purposes. Used for this analysis is the information by McNutt and Toppozada (1990, p. 12):

| | |
|---|---|
| Latitude: | 37°02.33′ N.±1 km |
| Longitude: | 121°52.76′ W.±1 km |
| Focal depth: | 17.6 km ±1 km |
| Magnitude: | $M_S$ 7.1 based on 21 observations |
| Fault plane: | Strike N. 50°±10° W. |
| | Dip 70°±15° SW. |

Rupture length was given as 40 km (p. 16). The 17.6 km focal depth was greater than the more common 10 km. Benuska (1990, p. 9) states "During the next seven to ten seconds [after the faulting began] the rupture spread approximately 20 km both to the northwest and southeast...." Additional detail may be found in Plafker and Galloway (1989).

Based on the foregoing, the model has a 40 km line source, centered at the longitude and latitude stated above, and having a strike of 50° NW. The epicenter is at the middle of the line source. Figure 2 is a cross section through the fault. Figure 3 is a topographic map of the epicentral area including adjacent areas in Santa Cruz and Santa Clara Counties. The heavy black line in this figure is the surface projection of the line source of the modeled Loma Prieta faulting. The diamond in the center represents the epicenter. The closest important community to this line is Watsonville.

## Seismic Model

Distance from an earthquake is one factor which will greatly influence dwelling damage. The seismic energy released during an earthquake is contained in the volume of rock surrounding the slippage on the fault plane. This energy attenuates with distance, and this distance must be accounted for in predictive loss estimation algorithms.

Our model assumes that seismic energy can be considered as a line source located on the fault plane at the focal depth of the earthquake (fig. 2). The horizontal length of the line source is the same as the horizontal length of the rupture on the fault plane. For some earthquakes this length may be determined from the length of the surface breakage along the fault. Inasmuch as surface faulting for the Loma Prieta earthquake was absent or obscured by surficial features, the distribution of aftershocks and other seismically determined factors such as fault-plane solutions were used to estimate the dimensions of the causative fault.

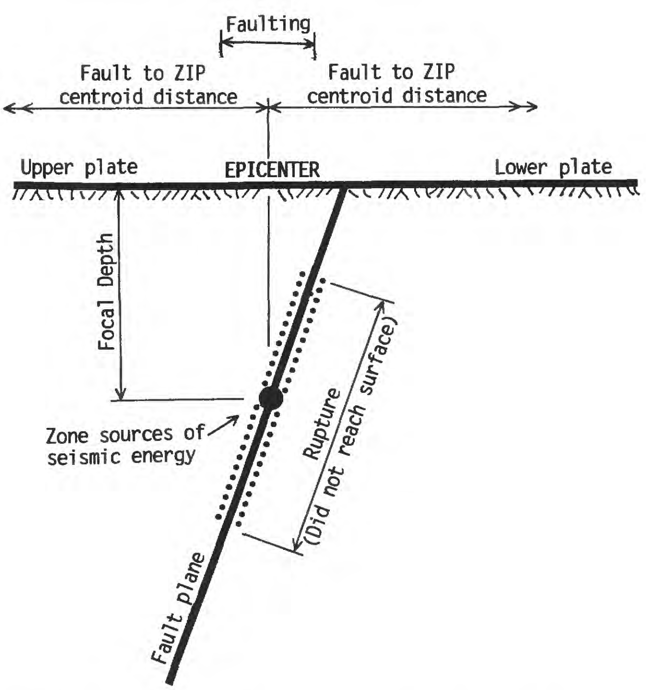



**Figure 2.** Diagrammatic cross section through the fault (view is northwest) modeling the earthquake's line source and zone source of seismic energy.

## Terminology and Definitions

Summarized below are certain abbreviations and word usages found in the text and tables. These are further explained and discussed elsewhere in the text.

*HO or homeowners multiple peril policy.*—This is the basic homeowners policy. The term "dwelling(s)" when used in this context includes structures and their contents; "building(s)" refers only to structures. The policy covers many perils, especially fire, but specifically excludes "earth movement." "Earth movement" includes landslide and earthquake. An earthquake endorsement has the effect of reversing this exclusion with respect to earthquake, but at a much higher deductible than the basic policy deductible. It is possible to buy a separate earthquake insurance policy which has the same effect. There is no known insurance available for nonseismic landslide. The earthquake endorsement will apply only if the landslide is caused by earthquake; technically the policy insures only the replacement of the structure, not the land, but the land would obviously have to be replaced to rebuild the house. The combination homeowners policy (HO) and earthquake endorsement (EQ) provides these five coverages (in order of importance in terms of earthquake losses):

(1) Coverage for damage to the structure up to the stated limit or replacement cost, whichever is specified, subject to a deductible. The deductible is usually 10 percent of the insured limit, but may be 5 or 15 percent or a combined deductible for all coverages.

(2) Coverage for contents, which is limited to 50 or 75 percent of the structure limit and is usually subject to its own deductible, but the deductible may be combined with the structure deductible.

(3) Coverage for "loss of use," which includes additional living expense and fair rental value. There is no deductible, but the limit is usually one year. "Ale" and ALE" (additional living expense) when used in the tables or the text has the same meaning.

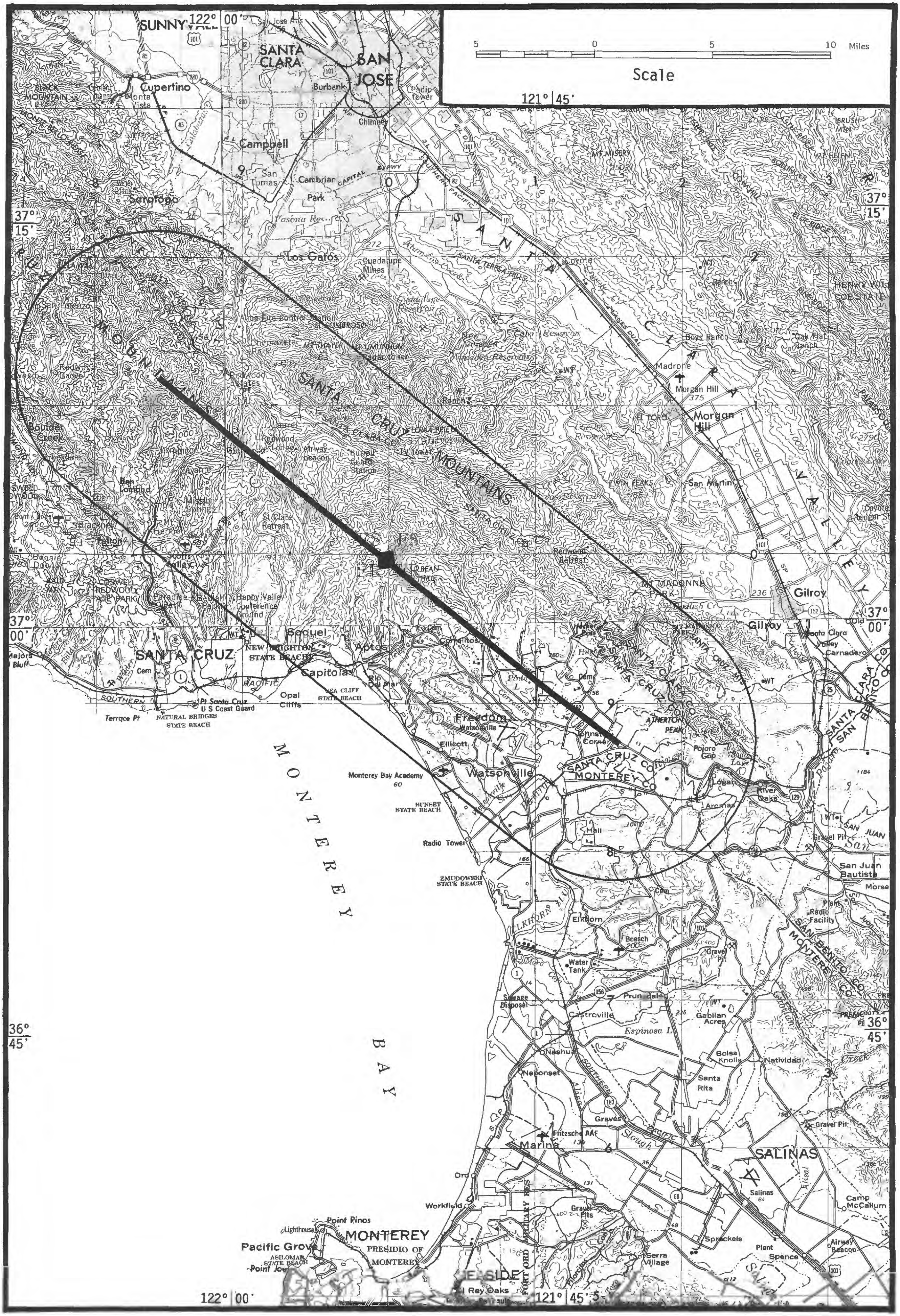
(4) The main homeowners policy covers fire and, in most policies, breakage of glass from an earthquake even if no earthquake endorsement is purchased, often with a $250 deductible.

(5) Coverage for secondary buildings, such as detached garages and out buildings.

A renters policy covers only contents and loss of use.

A condominium unitowner policy ("Condo") is broader than a renters policy, but the condominium association insures the structure. Additional living expense is also included in many cases.

The term "mobile home" includes the coach, contents, and appurtenances unless context indicates otherwise. Mobile homes and manufactured housing are considered to be synonymous in this study.


5 0 5 10 Miles
Scale
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121° 45'
37° 15'
37° 00'
36° 45'
SUNNYVALE
SANTA CLARA
SAN JOSE
Cupertino
Campbell
Burbank
Chimney
Cambrian Park
Saratoga
Los Gatos
Guadalupe Mines
SANTA CRUZ MOUNTAINS
SANTA CLARA VALLEY
Coyote
Madrone
Morgan Hill
San Martin
Gilroy
Boulder Creek
Ben Lomond
Felton
Scotts Valley
Soquel
Aptos
SANTA CRUZ
Capitola
Freedom
Watsonville
Monterey Bay Academy
Radio Tower
ZMUDOWSKI STATE BEACH
Elkhorn
Castroville
Espinosa L
Nashua
Neponset
Marina
Fritzsche AAF
SALINAS
Natividad
Santa Rita
Gabilan Acres
Bolsa Knolls
Spreckels
Camp McCallum
Ord
Workfield
Point Pinos
Pacific Grove
MONTEREY
PRESIDIO OF MONTEREY
SEASIDE
Del Rey Oaks
MONTEREY BAY
SANTA CRUZ CO
MONTEREY CO
SAN BENITO CO
San Juan Bautista
Aromas
Logan
River Oaks
Sargent
Pajaro Gap
ATHERTON PEAK
Corralitos
Rio Del Mar
NEW BRIGHTON STATE BEACH
SEA CLIFF STATE BEACH
SUNSET STATE BEACH
NATURAL BRIDGES STATE BEACH
Terrace Pt
Pt Santa Cruz U S Coast Guard
Opal Cliffs
Majors Bluff
MT MADONNA PARK
Redwood Retreat
St Clare Retreat
Happy Valley Conference Ground
Paradise Park
LOMA PRIETA
MT THAYER
MT UMUNHUM
Almaden
Calero Reservoir
Boys Ranch
Oak Flat Ranch
Sprig
Prunedale
Gravel Pit
Serra Village
Plant Spence
Airway Beacon

## Determining Monetary Losses from Insurance Data

Paid insurance claims provide a substantially improved basis for monetary loss estimation of future earthquakes for two reasons. First, paid insurance claims represent the cost of repair and are therefore a direct measure of vulnerability. In contrast, when vulnerability is derived from physical damage, estimates of cost of repair must be made (of the various damaged structural and nonstructural components of a building, including depreciation if applicable) to calculate costs. Consequently, it is much more difficult to determine the percentage loss or cost of repair from damage data than it is from paid insurance claims. Second, cost of repair data need not be referenced to Modified Mercalli intensity for use in determining vulnerability. The use of paid insurance claims as the basis for building vulnerability relationships was suggested by Steinbrugge and others (1984).

Normally, private insurance has a deductible clause, wherein the insurer shares losses with the owner. This is also generally true in some related form where governmental insurance or assistance program is provided. Aggregate loss estimates for future earthquakes must necessarily consider the impact of deductibles (Steinbrugge, 1990). A percentage deductible is used in this study; percentages may readily be changed to dollars or to various combinations of dollars and percentages through simple mathematical computations.

Despite the advantages of using paid earthquake insurance claims, they have some disadvantages. The data base of paid claims that have been analyzed is restricted to California. Also, the location of each large claim should be field checked to ascertain if the claim is a result of only ground shaking or if ground failure such as landsliding or liquefaction has been a factor.

The Loma Prieta earthquake provided an unusual opportunity to examine relationships among values, monetary losses, and monetary loss attenuation with distance for dwellings and mobile homes. This event is unique in United States experience in that it has been the largest magnitude earthquake to date for which substantial amounts of reliable quantitative monetary loss data are available. [Note added in press: When monetary losses become available for the 1994 Northridge, California, earthquake, they are expected to exceed those of Loma Prieta.]

◄ **Figure 3.** Epicentral area of the Loma Prieta earthquake. The heavy black line is the surface projection of the modeled line source of the seismic energy. The diamond at the midpoint of the heavy black line is the epicenter. See figure 2 for the model of the line source. The closed loop about the heavy black line is the limit of the probable maximum loss zone (PML zone, defined in section "Definition of PML Zone").

The Loma Prieta study area is confined to nine counties (fig. 1) around the San Francisco Bay and Monterey Bay, as follows:

| | | |
|---|---|---|
| Alameda | Monterey | San Mateo |
| Contra Costa | San Benito | Santa Clara |
| Marin | San Francisco | Santa Cruz |

Reliable insurance loss information came from two principal sources which are described below.

### Source A: California Department of Insurance

On January 31, 1990, the California Department of Insurance issued a special data call for loss statistics relating to the Loma Prieta earthquake to all insurers licensed to do business in the State of California. Under the department's general regulatory authority, all insurers were required to respond. On February 15, 1991, the department issued a second data call to update the information from the first data call. This time, the insurers reported that the total incurred losses for all coverages as $901,762,236 on a total of 56,667 claims. No further information was requested from the insurers. No insurer became insolvent because of this earthquake. Information from this latter data call is referred to as "Source A" throughout this study.

Table 1 is a summary of some of the results received from 212 insurer groups. Most groups in turn have several licensed insurers, but under common management, and so the total number of insurers reporting actual losses was much greater. There are about 1,500 insurers licensed in California, half life and health and half property/casualty. The remaining insurers had few or no losses. The five largest groups paid out 70 percent of the residential losses, and the 15 largest groups paid out 90 percent of the residential losses. The fire losses are separately stated in table 1, since they are not covered under an earthquake policy but are paid under many lines of insurance in addition to the "fire" line of insurance. For instance, a loss under an earthquake endorsement attached to a homeowners policy may be allocated to the homeowner's line or to the earthquake line with any ensuing fire loss allocated to the homeowners line. Also, it is possible to have losses under a homeowners policy whether or not there was an earthquake endorsement (for example, for glass breakage or fire).

It is important to reiterate that our loss estimation study of wood frame dwellings is based on insurance data. For the Loma Prieta study area, our data base is limited because only 30 to 35 percent of the dwellings had earthquake insurance; many owners of low-value dwellings, brick homes, or older homes perhaps chose not to insure because of the cost. Nevertheless, it does not appear that our results are seriously impacted by this shortcoming. In particular, the geographic distribution of insured dwellings seems to be fairly even. Another limitation to our data was that the amount the insurer paid was subject to the provisions of the insurance

**Table 1.** Summary of insurance losses paid for all lines of insurance.

[From California Department of Insurance's second call for data (Source A, see text). "MP", multiple peril.]

| Insurance Lines | Losses Other Than Fire: Number of Claims Reported | Paid | Paid Losses x$1000 | Fire Losses Only: Number of Claims Reported | Paid | Paid Losses x$1000 |
|---|---|---|---|---|---|---|
| Life | 40 | 40 | 3,311 | -- | -- | -- |
| Accident and health | 198 | 196 | 1,278 | -- | -- | -- |
| Fire | 1,759 | 743 | 28,844 | 170 | 148 | 3,042 |
| Allied lines | 1,131 | 295 | 47,644 | 15 | 11 | 42 |
| Farmowners MP | 185 | 98 | 2,411 | 2 | 0 | 0 |
| Homeowners MP | 35,670 | 17,864 | 162,839 | 725 | 687 | 12,283 |
| Commercial MP | 6,071 | 1,604 | 101,940 | 63 | 43 | 4,177 |
| Other liability | 249 | 193 | 7,059 | 6 | 6 | 19 |
| Inland marine | 2,185 | 1,548 | 109,624 | 14 | 14 | 9,829 |
| Earthquake | 55,112 | 26,291 | 397,727 | -- | -- | -- |
| Workers compensation | 615 | 496 | 3,576 | -- | -- | -- |
| Automobile | 6,956 | 5,539 | 8,563 | -- | -- | -- |
| Glass | 99 | 89 | 216 | -- | -- | -- |
| Burglary and theft | 2 | 2 | 6 | -- | -- | -- |
| Boiler and machinery | 56 | 6 | 329 | -- | -- | -- |
| Other | 1,135 | 710 | 6,406 | 55 | 44 | 417 |
| TOTAL | 111,463 | 55,714 | 881,772 | 1,050 | 953 | 19,990 |

contract— that is, there are limits, deductibles, and exclusions. In many cases, the dollar losses as reported are net amounts (total loss less deductible—usually about $10,000 to $15,000), and so the deductible had to be estimated or computed and added back in order to obtain the gross losses.

Data for mobile homes (manufactured housing) had many of the same constraints which applied to wood frame dwellings.

### Source B

Source B information was obtained by one of the authors (Steinbrugge) from a company which also reported to the California Department of Insurance's call for data. This data source contains substantially greater amounts of information than that acquired by the department. The advantage of this additional information is that it facilitated estimates of losses due to geologic effects, particularly landsliding. Additionally and most importantly, its data contained information on all of their insured dwellings, whether insured for earthquake or not and whether losses were paid or not. This allowed the calculation of percentage loss as a function of all insured dwellings in a specified region such as a ZIP code area. These loss percentages are crucial to the methods of loss estimation for future earthquakes.

Source B has a 20 percent market share. The geographic distribution of its insureds was reasonably uniform throughout the Loma Prieta study area. Their underwriting practices did not influence market share in potentially geologically hazardous areas such as landslide regions in the epicentral region and elsewhere, nor in the "poor ground" areas such as the heavily damaged San Francisco Marina District and other districts such as the reclaimed lands of Foster City on the San Francisco Peninsula. In short, there appears to have been no biases relating to the issuance of policies and building values.

Table 2 shows that 85,382 dwelling earthquake insurance policies from source B were in force in the study area at the time of the Loma Prieta earthquake. Data are listed by county in order to provide an overview of the geographic distribution of the policies, paid insurance losses, and their paid amounts. Except for the most distant areas of some counties, each insured dwelling probably felt the earthquake though it may or may not have had damage. The third column lists the number of dwellings having building losses which exceeded the insurance deductible; the fourth column pertains to dwellings with contents losses; the fifth column refers to the number of houses which were uninhabitable for some period of time due to damage. Detailed data were available for all 242,789 dwellings. Of these 242,789 dwellings, only 302 were identified as being of masonry construction (masonry dwellings are therefore not part of this study).

Table 3, column 4, shows the density of the loss data in terms of the percentage of insured dwellings with paid losses. Counties are ranked by these percentages. Clearly, Santa Cruz County was the most heavily hit, followed by San Francisco, San Benito, Santa Clara, and Monterey Counties. It should be noted in figure 1 that San Francisco County is more distant from the earthquake than San Mateo County but that the percentage of insured dwellings with paid losses is larger. This is attributable, at least in part, to

**Table 2.** Homeowner (Ho.) dwellings and paid earthquake (Eq.) losses.

[Data from source B, see text.]

| County | Number of Insured Dwellings | | Dwellings With Eq. Insurance Having: | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Paid Loss on:[1] | | | Amount of Paid Loss:[3] | | |
| | Ho. | Eq. | Bldg. | Conts. | Ale[2] | Bldg. | Conts. | Ale[2] |
| Alameda | 56,226 | 19,421 | 224 | 31 | 10 | 2,091 | 128 | 50 |
| Contra Costa | 45,465 | 13,698 | 82 | 18 | 4 | 885 | 36 | 19 |
| Marin | 10,356 | 3,312 | 13 | 4 | 0 | 76 | 96 | 0 |
| Monterey | 11,963 | 2,230 | 88 | 84 | 29 | 503 | 192 | 47 |
| San Benito | 1,013 | 354 | 46 | 59 | 4 | 257 | 61 | 36 |
| San Francisco | 13,038 | 3,378 | 194 | 82 | 21 | 2,823 | 281 | 85 |
| San Mateo | 30,018 | 11,948 | 228 | 71 | 12 | 2,516 | 580 | 55 |
| Santa Clara | 64,281 | 28,077 | 2,015 | 1,151 | 309 | 34,093 | 8,376 | 2,981 |
| Santa Cruz | 10,429 | 2,964 | 2,640 | 1,865 | 422 | 30,342 | 6,581 | 2,209 |
| Totals | 242,789 | 85,382 | 5,530 | 3,365 | 811 | 73,586 | 16,331 | 5,482 |

[1]A dwelling may have a paid loss in each of the three columns, or combination thereof, and be counted in each column in which a paid loss occurred.

[2]Ale means "additional living expense," which is paid when homeowner is unable to occupy dwelling due to earthquake damage.

[3]In thousands of dollars.

**Table 3.** Percent of homeowner earthquake insured dwellings having paid losses.

[Source B, see text.]

| County | Earthquake Insured Dwellings | Dwellings With Paid Loss[1] | Percent of Dwellings With Paid Loss |
|---|---|---|---|
| Santa Cruz | 2,964 | 1,534 | 51.8 |
| San Francisco | 3,378 | 318 | 9.4 |
| San Benito | 354 | 33 | 9.3 |
| Santa Clara | 28,077 | 1,920 | 6.8 |
| Monterey | 2,230 | 79 | 3.5 |
| San Mateo | 11,948 | 286 | 2.4 |
| Alameda | 19,421 | 223 | 1.1 |
| Contra Costa | 13,698 | 82 | 0.6 |
| Marin | 3,312 | 14 | 0.4 |

[1]To be counted, dwellings must have any combination of paid building, contents, and Ale Loss. In contrast, the count in column 3 of table 2 is for dwellings having building damage; contents for column 4, and Ale for column 5.

the intensified damage in the Marina District of San Francisco, where high site response due to structurally poor ground conditions increased the damage compared to adjoining districts. A second reason is that single family dwellings in large sections of San Francisco have certain characteristics not common throughout the Loma Prieta study area.

> Many of these wood frame structures are located on 25-foot lots, or somewhat wider, and often no space exists between the sides of adjoining buildings. Also these homes are conventionally two story. The garage, laundry areas, storage areas, etc., are in the first story; the second story is living space. An arrangement of this type leads to numerous partitions in the second story with a minimum number of partitions in the first story. The front wall in the first story has numerous openings. The rear wall of the first story has fewer openings than the front.... The result is a building which in general is weak in the first story, especially against transverse lateral forces. (Steinbrugge and others, 1959, p. 76. See also pages 76/83 for types of damage.)

Third, the houses were, on the average, older than those elsewhere in the study area.

Table 4 shows the percentage of the homeowners policies for sources A and B which included earthquake insurance. At the time of the earthquake, California state law required every insurance company writing dwelling coverages to also offer earthquake insurance. This offer was made in writing to each fire insured policy holder. Therefore, the percentages are indicators of the public's awareness of the earthquake hazard and insurance response thereto. The first five counties in the table include one or more of the San Andreas, Hayward, and Calaveras faults within their boundaries. These faults are well-publicized and locally well-known, and can account for the high percentages. Except for San Francisco, the percentage of homeowners carrying earthquake insurance was consistent between the two data sources.

The numerous popular books on the great 1906 San Francisco earthquake have been on booksellers shelves for many years. Structurally poor ground regions of the Marina

**Table 4.** Percentage of homeowners policies also with earthquake coverage.

[Sources A and B, see text.]

| County | Source B | | Source A | |
|---|---|---|---|---|
| | Number of Homeowner Policies | Percent of Homeowners With EQ. Coverage | Number of Homeowner Policies | Percent of Homeowners With Eq. Coverage |
| Santa Clara | 81,314 | 34.5 | 252,721 | 31.6 |
| San Mateo | 37,944 | 31.5 | 120,363 | 31.8 |
| San Benito | 1,210 | 29.3 | 3,657 | 27.4 |
| Alameda | 70,210 | 27.7 | 203,365 | 27.8 |
| Contra Costa | 55,149 | 24.8 | 160,425 | 21.3 |
| Marin | 13,822 | 24.0 | 42,030 | 24.0 |
| Santa Cruz | 12,502 | 23.7 | 37,593 | 22.5 |
| Sonoma[1] | 20,030 | 20.7 | --- | --- |
| San Francisco | 21,118 | 16.0 | 79,382 | 26.5 |
| Monterey | 14,873 | 15.0 | --- | --- |
| Solano[1] | 17,457 | 13.7 | 40,660 | 14.1 |
| Napa[1] | 6,057 | 9.3 | 17,804 | 10.7 |
| San Joaquin[1] | 16,380 | 5.2 | --- | --- |
| Sacramento[1] | 40,401 | 4.1 | --- | --- |

[1]Counties contiguous to the study area.

and Mission districts of San Francisco are on maps available to the public. As mentioned above, the prevailing type of wood frame construction in San Francisco is more vulnerable to earthquake damage than elsewhere in the Loma Prieta study area.

The last two counties in table 4 are located in California's Central Valley and have a lower seismicity than the other counties. The percentages for these two counties reasonably reflect the public's perception of this lower hazard.

Additional data from several other companies have been used to fill voids or to otherwise strengthen the loss estimation analyses. These instances are mentioned where they occur.

### Postal Zip Codes and Distances from Earthquakes

One direction of this study is to develop loss estimation algorithms which are transferable to other regions under practical conditions. For loss estimation purposes and also for disaster response planning, dwelling data are normally more available on a postal ZIP basis than on other geographic bases. Some sources, such as the national census, can be readily converted to a ZIP basis. ZIP boundaries may extend beyond city boundaries; as a consequence, the area included in a ZIP by its postal name may also include nearby small communities. ZIPs usually contain a sufficient number of dwelling losses to be statistically significant with the distance attenuated loss percentages.

For the Loma Prieta study area, distances were computed to each ZIP's geographic centroid. Locations of geographic centroids are essentially identical to those of housing centroids for the usual ZIP, but errors may occur when large uninhabited areas are included. The term "ZIP to fault" distance or "fault distance" is defined as the shortest distance from the surface projection of the earthquake's line source to the ZIP's population weighted centroid. An exception to this definition is for mobile home parks, where in some instances the distance from the line source is that from the park rather than from its ZIP centroid.

Figure 4 is a map of ZIPs in the vicinity of the Loma Prieta earthquake. The heavy black straight line with the diamond in the center has the same meaning as that in figure 3. The closed loop about the heavy black line is the 6 mile probable maximum loss (PML) zone; this will be further defined and discussed. ZIP boundaries within the Santa Cruz Mountains seem to have been in a state of flux at the time of the earthquake, inasmuch as four published ZIP maps and atlases were examined and each had different boundaries for ZIP 95030 within the Santa Cruz Mountains. Other ZIP boundaries in the mountains also had uncertainties, but to a smaller degree. The boundary uncertainties do not affect our distance calculations since the centroids were determined on a population weighted basis. Additionally the uncertain boundaries are in very lightly populated areas. Also, for reasons discussed later, ZIP 95030 was eliminated from the loss over deductible analysis and resulting equations.

## Dwelling Losses Before and after Deductible

As has been mentioned before, the detail of the information on individual dwellings found in source B exceeds that in source A. Table 5 shows paid loss data from source

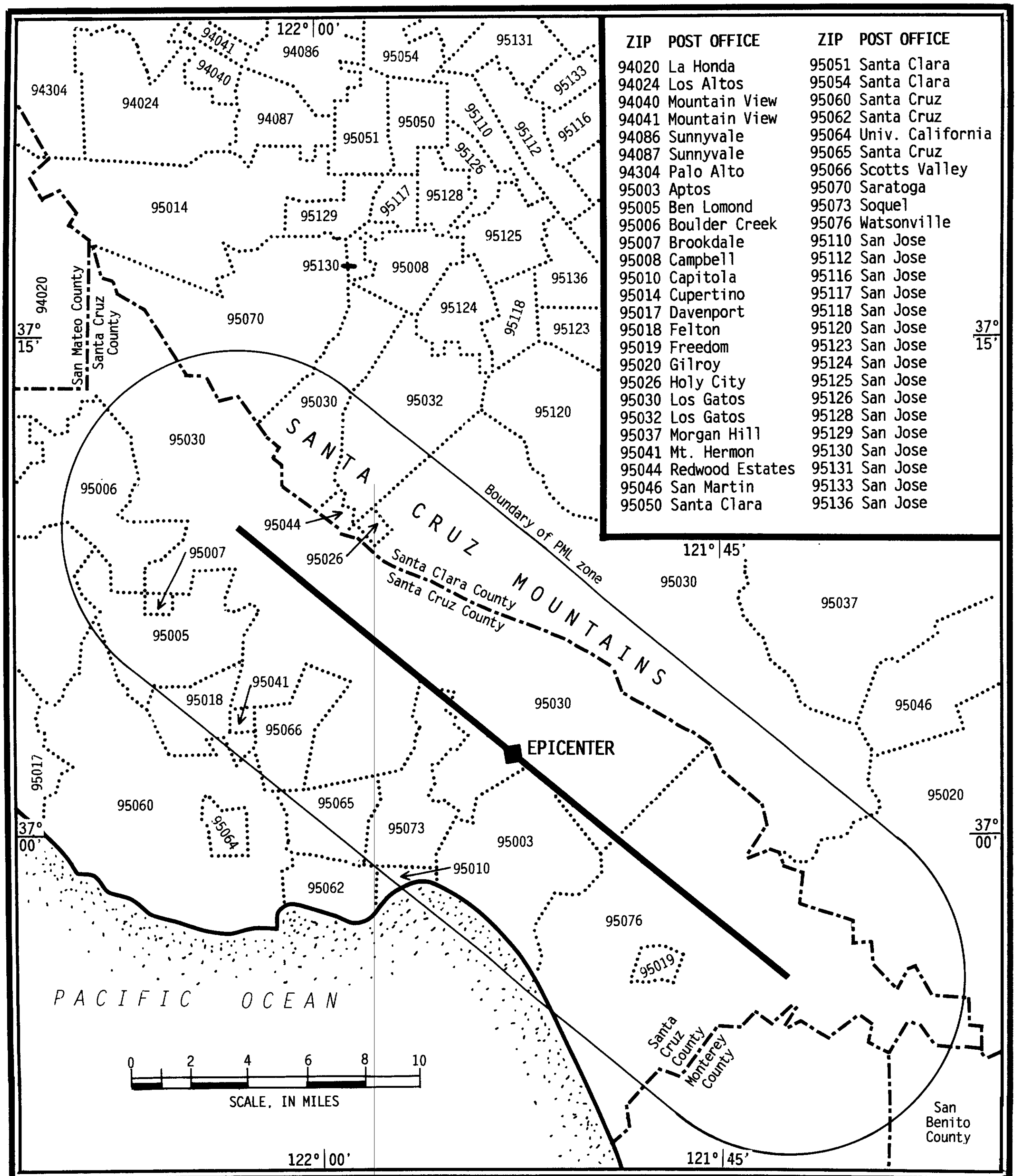



**Figure 4.** Postal ZIPs in epicentral area of the Loma Prieta earthquake. See figure 3 for relationships to the topography. ZIPs limited to portions of Santa Cruz and Santa Clara Counties. ZIP boundaries in the Santa Cruz Mountains are uncertain. Map adapted from "ZIP Codes in the San Francisco Bay Area" by permission of the copyright owner, Western Economic Research Co., Panorama City, California. Heavy black line and loop are explained in figure 3.

B for 45 dwellings of the 2,888 insured dwellings in Santa Cruz County. Losses include those paid under earthquake and/or homeowners policies, under condominium policies, and under HO tenants (renters) policies. Specifically shown is a portion of ZIP 95003, which extends north from Monterey Bay into the Santa Cruz Mountains. Aptos and Rio Del Mar are in this ZIP, as are mountainous rural areas. Table 5 dwellings are in Santa Cruz County, where the highest percentage of paid losses was found (table 3).

Column 1 is the dwelling's ZIP. Column 2 is year built. Columns 3 and 4 are the dollar deductibles (HO for homeowners; EQ for earthquake). The "9" in column 5 indicates that the number of brick masonry chimneys is unknown; other numbers indicate number of chimneys. Column 6 gives the number of stories—H means one and a half, and U or blank means unknown; coding available includes B for bi-level, I for two and a half, and T for tri-level (none of these shown on this page of table 5). In column 7, K is wood shake, W is wood shingle, U is unknown, T is clay tile, and C is concrete tile; blank means unknown. Columns 8 and 9 are the amounts ("LIMIT") of fire insurance coverage. "EQ Blanket" in column 10 is the amount of earthquake insurance coverage; fire insurance coverage represents dwelling value, whereas earthquake coverage may be written for any amount at $100,000 or over for HO (non-tenant) and $10,000 or over for tenant and condo. Column 11 is the percentage of insurance to value; this allows revision of column 8 values when a homeowner insured a dwelling for something less than value. Contents limits do not allow this kind of revision. Column 18 (next to last column) is the occupancy designation: T for tenant (only contents insured); C for condominium unit owner; and N for non-tenant (home owner).

Table 44 (at end of report) is a summary of loss data by ZIP in ZIP-fault distance order for the Loma Prieta study area. A negligible number of corrections and deletions was made to the source data, mostly to dwellings which were incorrectly coded as to location. ZIPs with few insured dwellings are normally ZIPs assigned to post office boxes, to governmental entities, or to organizations with very high mail uses.

The meanings of table headings for table 5 also apply here, with these additions. "Cover" is an insurance term for insurance coverage, that is, an insurance policy. "CONTS." refers to the contents of the building.

Earthquake losses could be paid under either the earthquake policy ("EQ COVER") and/or under the homeowner policy ("HO COVER") owing to policy wording and differences in deductibles. ZIP 95030 had the heaviest losses because of geologic hazards in the Santa Cruz Mountains. Methods for computing the values in columns 7, 12, 28, 29, and 30 are shown at the bottom of the last page of table 44.

The insurance deductible used by source B differed considerably from that used by source A companies. Source B allowed the insured to purchase a different amount of earthquake insurance from that for fire. The amount of earthquake insurance for HO (non-tenant) could be between $100,000 (the minimum) and the amount of building and contents for fire insurance plus an amount for ALE (additional living expense). For tenants and condo unitowners, a minimum of $10,000 applies to the earthquake coverage and additional limits may be purchased. The earthquake deductible was 10 percent of the amount of earthquake coverage and not of the fire coverage and is applied in dollars to the total earthquake loss. Claims practice allowed the determination of what portion of the deductible was applied to the building, contents, or ALE loss. For example, assume a person has a $200,000 dwelling with fire insurance and it was insured to full value. Were that person to chose $150,000 in earthquake insurance coverage, the earthquake deductible would be $15,000. This is 7.5 percent in terms of dwelling value. In a few instances, deductibles for Loma Prieta dwellings with paid losses became as low as 2 percent and 3 percent of building value.

It should be noted in passing that loss figures may be compiled somewhat differently by different companies, depending upon the adjustment practices. Should a dwelling become a total loss, the order in which a deductible is applied to the building, to its contents, and to additional living expense may cause one or more of these three loss components to be underestimated. This discrepancy in methods can cause differences in loss values.

## Probable Maximum Loss (PML)

It is intended to use Loma Prieta losses as a basis for estimating the probable maximum losses for a probable maximum earthquake. This process and its analysis is covered in following sections.

### Definition of Probable Maximum Loss (PML)

"Probable maximum loss" (PML) is a term commonly used in California earthquake insurance loss estimation. The California Department of Insurance (1981, p. 6) defined the geologic aspects of PML in "California Earthquake Zoning and Probable Maximum Loss Evaluation Program," as follows:

> The *probable maximum loss* for an individual building is that monetary loss expressed in dollars (or as a percentage of insured value) under the following conditions:
>
> (a). Located on firm alluvial ground or on equivalent compacted man-made fills in a probable maximum loss zone [defined later], and
>
> (b). Subjected only to the vibratory motion from the maximum probable earthquake, that is, not astride a fault or in a resulting landslide.

The California Department of Insurance has changed a portion of its original definition of PML to a loss over deductible approach. See Steinbrugge and Algermissen (1990) in the sections "Loss Over Deductible Approach" (p. A60) and "Applications to Simpler Methods" (p. A61) for the basis for the change.

Wood frame dwellings meeting these criteria in the probable maximum loss zone (PML zone) are grouped

**Table 5.** Santa Cruz County paid losses (portion of computer hard copy).
[Source B, see text. Shown are 45 out of 2,888 homeowner, condominium, and tenant policies.]

| | | | | | | | | | | INS. | LOSS AFTER DEDUCTIBLE | | | | | | | FAULT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DEDUCTIBLE | | NUMBER | | | LIMIT | | EQ | TO | EQ COVER | | | HO COVER | | | OCCUP. | DIST. |
| ZIP | YEAR | HO | EQ | CHIM. | HT. | ROOF | DWELL. | CONTS. | BLANKET | VALUE | DWELL. | CONTS. | ALE | DWELL. | CONTS. | ALE | TYPE | (mi.) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) |
| 95003 | 84 | 500 | 20,000 | 9 | U | U | 192,200 | 146,650 | 200,000 | 100 | 11,065 | 1,368 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 76 | 500 | 15,240 | 0 | 2 | | 174,000 | 133,000 | 152,400 | 100 | 0 | 0 | 0 | 2,755 | 0 | 0 | N | 3.5 |
| 95003 | 72 | 250 | 10,000 | 9 | U | U | 88,800 | 74,100 | 100,000 | 100 | 53,740 | 398 | 2,500 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 78 | 250 | 10,000 | 9 | U | U | 91,400 | 73,550 | 100,000 | 100 | 7,024 | 2,985 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 83 | 250 | 2,000 | 9 | U | U | 2,820 | 28,200 | 20,000 | 75 | 4,248 | 1,450 | 0 | 0 | 0 | 0 | C | 3.5 |
| 95003 | 72 | 250 | 11,600 | 1 | 1 | | 123,600 | 95,200 | 116,000 | 100 | 28 | 755 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 65 | 250 | 10,000 | 9 | U | U | 135,500 | 106,625 | 100,000 | 99 | 23,960 | 7,895 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 82 | 250 | 10,000 | 0 | 1 | | 124,600 | 95,950 | 100,000 | 100 | 382 | 853 | 0 | 59 | 0 | 0 | N | 3.5 |
| 95003 | 85 | 500 | 20,000 | 0 | H | | 214,400 | 171,300 | 200,000 | 100 | 0 | 0 | 0 | 535 | 0 | 0 | N | 3.5 |
| 95003 | 80 | 500 | 10,000 | 3 | 2 | K | 304,400 | 238,300 | 100,000 | 100 | 11,134 | 0 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 84 | 500 | 24,000 | 1 | 2 | T | 237,400 | 183,050 | 240,000 | 100 | 0 | 0 | 0 | 5,248 | 0 | 0 | N | 3.5 |
| 95003 | 79 | 1,000 | 10,000 | 1 | H | | 219,300 | 166,975 | 100,000 | 95 | 22,053 | 14,255 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 53 | 1,000 | 10,000 | 0 | 1 | | 83,200 | 64,900 | 100,000 | 95 | 3,343 | 0 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 83 | 250 | 15,000 | 1 | 2 | K | 190,000 | 145,000 | 150,000 | 100 | 14,940 | 3,099 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 75 | 1,000 | 10,000 | 9 | U | U | 283,600 | 215,200 | 100,000 | 100 | 43,107 | 9,317 | 5,000 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 87 | 250 | 8,600 | 9 | U | U | 9,370 | 98,700 | 86,000 | 100 | 5,061 | 3,229 | 0 | 0 | 0 | 0 | C | 3.5 |
| 95003 | 69 | 250 | 12,200 | 9 | U | U | 132,800 | 102,100 | 122,000 | 100 | 1,631 | 2,051 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 37 | 1,000 | 35,730 | 1 | 2 | | 360,800 | 273,100 | 357,300 | 100 | 52,252 | 24,665 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 86 | 250 | 16,500 | 0 | 1 | K | 171,200 | 130,900 | 165,000 | 100 | 0 | 0 | 0 | 1,470 | 100 | 0 | N | 3.5 |
| 95003 | 58 | 500 | 10,000 | 1 | 1 | K | 128,700 | 99,025 | 100,000 | 100 | 9,547 | 0 | 300 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 75 | 250 | 10,000 | 0 | 1 | | 118,700 | 94,025 | 100,000 | 100 | 16,768 | 1,919 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 88 | 250 | 1,000 | 9 | U | U | 5,000 | 50,000 | 10,000 | 95 | 9,619 | 381 | 0 | 0 | 0 | 0 | C | 3.5 |
| 95003 | 66 | 250 | 15,000 | 0 | 2 | K | 182,800 | 139,600 | 150,000 | 100 | 16,979 | 785 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 62 | 250 | 10,000 | 1 | 1 | | 102,000 | 79,000 | 100,000 | 100 | 0 | 0 | 0 | 910 | 0 | 0 | N | 3.5 |
| 95003 | 55 | 500 | 10,000 | 1 | 1 | K | 146,000 | 112,000 | 100,000 | 100 | 54,352 | 1,802 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 73 | 250 | 10,000 | 1 | 1 | K | 160,000 | 122,500 | 100,000 | 100 | 3,804 | 0 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 60 | 500 | 10,000 | 1 | 1 | | 92,000 | 71,500 | 100,000 | 100 | 1,026 | 0 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 65 | 500 | 10,000 | 2 | 1 | | 145,000 | 116,250 | 100,000 | 100 | 1,848 | 1,133 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 69 | 250 | 19,200 | 1 | 1 | K | 198,400 | 151,300 | 192,000 | 100 | 15,009 | 6,576 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 89 | 500 | 30,000 | 0 | 1 | | 350,000 | 277,500 | 300,000 | 100 | 0 | 0 | 0 | 2,499 | 0 | 0 | N | 3.5 |
| 95003 | 60 | 250 | 10,000 | 1 | 1 | | 153,600 | 127,700 | 100,000 | 95 | 0 | 0 | 0 | 207 | 0 | 0 | N | 3.5 |
| 95003 | 89 | 250 | 1,000 | 9 | U | U | 3,640 | 36,400 | 10,000 | 85 | 3,849 | 931 | 0 | 0 | 0 | 0 | C | 3.5 |
| 95003 | 66 | 500 | 16,000 | 1 | 2 | | 202,000 | 161,500 | 160,000 | 95 | 0 | 2,018 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 75 | 250 | 5,000 | 9 | U | U | 0 | 55,000 | 50,000 | 100 | 0 | 6,090 | 0 | 0 | 0 | 0 | T | 3.5 |
| 95003 | 63 | 250 | 10,000 | 1 | 1 | | 101,000 | 78,250 | 100,000 | 100 | 0 | 0 | 0 | 2,256 | 0 | 0 | N | 3.5 |
| 95003 | 63 | 250 | 10,000 | 1 | 1 | W | 115,000 | 88,750 | 100,000 | 100 | 26,965 | 3,500 | 3,000 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 74 | 250 | 10,000 | 1 | 2 | K | 127,800 | 98,350 | 100,000 | 100 | 1,079 | 1,103 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 89 | 500 | 10,000 | 1 | 2 | | 213,000 | 162,250 | 100,000 | 100 | 0 | 0 | 0 | 672 | 0 | 0 | N | 3.5 |
| 95003 | 86 | 500 | 10,000 | 1 | 1 | K | 107,000 | 85,250 | 100,000 | 95 | 0 | 0 | 0 | 525 | 0 | 0 | N | 3.5 |
| 95003 | 80 | 500 | 10,000 | 1 | H | C | 174,000 | 135,500 | 100,000 | 100 | 60,196 | 5,476 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 66 | 500 | 16,000 | 1 | H | | 160,000 | 122,500 | 160,000 | 95 | 13,683 | 8,230 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 70 | 250 | 10,000 | 1 | 1 | | 126,000 | 97,000 | 100,000 | 100 | 6,751 | 469 | 714 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 75 | 500 | 10,000 | 0 | 2 | | 92,200 | 74,150 | 100,000 | 100 | 0 | 0 | 0 | 0 | 100 | 0 | N | 3.5 |
| 95003 | 66 | 500 | 10,600 | 1 | 1 | | 113,400 | 95,550 | 106,000 | 100 | 6,956 | 5,800 | 0 | 0 | 0 | 0 | N | 3.5 |
| 95003 | 65 | 500 | 12,000 | 1 | 1 | | 120,000 | 92,500 | 120,000 | 100 | 2,488 | 4,445 | 0 | 0 | 0 | 0 | N | 3.5 |

together as a class probable maximum loss percentage (class PML). The class PML percentage is the aggregate loss divided by its aggregate value at zero deductible. The word "class" is normally omitted and context indicates its inclusion. A percentage PML is determined for a specific event such as the Loma Prieta earthquake, and PMLs from various earthquakes can be used as the basis for estimating the PML for different magnitude earthquakes. The percentage PML is the average within a PML zone, defined below.

### Definition Of PML Zone

The PML zone (fig. 3) is defined as that area within 6 miles (10 km) of the linear surface projection of the earthquake's line source of energy (Steinbrugge and Algermissen, 1990, p. A37). One may consider the PML zone to be a quantified form of an earthquake's macroseismal region or epicentral region. The monetary loss is assumed to be uniform throughout the zone and then to decrease beyond the zone boundary. This 6 mile (10 km) distance is the same as the customary focal depth of California earthquakes. The Loma Prieta focal depth was 17.6 km, deeper than customary. The Loma Prieta earthquake allowed the testing of this distance limit because loss data were distributed beyond the 6 mile PML zone boundary. The reasonableness of the PML zone model when applied to Loma Prieta data will be examined in a following section.

## Losses in the Loma Prieta PML Zone

Losses in the PML zone were examined from three viewpoints, each having a different objective in mind:

(1) Losses to all buildings, including those damaged or destroyed by landsliding, soil liquefaction, and other ground displacements. Their aggregate losses are unique to the Loma Prieta earthquake and are not likely to be transferable to other areas for loss estimation purposes.

(2) Losses to all buildings, excluding those where ground displacements such as landsliding, soil liquefaction, and other ground displacements occurred. Buildings may be on steep hillsides or on level land. These losses have the advantage of reducing the difficulties associated with region-specific ground displacements. There are significant uncertainties with these losses.

(3) Losses to buildings on level or gently sloping ground where no geologic hazards are known. This excludes hazards which will be later defined in the section after next on geohazards. This information has the best potential of the three for transferability to other regions where site-specific geologic information can be independently included in the loss algorithms.

**Table 6.** Number of insured dwellings from source B data grouped by decade.

[Data comprise insured dwellings, with or without earthquake coverage.]

| Age Group | Study Area: 9-County | Study Area: PML Zone[1] |
|---|---|---|
| Pre-1901 | 988 | 28 |
| 1901-09 | 1,378 | 18 |
| 1910-19 | 2,238 | 12 |
| 1920-29 | 6,028 | 80 |
| 1930-39 | 10,649 | 153 |
| 1940-49 | 21,416 | 397 |
| 1950-59 | 57,664 | 1,043 |
| 1960-69 | 60,971 | 1,805 |
| 1970-79 | 48,952 | 2,044 |
| 1980-89 | 32,242 | 1,180 |
| | 242,526 | 6,760 |

[1]PML, probable maximum loss (defined in text).

### Losses by Age Groups

Experience has shown that older wood frame dwellings are much more vulnerable to damage than are the more modern ones (Steinbrugge and Algermissen, 1990). The dividing year between older and newer dwellings has been 1940; this has been supported by loss experience from the 1971 San Fernando and 1983 Coalinga earthquakes. The validity and appropriateness of the 1940 dividing year applied to the 1989 Loma Prieta data were re-examined. Post-earthquake field observations everywhere in the study area confirmed the reasonableness of this division, although the year could be changed in some communities.

The need and appropriateness to continue this age separation is diminishing. Table 6 is an age distribution by decade of source B dwellings at the time of the earthquake. Since then, the number of pre-1940 dwellings has been slowly decreasing due to demolition. Some have been earthquake strengthened (retrofitted) and now they should be considered as being equivalent to post-1939 construction. Much of the 1940-49 construction reflects better construction as a result of the 1933 Long Beach earthquake with its resulting building code changes and changes in construction practices. Experience from the 1983 Coalinga earthquake indicated that it was reasonable to combine the 1940-49 data with the post-1949 data (Steinbrugge and Algermissen, 1990, table 17). Table 6 shows that the older buildings in the study area and also in the PML zone are comparatively few in number. Table 7 shows that the num-

**Table 7.** Homeowner insured dwellings from source B data, with or without earthquake coverage.

| Age Group | 9-County Study Area: Number of Dwellings | 9-County Study Area: Percent of Total | PML[1] Zone: Number of Dwellings | PML[1] Zone: Percent of Total |
|---|---|---|---|---|
| Pre-1940 | 21,281 | 8.8 | 291 | 4.3 |
| 1940-49 | 21,416 | 8.8 | 397 | 5.9 |
| Post-1949 | 199,829 | 82.4 | 6,072 | 89.8 |
| All ages | 242,526 | 100.0 | 6,760 | 100.0 |

[1]PML, probable maximum loss (defined in text).

**Table 8.** Paid losses to dwellings with earthquake coverage grouped by decade.

[Excludes earthquake losses paid under homeowner policies.]

| Age Group | Paid Loss, x$1000: 9-County | Paid Loss, x$1000: PML[1] Zone |
|---|---|---|
| Pre-1901 | 661 | 484 |
| 1901-09 | 373 | 87 |
| 1910-19 | 1,031 | 77 |
| 1920-29 | 2,189 | 802 |
| 1930-39 | 2,575 | 562 |
| 1940-49 | 3,696 | 1,026 |
| 1950-59 | 10,273 | 4,221 |
| 1960-69 | 22,505 | 11,443 |
| 1970-79 | 26,000 | 14,979 |
| 1989-89 | 14,756 | 8,736 |
| | 80,058 | 42,418 |
| Pre-1940 | 6,829 | 2,012 |
| Post-1939 | 73,229 | 40,406 |

[1]PML, probable maximum loss (defined in text).

ber of pre-1940 dwellings in the PML zone were fewer on a percentage basis than those for the entire study area—4.3 percent and 8.8 percent, respectively.

Of the 291 pre-1940 buildings in the PML zone, only 32 had paid insurance losses. These were too few for a meaningful PML and loss over deductible analysis. Table 8 is another viewpoint using paid losses. Although the pre-1940 dwelling failures were often of large scale and spectacular, they contributed only 4.7 percent of the total dollar loss in the PML zone from the Loma Prieta earthquake. In the study area, losses to these older buildings contributed 8.5 percent to the total.

Because pre-1940 construction will become increasingly less significant over time in loss estimation studies, our analysis from this point is primarily directed to post-1939 data. It is reasonable for future loss estimation purposes to use the post-1939 PML values for dwellings of all ages because aggregate losses will differ little for moderate to large earthquakes in California.

## Elimination of Losses Due to Major Geohazards

Topographic contours in figure 3 clearly indicate the mountainous terrain of most of the PML zone. Landslides, permanent ground displacements, and related geologic effects were common throughout the PML zone. These are defined as sites with geohazards.

The definition of geohazards is broadly interpreted to include construction sites on steep slopes where differential ground movements may or may not have been observed. For example, a wood frame house on a steeply sloping site may be one story at street level. The floor at that level is usually anchored to a reinforced concrete foundation. The rear, being downside, may have three stories of wood frame construction down to its reinforced concrete foundation. The two side walls will slope from one story to three stories. The relative structural rigidity of these walls from the first floor to the reinforced concrete foundations varies; thus, in an earthquake torsional stresses within the building can result in wall failures. Failure is more likely with weak wall sidings like fiberboard, as seen in the 1984 Morgan Hill earthquake. Numerous examples of this torsional problem were also observed in the 1992 Landers–Big Bear earthquake (EERI Newsletter, Sept. 1992, p. 6). Often it is difficult to determine if differential ground movements or torsion caused such a failure, or a combination thereof. Several such suspected Loma Prieta sites with losses have been included as geohazard losses.

It is necessary to have commonality among geologic data if information for loss estimation purposes is to be transferable among geographic areas. Commonality is also required by the PML definition because of the phrase "firm alluvial ground." This excludes dwellings in geologically hazardous areas such as landslide terrain and marshlands.

The method used to eliminate dwellings having losses due to geohazards in the Loma Prieta study area was to field investigate all buildings within 10 miles of the fault with high paid losses. Investigations were further restricted to post-1939 earthquake insured construction and to ZIPs having 100 or more earthquake policies. By the time of our inspections, repairs had usually been made and ground cracks had disappeared, but major losses were apparent when driveways and walkways led to nonexistent houses. Evidence was not as clear in the more rural and mountainous areas. Within these constraints, 176 high loss buildings were found within 10 miles of the fault. Of these, 86 buildings were in ZIP 95030; this ZIP is almost entirely in the Santa Cruz Mountains, where extensive landsliding occurred at many building sites. The remaining 90 dwellings were scattered among 17 ZIPs; almost all of

**Table 9.** Geohazard grades for dwellings in source B data.

[Dwellings are wood frame, post-1939 construction. Data limited to ZIPs which have 100 or more earthquake insured dwellings; also limited to ZIPs 10 miles or less from the fault.]

Geohazards grades:
1. Site or near vicinity examined, generally level.
2. Site or near vicinity examined, slight to moderate slopes.
3. Site or near vicinity examined, steeply sloping with significant to severe landsliding potential.
4. House gone due to landslide; remnants existed.
5. House inaccessible (locked gate, road out, and so forth) in an area of landslides or having high landslide potential.

| ZIP | ZIP To Fault (miles) | Dwellings with: Eq. Insur. | Dwellings with: Paid Loss | Dwellings with Geohazard Grade 1 | 2 | 3 | 4 | 5 | Post Office |
|---|---|---|---|---|---|---|---|---|---|
| 95076 | 2.1 | 408 | 141 | 3 | 1 | 6 | 0 | 4 | Watsonville |
| 95003 | 3.5 | 466 | 193 | 1 | 0 | 3 | 2 | 3 | Aptos |
| 95066 | 3.9 | 290 | 111 | 0 | 0 | 2 | 0 | 3 | Santa Cruz[2] |
| 95073 | 4.3 | 152 | 70 | 0 | 0 | 8 | 0 | 5 | Soquel |
| 95006 | 4.7 | 197 | 76 | 0 | 1 | 5 | 2 | 7 | Boulder Creek |
| 95005 | 4.8 | 156 | 59 | 0 | 1 | 2 | 0 | 0 | Ben Lomond |
| 95065 | 5.3 | 123 | 55 | 0 | 0 | 0 | 0 | 3 | Santa Cruz |
| 95018 | 5.5 | 152 | 63 | 0 | 1 | 4 | 0 | 0 | Felton |
| 95030[1] | 5.7 | 841 | 380 | | | | | | Los Gatos |
| 95062 | 7.5 | 258 | 64 | 3 | 0 | 0 | 0 | 0 | Santa Cruz |
| 95032 | 7.6 | 565 | 66 | 1 | 1 | 1 | 0 | 0 | Los Gatos |
| 95070 | 8.5 | 1,363 | 83 | 1 | 1 | 1 | 1 | 1 | Saratoga |
| 95060 | 8.9 | 482 | 120 | 2 | 1 | 2 | 1 | 0 | Santa Cruz |
| 95020 | 9.6 | 489 | 45 | 0 | 0 | 0 | 0 | 0 | Gilroy |
| 93907 | 10.0 | 186 | 11 | 0 | 0 | 0 | 0 | 0 | Salinas |
| 95120 | 10.0 | 1,096 | 20 | 0 | 0 | 0 | 0 | 0 | San Jose |
| 95124 | 10.0 | 1,096 | 6 | 0 | 0 | 0 | 0 | 0 | San Jose |
| 95130 | 10.0 | 322 | 18 | 0 | 0 | 0 | 0 | 0 | San Jose |

[1]This ZIP was not field inspected.
[2]Includes Scotts Valley.

these 90 (or their general sites) were field inspected. It should be noted in table 9 that the number of geohazard dwellings in a particular ZIP (columns 5 through 9) is small compared to the number of dwellings in that ZIP (column 3). Field inspections determined a geohazard grade for these dwellings, with grades defined as follows:

Grade 1: Site or near vicinity examined. Generally level.

Grade 2: Site or near vicinity examined. Slight to moderate slopes.

Grade 3: Site or near vicinity examined. Steeply sloping sites with significant to severe landsliding potential.

Grade 4: House gone due to geohazards, normally landslide. Remnants existed.

Grade 5: House inaccessible (fence across road, road out, and so forth) in an area having had landslides or having high landslide potential.

Field inspections indicated that almost all dwellings with geohazards grades 4 and 5 (table 9) had major losses associated with landsliding or land movements. Essentially all buildings having grade 3 were also undoubtedly affected by land movement or torsion, but this could not be proven in all instances. The four ZIPs at 10 miles from the fault (93907, 95120, 95124, 95130) are mostly on nearly level land; as might be expected, no large losses occurred. Increased distance from the fault was also a major contributing factor to reduction in losses.

Paid losses due to geohazards, including those in ZIP 95030, amounted to about 27 percent of all paid losses in the nine-county study area.

### PML and Loss Over Deductible

Loss over deductible data are examined on four bases: (1) ZIP basis, (2) PML zone basis, (3) Watsonville study area basis, and (4) other California experience. PMLs are examined using other California experience. The results are PML and loss over deductible data in the form of tables, graphs, and equations intended for loss estimation purposes.

Source B earthquake insurance policies allowed, in effect, a homeowner to select the deductible. The earthquake deductible was 10 percent of the amount of the earthquake policy which has a $100,000 minimum. There is no required relationship between amount of the earthquake policy and the fire policy. Therefore, building value was determined from the fire insurance policy adjusted for insurance to value.

A more precise and restrictive "high loss" definition of value was used for the PML and loss over deductible analyses. Whenever the ratio of structure loss to structure value equalled or exceeded 2/3, then this loss was correlated with its geohazard, if any. The 2/3 amount (0.667) was determined by the algorithm:

$$\frac{\text{(EQ paid loss + EQ deductible)}}{\text{(HO fire insured amount adjusted to value)}}$$

For purpose of this study, all dwellings having 2/3 loss or greater as defined above and a geohazard grade of 3 or more were deleted from the PML and loss over deductible analysis. Additionally, all dwellings in ZIP 95030, with its large number of geohazard losses in the Santa Cruz Mountains, were deleted because it became impractical to evaluate the geohazard grade at many sites.

Whenever information on a building's value, deductible, and paid loss is known, the building's loss at any deductible greater than the policy deductible can be computed. These and derived information may be summed for all buildings in any geographic grouping. Finally, each building's loss over deductible can be computed for a range of deductibles and then summed by individual ZIPs, by PML zone, and by study area as discussed in the following sections.

The methods used to determine replacement value vary among insurance companies. The California Department of Insurance conducted a data call in the winter of 1993 to examine company practices. One conclusion from this study was:

> There is a large variation in the replacement cost calculation methodology among companies. This results in variations as much as 50% in replacement cost calculations for the same dwelling. The replacement cost formulas do not ..... address the costs of hillside construction. (California Department of Insurance, unpublished data, January, 1994).

Where applicable, we considered the reliability of replacement values in our analysis.

Table 10 shows the paid losses and values for dwellings in the PML zone as a function of percent deductible. It can be seen that the majority of buildings had deductibles between 5 and 11 percent. It is also evident that determining loss over deductible values are impossible for 0 and 1 percent deductibles because of the absence of data.

There are several aspects of loss over deductible calculations which are sometimes not clearly understood. As shown in table 10, at 5 percent deductible, there were 100 dwellings of which 53 had paid losses. The loss over deductible at 5 percent deductible is thus the paid losses divided by the value of all buildings with a 5 percent deductible. If one or more of the 40 buildings at 4 percent deductible sustained losses which would have exceeded the 5 percent deductible, then these losses must be added to those stated in the previous sentence. This process is continued for all deductibles. Although a person might wish to add the deductible to the losses to obtain losses at zero deductible, these losses would not include the very numerous losses from 1 to 4 percent of value which had been excluded by the deductible. This would not produce satisfactory loss over deductible information for the lower deductibles.

**Table 10.** Paid losses and values as function of percent deductible for dwellings in PML zone.

[Data from source B; limited to wood frame, post-1939 construction and to ZIPs which had 10 or more earthquake insured buildings, excluding ZIP 95030. All values and losses in millions of dollars.]

| | Number of Bldgs. | | | Value | |
|---|---|---|---|---|---|
| Pct. Ded.[1] | All Bldgs. | Paid Loss | Paid Loss | All Bldgs. | Paid Loss Bldgs. |
| 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| 1 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| 2 | 1 | 1 | 0.03 | 0.55 | 0.55 |
| 3 | 17 | 9 | 1.46 | 6.88 | 4.39 |
| 4 | 40 | 28 | 1.52 | 10.78 | 7.83 |
| 5 | 100 | 53 | 1.89 | 20.56 | 11.17 |
| 6 | 131 | 72 | 1.31 | 23.18 | 12.48 |
| 7 | 173 | 75 | 1.71 | 27.63 | 12.06 |
| 8 | 273 | 126 | 2.35 | 39.22 | 17.92 |
| 9 | 491 | 204 | 3.30 | 72.39 | 30.45 |
| 10 | 293 | 91 | 1.44 | 40.74 | 11.97 |
| 11 | 131 | 40 | 0.36 | 14.31 | 4.32 |
| 12 | 85 | 30 | 0.34 | 9.86 | 3.13 |
| 13 | 78 | 14 | 0.15 | 7.50 | 1.33 |
| 14 | 49 | 8 | 0.18 | 5.16 | 0.61 |
| 15 | 27 | 9 | 0.13 | 2.85 | 1.08 |
| 16 | 16 | 3 | 0.03 | 1.46 | 0.29 |
| 17 | 13 | 2 | 0.02 | 0.99 | 0.12 |
| 18 | 9 | 1 | 0.01 | 1.03 | 0.06 |
| 19 | 1 | 0 | 0.00 | 0.10 | 0.00 |
| 20 | 5 | 1 | 0.00 | 0.36 | 0.10 |
| | 1,933 | 767 | 16.22 | 285.53 | 119.85 |

[1]Percent deductible is average of earthquake dollar deductible in terms of percent of value, plus or minus 0.5 percent.

### Loss Over Deductible—Zip Basis

Table 11 shows the percentage loss over deductible for all ZIPs which are not over 10 miles from the fault. All data are on wood frame dwellings built after 1939. ZIP 95030 in the Santa Cruz Mountains was not included for reasons previously discussed. Additionally excluded were all buildings having losses over 2/3 of value and which also had a geohazard grade 3 (table 9) or greater. Buildings with lower geohazard grades could have large losses which would not necessarily be due solely to geohazards. It follows that the losses over deductibles are on the high side because all geohazard related losses were not removed.

ZIPs in the PML zone are the first eight in table 11 (Watsonville through Felton). Each has a data distribution similar to that shown in table 10. The quality varies with the number of buildings and with the amount of the losses.

The aggregate dollar loss over deductible is a constantly decreasing number as the deductible becomes greater. In table 11, the 10 percent deductible (at the dotted line) is a reasonable percentage at which the data become well behaved for the 10 to 20 percent range. The greater the number of insured buildings (see bottom of table), the better the loss over deductible data become.

Our loss model assumes fairly uniform loss over deductible percentages within the PML zone; the actual distribution within the 6 mile PML zone may be seen at the 10 percent level in table 11. The greatest variation is between Felton ZIP 95018 at 2.72 percent and Ben Lomond ZIP 95005 at 1.40 percent. These are contiguous ZIPs, in mountainous terrain, and with relatively few insured buildings and losses—the small amount of data as well as the impact of omission/inclusion of one or more large geohazard losses are possible explanations.

Figure 5 provides insight into table 11 by plotting percent loss over deductible at 10 percent deductible against fault distance. Refer to the dotted orthogonal axes intersecting at 6 miles (PML boundary) and 1.0 percent. Compare the ZIP data in the upper left hand quadrant with those in the lower right hand quadrant; losses over deductible related to fault distances within and beyond the PML zone are grouped as expected. The two ZIPs in the upper right hand quadrant of figure 5 are in the city of Santa Cruz and geographically near those in the upper left hand quadrant; the reason for this scatter is not clear.

Figure 6 is a plot of average paid loss in each PML ZIP. This graph is easier to understand than figure 5 and has less data scatter. If dotted line axes were plotted through 6 miles and $5,000 loss similar to figure 5, a similar insight

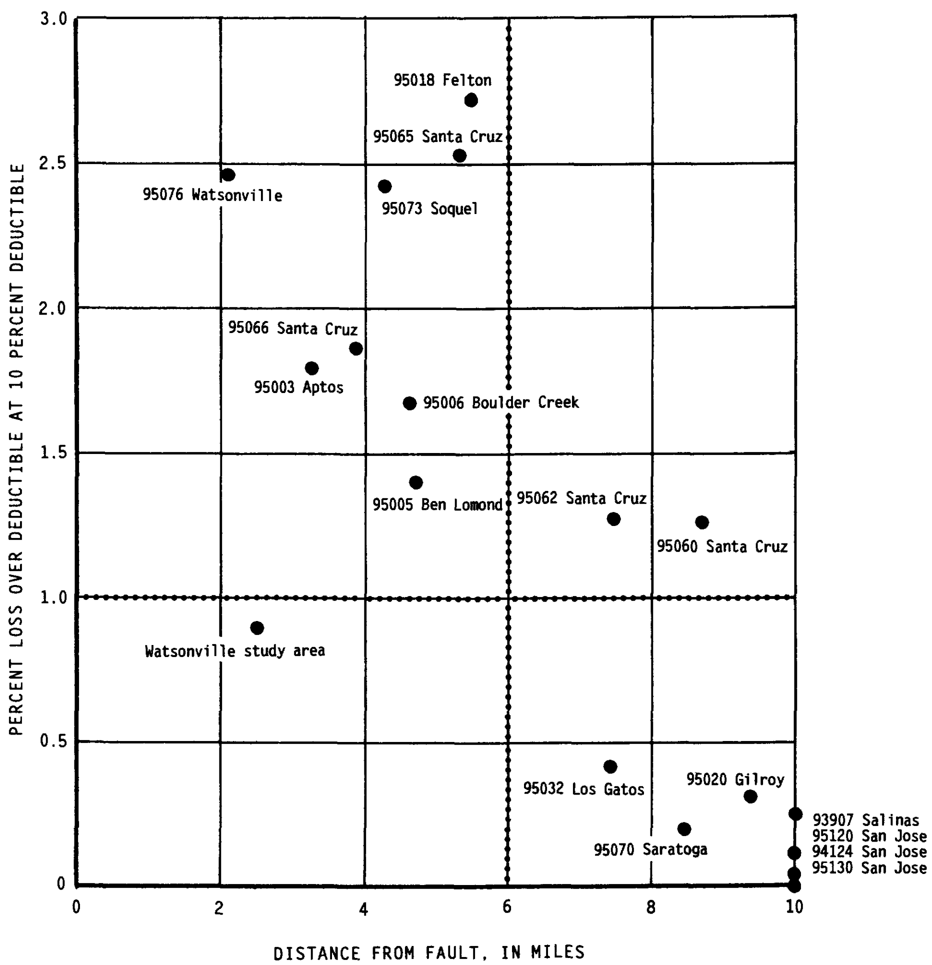



**Figure 5.** Percent loss over deductible at 10 percent deductible plotted against distance from the fault. See text for discussion. Watsonville study area is defined in section "Loss Over Deductible—Watsonville Study Area" and in figure 7.

**Table 11.** Percent loss over deductible for dwellings in ZIPs 10 miles or less from the fault as a function of percent deductible (defined in table 10).

[Data from source B and are limited to wood frame, post-1939 construction; data also limited to ZIPs which have 100 or more earthquake insured dwellings. Excluded are buildings with geohazards 3 through 5 having losses of 2/3 of value or more. ZIP 95030 excluded. Horizonal row of dots explained in text.]

| Pct. Ded. | Watson-ville ZIP 95076 | Aptos ZIP 95003 | Santa Cruz ZIP 95066 | Soquel ZIP 95073 | Boulder Creek ZIP 95006 | Ben Lomond ZIP 95005 | Santa Cruz ZIP 95065 | Felton ZIP 95018 | Santa Cruz ZIP 95062 | Los Gatos ZIP 95032 | Sara-toga ZIP 95070 | Santa Cruz ZIP 95060 | Gilroy ZIP 95020 | San Jose ZIP 95130 | San Jose ZIP 95124 | San Jose ZIP 95120 | Salinas ZIP 93907 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 0.39 | --- | --- | --- | --- | --- | --- |
| 4 | 6.07 | 4.54 | 2.45 | 3.82 | --- | --- | --- | --- | --- | --- | 0.40 | --- | 1.08 | --- | --- | --- | --- |
| 5 | 5.82 | 2.98 | 1.58 | 4.74 | --- | 4.93 | 8.59 | --- | --- | 1.31 | 0.30 | 2.69 | 0.31 | --- | 1.74 | --- | --- |
| 6 | 4.53 | 2.27 | 1.77 | 3.96 | 4.00 | 2.82 | 5.76 | --- | --- | 1.16 | 0.24 | 1.88 | 0.42 | --- | 0.45 | 0.14 | --- |
| 7 | 3.23 | 2.56 | 2.23 | 3.60 | 4.62 | 3.26 | 3.52 | 1.16 | --- | 1.00 | 0.18 | 1.98 | 0.23 | --- | 0.19 | 0.08 | --- |
| 8 | 2.41 | 2.28 | 1.81 | 3.05 | 3.20 | 2.26 | 3.23 | 2.93 | 1.69 | 0.85 | 0.13 | 1.86 | 0.39 | --- | 0.10 | 0.06 | --- |
| 9 | 2.60 | 2.17 | 1.97 | 2.58 | 2.48 | 1.43 | 3.63 | 2.53 | 2.02 | 0.68 | 0.26 | 1.29 | 0.31 | --- | 0.06 | 0.09 | 0.26 |
| 10 | 2.47 | 1.79 | 1.87 | 2.44 | 1.69 | 1.40 | 2.54 | 2.72 | 1.28 | 0.42 | 0.18 | 1.27 | 0.31 | --- | 0.04 | 0.11 | 0.25 |
| 11 | 2.14 | 1.64 | 1.70 | 2.13 | 1.47 | 1.27 | 2.17 | 2.87 | 1.21 | 0.38 | 0.16 | 1.14 | 0.32 | --- | 0.03 | 0.10 | 0.21 |
| 12 | 1.99 | 1.51 | 1.52 | 1.93 | 1.25 | 1.25 | 1.99 | 2.57 | 1.06 | 0.38 | 0.14 | 1.01 | 0.28 | --- | 0.03 | 0.09 | 0.18 |
| 13 | 1.76 | 1.36 | 1.40 | 1.73 | 1.10 | 1.10 | 1.76 | 2.37 | 0.93 | 0.32 | 0.13 | 0.89 | 0.36 | --- | 0.03 | 0.09 | 0.16 |
| 14 | 1.59 | 1.31 | 1.25 | 1.63 | 1.08 | 0.96 | 1.56 | 2.24 | 0.94 | 0.27 | 0.12 | 0.80 | 0.33 | --- | 0.02 | 0.08 | 0.14 |
| 15 | 1.49 | 1.20 | 1.14 | 1.50 | 0.93 | 0.90 | 1.39 | 2.22 | 0.87 | 0.23 | 0.11 | 0.72 | 0.30 | --- | 0.02 | 0.07 | 0.13 |
| 16 | 1.36 | 1.11 | 1.06 | 1.39 | 0.85 | 0.84 | 1.24 | 2.09 | 0.92 | 0.21 | 0.10 | 0.65 | 0.27 | --- | 0.02 | 0.07 | 0.12 |
| 17 | 1.26 | 1.03 | 0.97 | 1.29 | 0.76 | 0.78 | 1.10 | 1.95 | 0.86 | 0.18 | 0.10 | 0.59 | 0.25 | --- | 0.02 | 0.07 | 0.10 |
| 18 | 1.16 | 0.96 | 0.88 | 1.18 | 0.68 | 0.73 | 0.97 | 1.83 | 0.82 | 0.16 | 0.09 | 0.54 | 0.23 | --- | 0.02 | 0.06 | 0.09 |
| 19 | 1.08 | 0.89 | 0.80 | 1.08 | 0.60 | 0.67 | 0.89 | 1.73 | 0.77 | 0.14 | 0.08 | 0.49 | 0.21 | --- | 0.02 | 0.06 | 0.08 |
| 20 | 1.00 | 0.82 | 0.74 | 0.98 | 0.53 | 0.61 | 0.85 | 1.64 | 0.73 | 0.12 | 0.08 | 0.46 | 0.20 | --- | 0.01 | 0.06 | 0.07 |
| Fault distance, in miles: | | | | | | | | | | | | | | | | | |
| | 2.1 | 3.5 | 3.9 | 4.3 | 4.7 | 4.8 | 5.3 | 5.5 | 7.5 | 7.6 | 8.5 | 8.9 | 9.6 | 10.0 | 10.0 | 10.0 | 10.0 |
| Number of Eq. insured buildings: | | | | | | | | | | | | | | | | | |
| | 408 | 466 | 290 | 152 | 197 | 156 | 123 | 152 | 258 | 565 | 1,363 | 482 | 489 | 322 | 1,096 | 1,798 | 186 |
| Number of buildings with loss over deductible: | | | | | | | | | | | | | | | | | |
| | 141 | 193 | 111 | 70 | 76 | 59 | 55 | 63 | 64 | 66 | 83 | 120 | 45 | 6 | 20 | 52 | 11 |
| Average building value, x$1000: | | | | | | | | | | | | | | | | | |
| | 160 | 160 | 159 | 157 | 137 | 133 | 157 | 123 | 120 | 197 | 228 | 151 | 147 | 122 | 136 | 179 | 131 |
| Average value of paid loss, x$1000: | | | | | | | | | | | | | | | | | |
| | 11.94 | 7.75 | 8.62 | 15.53 | 6.80 | 5.90 | 12.03 | 6.58 | 5.00 | 3.43 | 1.64 | 5.50 | 1.84 | 0.03 | 0.16 | 0.42 | 0.75 |

would develop. Figure 5 is more informative since it includes deductibles and therefore eliminates a variable. The Watsonville study area, by itself in the lower left hand quadrant in both figures, will be discussed in the next section. Loss attenuation within the PML zone is not evident, although one could draw a line or curve through the entire 10 mile data set.

The variation in loss over deductible amounts among ZIPs may be partially attributed to construction: the number of stories, type of roof (wood, tile), masonry chimneys (or none), interior finishes, and the like. The influence of some of these construction components will be discussed later. Most probably of greater importance are geophysical factors: fault distance, directionality of seismic waves from their source, and building sites susceptible to geohazards.

The effect of geohazards on loss over deductible is shown in table 12. The effect on individual ZIPs varies from 7 to 52 percent. The reduction is 23 percent in the PML zone and is 21 percent in the 10 mile zone. The small percentage difference is due to the few losses over 10 percent beyond the PML zone—45 to 48 buildings, respectively. ZIP 95030 is excluded.

### Loss Over Deductible—Zone Basis

The information in table 11 is shown in aggregate form in columns 3 and 4 of table 13. The dots at 10 percent deductible have the same sense as those in table 11. The loss over deductibles in columns 2, 3, and 4 are better behaved at lower deductibles than those for individual ZIPs in table 11 owing to the larger data set of buildings and losses. The PML zone values in column 3 appear reasonable beyond the 5 percent deductible (table 10).

The effect of geohazard elimination in the PML zone is significant; compare columns 2 and 3 at 10 percent deductible. The effect of distance on loss is also significant; compare columns 3 and 4.

The 1983 Coalinga data shown here are for informational purposes and will be discussed below under "Other California Experience."

### Loss Over Deductible—Watsonville Study Area Basis

It has been stated that the elimination of grade 3 and higher geohazard buildings with high losses undoubtedly discounted an unknown number of losses from buildings with lessor or undetected geohazards. This undoubtedly increased the loss over deductible values for ZIPs in table 11 and for the PML zone in column 3 of table 13. It was therefore desirable to examine a test area where a better examination of the influence of geohazards on losses could be undertaken.

The City of Watsonville and the contiguous portions of the community of Freedom to the northwest were chosen for a detailed study (fig. 7). This study area consists of a small area surrounded by ZIP 95076 (fig. 4). Watsonville is the largest city entirely within the PML zone and also the closest large one to the faulting. The study area is mostly on level or gently sloping terrain. The principal exception is Struve Slough, where potential geohazards were

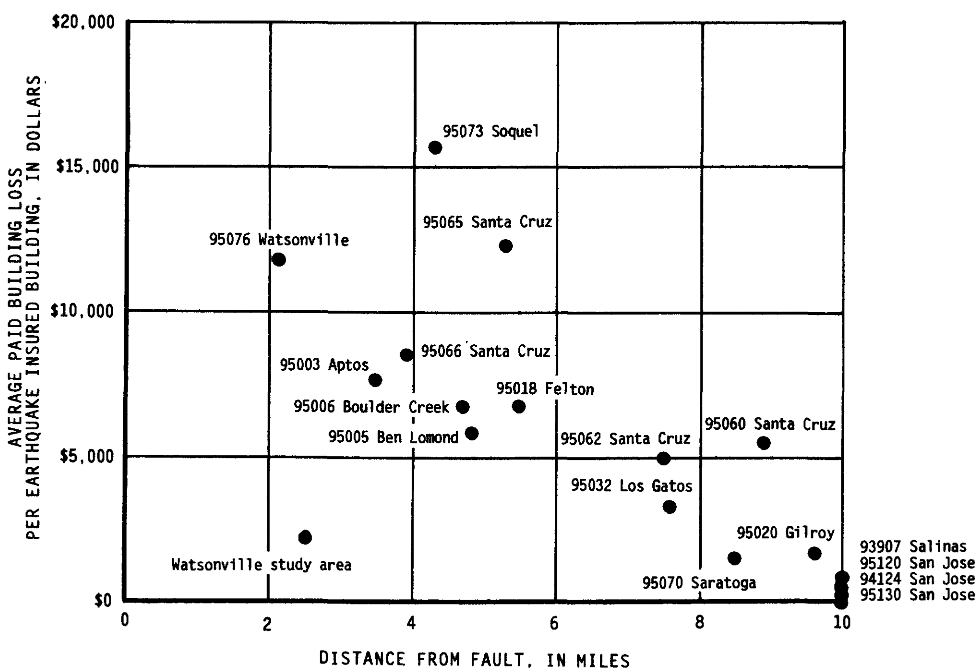



**Figure 6.** Average paid building loss per earthquake insured building plotted against distance from fault. See text for discussion.

**Table 12.** Effect of geohazards on loss over deductible in PML zone ZIPs.

[Data from source B. All buildings are within 6 miles from surface projection of the line source of faulting. Limited to wood frame post-1939 construction; also limited to ZIPs which have 100 or more earthquake insured dwellings.]

| ZIP | Distance To Fault (miles) | Percent Loss over Deductible at 10 Pct. Deductible: All Building Sites | Percent Loss over Deductible at 10 Pct. Deductible: Excluding Geohazard Sites[1] | Number of Buildings: Excluding Geohazard Sites[1] | Number of Buildings: Only at Geohazard Sites[1] | Reduction Due To Geohazard Elimination, (Pct.) |
|---|---|---|---|---|---|---|
| 95076 | 2.1 | 2.91 | 2.47 | 408 | 7 | 15 |
| 95003 | 3.5 | 2.04 | 1.79 | 466 | 6 | 12 |
| 95066 | 3.9 | 2.10 | 1.87 | 290 | 3 | 11 |
| 95073 | 4.3 | 4.13 | 2.44 | 152 | 9 | 41 |
| 95006 | 4.7 | 3.54 | 1.69 | 197 | 13 | 52 |
| 95005 | 4.8 | 1.95 | 1.40 | 156 | 2 | 28 |
| 95065 | 5.3 | 2.73 | 2.54 | 123 | 2 | 7 |
| 95018 | 5.5 | 3.23 | 2.72 | 152 | 3 | 16 |
| PML zone | -- | 2.66 | 2.06 | 1,944 | 45 | 23 |
| 10 mi zone | -- | 0.78 | 0.62 | 8,503 | 48 | 21 |

[1]Geohazard grades 3 and higher and having 2/3 building loss or greater.

**Table 13.** Percentage loss over deductible data for 1989 Loma Prieta and 1983 Coalinga earthquakes as a function of percent deductible.

[Data limited to wood frame, post-1939 construction. Loma Prieta data limited to ZIPs which had 100 or more earthquake insured dwellings. ZIP 95030 excluded. Horizontal row of dots explained in text; see also table 11.]

| Pct. Ded. | 1989 Loma Prieta Earthquake: Geohazards Included, 0-6 Miles From Fault (PML Zone) | 1989 Loma Prieta Earthquake: Excluding Geohazard Grades 3 Through 5 and Having 2/3 Loss or Greater: 0-6 Miles From Fault (PML Zone) | 1989 Loma Prieta Earthquake: Excluding Geohazard Grades 3 Through 5 and Having 2/3 Loss or Greater: 0-10 Miles From Fault | 1989 Loma Prieta Earthquake: WATSONVILLE Study Area, 2.5 Miles From Fault | 1983 COALINGA CITY[1], 6 Miles From Epic. |
|---|---|---|---|---|---|
| 0 | ... | ... | ... | ... | 4.61 |
| 1 | ... | ... | ... | ... | 3.78 |
| 2 | ... | ... | ... | ... | 3.10 |
| 3 | ... | ... | ... | ... | 2.47 |
| 4 | ... | ... | ... | ... | 1.96 |
| 5 | ... | ... | 1.15 | ... | 1.54 |
| 6 | 3.41 | 3.11 | 0.90 | ... | 1.24 |
| 7 | 3.17 | 2.91 | 0.82 | ... | 0.99 |
| 8 | 3.15 | 2.48 | 0.74 | ... | 0.78 |
| 9 | 3.15 | 2.35 | 0.74 | 1.20 | 0.66 |
| 10 ...... | 3.12 ........ | 2.06 ....... | 0.62 ......... | 0.91 .......... | 0.56 |
| 11 | 2.90 | 1.86 | 0.57 | 0.76 | 0.48 |
| 12 | 2.75 | 1.70 | 0.52 | 0.58 | 0.41 |
| 13 | 2.66 | 1.53 | 0.47 | 0.47 | 0.35 |
| 14 | 2.52 | 1.41 | 0.43 | 0.40 | 0.30 |
| 15 | 2.37 | 1.31 | 0.40 | 0.36 | 0.26 |
| 16 | 2.24 | 1.20 | 0.37 | 0.31 | 0.22 |
| 17 | 2.10 | 1.11 | 0.34 | 0.28 | 0.17 |
| 18 | 1.98 | 1.02 | 0.31 | 0.25 | 0.14 |
| 19 | 1.86 | 0.94 | 0.29 | 0.22 | 0.12 |
| 20 | 1.75 | 0.87 | 0.27 | 0.19 | 0.10 |
| Number of Eq. insured buildings: | | | | | |
| | 1,989 | 1,944 | 8,503 | 142 | ... |
| Number of buildings with paid losses: | | | | | |
| | 813 | 768 | 1,235 | 36 | 143 |
| Average value of buildings, x$1000: | | | | | |
| | 147 | 147 | 167 | 107 | ... |

[1]Steinbrugge and Algermissen, table 17, 1940-49 and post-1949 combined. Now post-1939.

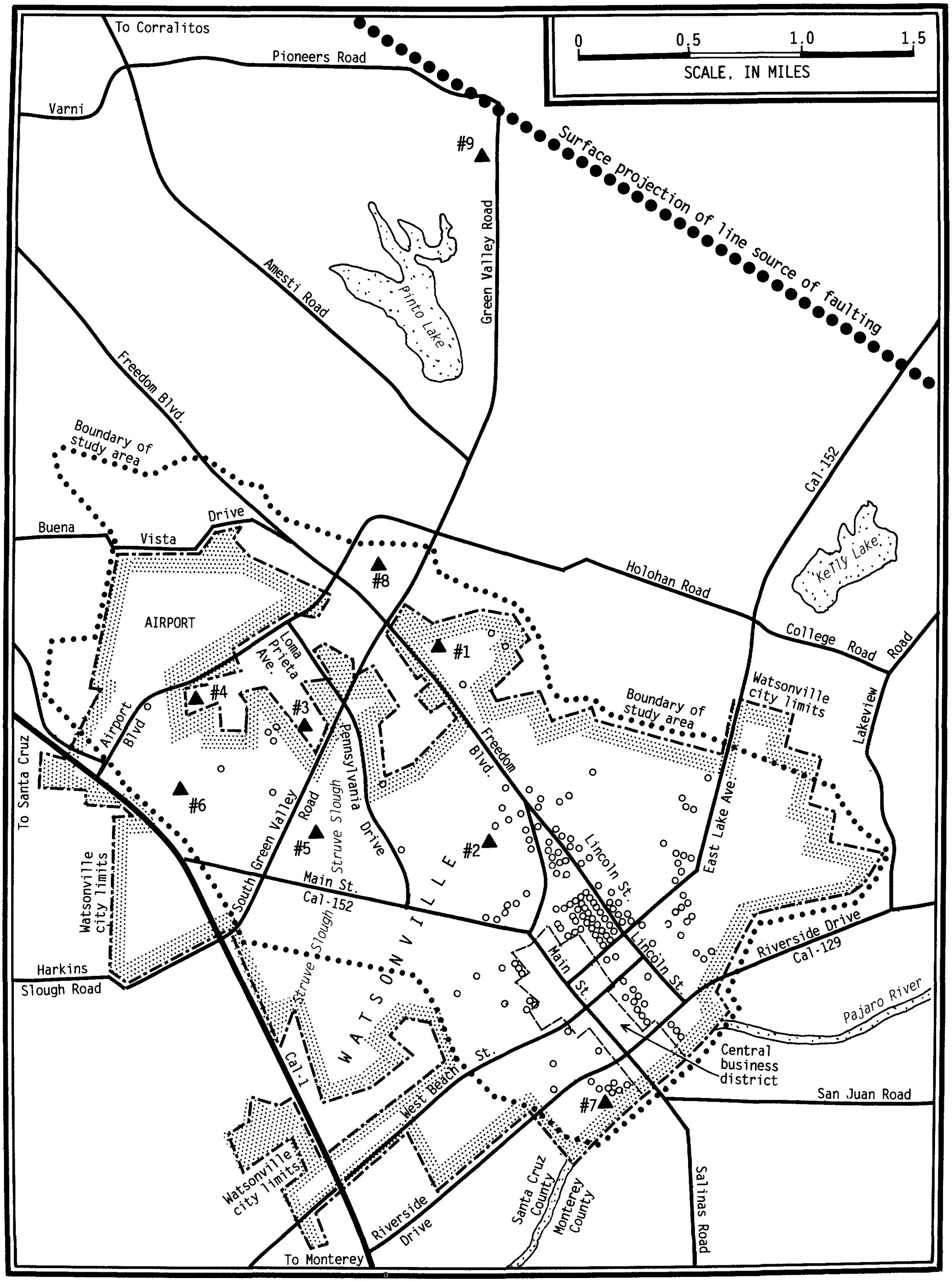



**Figure 7.** Watsonville study area and Watsonville city limits. Solid triangles are locations of mobile home parks; park numbers are identified in table 26. Open circles are structures outside of the central business district posted as hazardous after the earthquake.

found on hillsides and bottomland. This area has been developed in recent years, and most structures were expected to have had some geotechnical advice on foundations.

The study area is compact, about 3.5 miles long by 1.5 miles wide. The surface projection of the modeled earthquake's line source of seismic energy is shown in figure 7 (see also figs. 2 and 3). The centroid of all dwellings in the study area is about 2.5 miles from the surface projection of the line source. The quality of the dwelling distances from this line source must be understood in the limitations of the fault model.

Most housing in the study area is of post-1939 construction. The 1940 census states 2,829 one to four family units in Watsonville city; the 1990 census states 7,371. This represents over 250 percent growth due to post-1939 construction.

The open circles in figure 7 represent structures posted by inspectors immediately after the earthquake as "unsafe" based on the Applied Technology Council Field Manual (1989). The open circles were plotted from an unpublished City of Watsonville manuscript map which summarized the inspectors' postings. We excluded postings in the central business district and at several large industrial structures. As a result, the open circles normally represent wood frame dwellings when not located on the main thoroughfares named in figure 7. Open circles along these thoroughfares can be mercantile buildings of other than wood frame construction as well as wood frame dwellings. The "unsafe" structures were almost always of pre-1940 construction. City hall maps showing land annexations through 1930 indicated that about 75 percent of the open circle structures fell within the original city limits and these annexations. By strong contrast, the modern wood frame dwellings in the southeast section of the city had no posted "unsafe" dwellings. Many of these dwellings had concrete first floor slabs on grade and therefore did not have cripple wood studs supporting the first floor. Soil conditions in this southeastern section of Watsonville were soft alluvial materials appearing to be similar to those where high density damage was noted. Another possible soil indicator is the mapped 100 year flood limit, which may be roughly described as somewhat south of West Beach Street on fig. 7 and its northeasterly extension to the city limits.

The other newer areas of Watsonville to the northwest are on higher ground and construction is newer. Here posted "unsafe" buildings were few.

Available evidence indicates that dwelling age was the principal criteria for differences in dwelling damage and loss patterns.

In table 14, the loss over deductible at 10 percent deductible for the Watsonville study area may be compared using information from tables 11 and 12. Field inspections to identify geohazard sites were made of the post-1939 dwellings in the hill areas, including those around Struve Slough (fig. 7). The highest predeductible loss was 43.5 percent, with all others being substantially less. Some losses may have been associated with cuts and fills beneath dwellings, but no sites exceeded geohazard grade 2. The study area is surrounded by Watsonville ZIP 95076 with higher losses. Construction practices and quality were not reasonable explanations for the large differences. Seismic explanations will be later discussed in "PMLs and Equations for Loss Over Deductible."

**Table 14.** Loss over deductible comparisons at 10 percent deductible.

| Loss Over Deductible, in Percent | |
|---|---|
| Watsonville study area | 0.91 |
| Watsonville ZIP 95076 | 2.47 |
| PML zone | 2.06 |

### Loss Over Deductible—Other California Experience

The major importance of other California experience is that it provides loss over deductible information down to zero deductible, which is not available for Loma Prieta.

Table 13 information on the 1983 Coalinga earthquake is from table 17 of Steinbrugge and Algermissen (1990), revised to combine 1940-49 construction with that for post-1949 construction. This revision was for data compatibility purposes.

All further references to tables, figures, and curves in this section are to Steinbrugge and Algermissen (1990), except where otherwise stated. Information from their table 17 is shown graphically as curve 3 in their figure 4. "Curve 3 in figure 4 was considered to be the most useful for loss over deductible applications" (p. A42). Fortunately, the data source for this curve is the same as that for Loma Prieta source B, thereby eliminating most inconsistencies among insurance company loss adjusting practices.

We re-examined the choice of curve 3 among those shown in their figure 4. The following comparisons are made at zero loss over deductible for "post-49" buildings with "wood or concrete floors." The 6.60 percent for curve 4 compared to 4.29 percent for curve 3 is due to the changes in building values since all other data were the same. Building values for curve 4 were determined by two local realtors working independently. They determined average pre-earthquake market values on a city block-by-block basis, or by a group of blocks in some instances. The paid insurance losses are more realistic than the realtors' estimates based on groups of houses.

Curve 2 at 8.78 percent is the highest of the three for Coalinga. Half of this increase from curve 3 of 4.29 to 8.78 percent may be due to differences in building valuation methods discussed in the previous paragraph. The other half may be due to uncertainties in the numerical assignments to damage factors and to degrees of damage (Steinbrugge, Fowkes, and others, 1990, p. 373, under "Loss (Damage) Ratio"). In favor of curve 2 is its larger data base of 530 dwellings compared to 102 dwellings used for curve 3. On balance, the smaller amount of accurate insurance data outweighs the authors' larger data base of damage factors which were combinations of loss experience and judgment.

Curve 1 San Fernando 8.02 percent loss deficiencies are similar to those for curve 2 regarding numerical assignments to damage factors; the 8.02 percent perhaps should be reduced by 1 or 2 percent. A judgmental change of 1 or 2 percent may seem small on an individual dwelling basis, but this is certainly not true for aggregate loss estimations; see their Appendix "Sensitivity: Loss Over Deductible vs. Dwelling PML Changes." See also Steinbrugge and Algermissen (1990, p. A35), "Uncertainties Concerning Degrees of Damage."

We continue to judge curve 3 to be the best of those from previous earthquakes.

### PMLS and Equations for Loss Over Deductible

Since the Loma Prieta data did not include loss information in meaningful amounts at low deductibles, Coalinga's curve 3 (Steinbrugge and Algermissen, 1990, fig. 4) was examined as the model for the shape of the loss over deductible curve from 0 to 20 percent for Loma Prieta data. A comparison of Loma Prieta and Coalinga loss over deductible curves is shown in figure 8. The data for each earthquake were normalized to 1.00 at 10 percent deductible—see the open circle at this coordinate. Source data for this normalization were derived from tables 11 and 12. The solid curve in figure 8 is that for normalized Coalinga curve 3 data. The solid circles form a curve for the 1989 Loma Prieta PML zone. In the latter case, each dot is a computed value. A curve based on these dots correlates well from 10 to 20 percent. Below 10 percent, this curve deviates, owing to the reduced quantity of data. Not shown are similar curves for each ZIP in the PML zone; these were centered about the dotted line. The range of the curves for these eight ZIPs is shown in figure 8 at the 20 percent deductible.

The 1983 Coalinga curve 3 was the model accepted for extending the Loma Prieta data to zero deductible. The three objectives described at the beginning of "Losses in the Loma Prieta PML Zone" are now considered. Equations 1, 2, and 3 and their development which follows are for the Loma Prieta earthquake: (1) Watsonville study area, (2) PML zone excluding major geohazards, and (3) PML zone including all geohazards.

The Watsonville study area data were not shown on figure 8 since they mostly overlaid the Coalinga curve. Figure 9 is an expansion of a portion of figure 8 to include the Watsonville study area. The logarithmic equation for the normalized Watsonville study area curve shown in figure 9 is:

$$L_D = 7.165841\, e^{-0.188469\, D}$$

where

$L_D$ = percent loss over deductible, and
D = deductible in percent.

This equation is based on the normalized Coalinga curve 3 from 0 to 10 percent and normalized Watsonville study area from 10 to 20 percent. We chose to eliminate the normalization by multiplying the equation by 0.91 (percent loss over deductible at 10 percent deductible), which is the

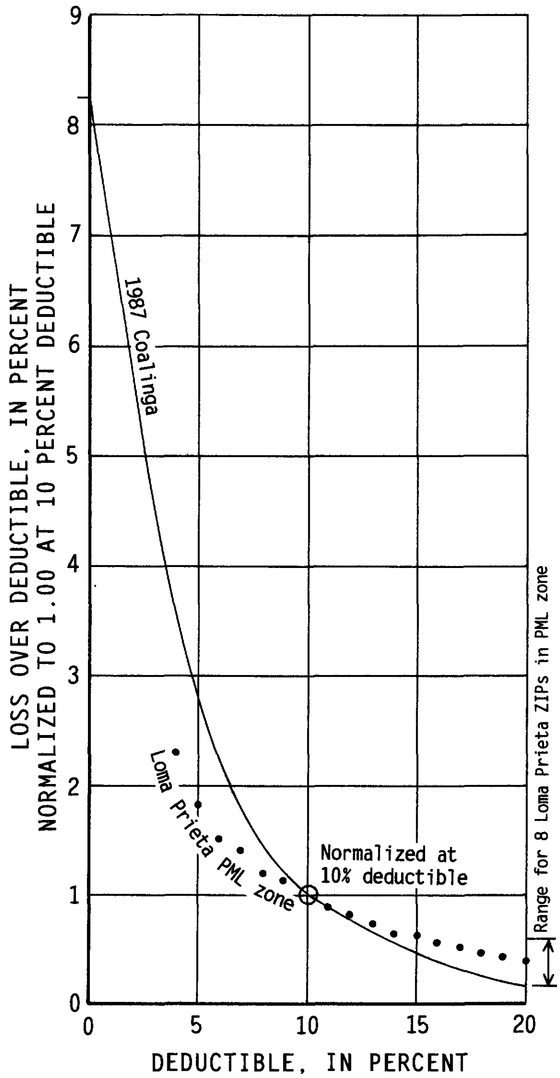



**Figure 8.** Loma Prieta and Coalinga loss over deductible data with each normalized at 10 percent deductible. Also shown is the range of normalized loss over deductible data for all ZIPs in the PML zone at 20 percent deductible.

same number used in normalizing (table 13, column 5). The equation for the Watsonville study area becomes

$$L_D = 6.520915\, e^{-0.188469\, D} \qquad (1)$$

The PML is 6.5 percent by substituting zero for D; it is for post-1939 wood frame construction. The quality of the PML relies on the assumption that Coalinga curve 3 can be validly extended to zero deductible. A caveat lies in the small size of the data sample compared to that for the entire PML zone. In its favor is that geohazards are not a factor.

Equation 2 is the loss over deductible for the PML zone excluding identified geohazard sites 3 through 5 and having losses equal to or greater than 2/3. (Subsequent examination showed that the omission of the 2/3 criteria has little effect on the results from equation 2.) The equation was developed from the data for normalized Coalinga curve 3 from 0 to 10 percent and from the normalized PML zone data for 10 to 20 percent (table 13). Using the normalization factor of 2.06 from column 3 in table 13, the loss over the deductible for the PML zone excluding geohazards becomes

$$L_D = 12.38043\, e^{-0.148801\, D} \qquad (2)$$

The correlation between the PML zone data and Coalinga curve 3 in figure 9 is not as good as that for the Watsonville study area data and that for Coalinga. It is probable that the quality of the 12.4 percent PML from equation 2 is also not as good.

Equation 3 is for loss over deductible when geohazards are included. Also included are dwellings in ZIP 95030, which was not part of the two previous equations. Utilizing the normalization factor of 3.12 in a manner similar to before; the loss over deductible for the PML zone including geohazards becomes

$$L_D = 17.464163\, e^{-0.133153\, D} \qquad (3)$$

The PML is 17.5 percent from equation 3. This PML can be partially verified by determining its lower limit when dividing all paid losses plus their deductibles by the value of all dwellings; this results in 15.6 percent. This appears to be a reasonable value.

Equations 1, 2, and 3 have the following meanings for the Loma Prieta PML zone. Equation 1 applies to buildings in large areas of level and gently sloping firm alluvial soils at distances from mountains. Equation 2 applies to buildings in mountainous terrain and steeply sloping hillsides where landsliding and other geohazards do not damage housing or are not included. Equation 3 is specific for the Loma Prieta earthquake. Damage in this earthquake from ground displacements such as landslides was minimal owing to several years of drought. This same earthquake after several years of unseasonably wet weather would have resulted in greater losses, and equation 3 would thus not be representative.

A comparison between Coalinga curve 3 and the Watsonville study area shows no apparent inconsistencies. The PML increases with magnitude as expected:

| | PML Percent | Magnitude |
|---|---|---|
| Coalinga curve 3 | 4.61 | 6.7 |
| Watsonville study area | 6.52 | 7.1 |

The Coalinga 4.61 percent PML is from table 13, last column.

As a general observation, loss estimation is almost always weak for light damage from 0 to 5 percent of value. For example, at what amount of wall and ceiling cracking should the entire room be repainted instead of just matching the color and repainting the patch? Was the room

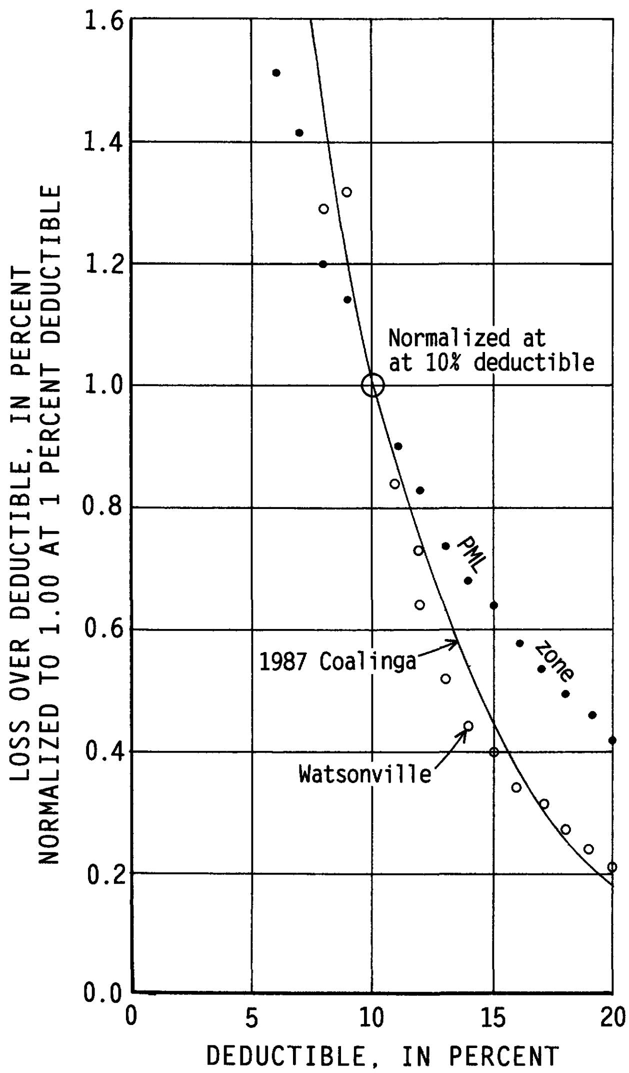



**Figure 9.** Expansion of a portion of figure 8 including the Watsonville study area. The Watsonville study area data essentially overlaid the Coalinga curve in figure 8. The solid circles are for the Loma Prieta PML zone. The open circles are for the Watsonville study area.

badly in need of repainting before the event and if so, should its depreciated value be considered? Parallels exist with a new or old automobile receiving a small dent of unknown origin in the case of no deductible. The amount of the loss as viewed by the owner is often based on who is going to pay the loss. Practices differ among insurance companies with respect to dwellings, but often depreciated value is not considered for repainting purposes.

## Size of the PML Zone

### Loma Prieta Earthquake

As seen from figures 5 and 6, the 6-mile limit to the PML zone for the Loma Prieta event is a reasonable value. Guidelines for damage attenuation within the PML zone are difficult to ascertain because of ambiguous data. For the present it remains reasonable to use a simplistic average value for the PML zone.

### Smaller Magnitude Earthquakes

Studies of instrumental data (Cloud and Perez, 1967) from the 1966 Parkfield, California, earthquake provide insights into the PML zone boundary. The earthquake's magnitude was about 5.5, and surface faulting was observed. Five accelerograms were obtained within 10 miles of the trace of the San Andreas fault. Cloud and Perez (1967, fig. 10) suggested no reduction in the acceleration from the observed fault trace to 3.3 miles from the trace and comparatively little reduction at 5.7 miles. This is a rural area having only widely scattered dwellings, and no quantified dwelling losses are known. Somewhat surprisingly, the 5.7-mile distance agrees well with the PML boundary but by no means substantiates it as a universal value.

Another insight from the Parkfield earthquake is by Housner and Trifunac (1967):

> Integrated velocities and displacements show that near the fault at Cholame the surface motion exhibited a transient horizontal displacement pulse of approximately ten inches amplitude and one and one-half seconds duration, normal to the fault. Although 50 per cent of g ground acceleration was recorded at the fault, the ground motion attenuated rapidly with distance and at ten miles from the fault the maximum acceleration was reduced to one-tenth of its near-fault value..... (from paper's abstract)

The Parkfield earthquake was unusual in its pulselike shock and was quite different from the Loma Prieta event in this respect. All earthquakes examined in this study were different from each other in one or more respects, and this variability will probably be the future norm.

Magnitude 5 is usually near the threshold for significant monetary losses, admitting that small losses do occur in smaller earthquakes. Small magnitude earthquakes may be considered as a point source rather than as a line source, in which case the PML zone is bounded by a 6-mile- radius circle. Losses from earthquakes of magnitude 5 to 5.5 are usually confined to areas much smaller than this circular PML zone; aggregate losses are small.

The 1969 Santa Rosa, California, 5.6 and 5.7 magnitude earthquakes, were separated in time by somewhat more than an hour and are examples of circular PMLs. Generalized dwelling losses and their geographic distribution were mapped (Steinbrugge, 1970, fig. 18). The higher losses were within a 1 mile radius of the center of these losses. Dollar losses were estimated at $1,370,000 (1969 dollars) for a city with a population of then 50,000. Dwelling damage was predominately to older houses, and figure 18 overstates the post-1939 losses in the city of Santa Rosa. It has been suggested that damage was intensified by local geologic conditions (Steinbrugge, 1970, p. 52).

The 1957 San Francisco (Daly City), California, earthquake is a second example (Steinbrugge and others, 1959). Dwelling damage in this magnitude 5.3 shock was typically considerably less than 5 percent, and only in isolated cases did it exceed 5 percent. Houses were constructed shortly before earthquake, and some were still under construction. The majority of the dwelling damage was confined to sites along a high bluff area about 1½ miles long and less than half a mile wide (Steinbrugge and others, 1959, fig. 1). There were examples of permanent ground displacement in the form of buckled concrete sidewalks and street curbs. For this earthquake, the 6 mile PML zone is clearly too large. Damage was accentuated by slumping of the bluff. Landsliding occurred again to the same bluff in the 1989 Loma Prieta earthquake.

A 6-mile PML zone is too large for most magnitude 5 to 5.5 earthquakes because dwelling damage, especially on firm ground, is confined to a relatively small area. This can be simplistically taken into account by using or estimating total dwelling losses from events such as the two above examples, then dividing each respective total losses by its estimated total dwelling values. Although crude, such estimated values are better than those previously determined by extrapolation from larger earthquakes.

### 1906 San Francisco Earthquake

We consider the maximum credible magnitude earthquake for practical loss estimation purposes to be $M_S$ 8.25 for the San Andreas fault in the San Francisco Bay region and also in southern California. No reliable contemporary quantified monetary dwelling loss estimates exist for this magnitude (Lawson, 1908). Relevant quantified contemporary information was summarized in Steinbrugge and Algermissen (1990, p. A37/A38):

> Only the 1906 San Francisco earthquake has usable loss experience for wood frame dwellings on firm soil in the near vicinity of a great earthquake. Over 1,000 houses were examined immediately after that earthquake in the cities from Belmont to Redwood

City. All houses were within 1 to 4 miles from the San Andreas fault. Damage information is found in Lawson (1908), beginning on page 354 of volume I, part II.

Some comparisons between 1906 San Francisco and 1983 Coalinga are of interest. In 1906, the dwelling foundations were unreinforced brick, unreinforced concrete, or wood. Foundation anchorage generally did not exist by today's standards. Of 842 houses, 190 moved on their foundations, or 23% moved. In Coalinga in 1983, 11% of all houses moved a measurable amount; 24% of all pre-1940 houses also moved a measurable amount (Steinbrugge and others, 1990). Interestingly, the older Coalinga dwellings shifted in percentage terms as much as did the 1906 example. Admittedly, wood frame dwelling construction, including foundations, were different.

Brick chimneys were not reinforced in 1906. Of 1,097 brick chimneys examined, 88% fell. In Coalinga, 130 pre-1949 chimneys had at least moderate damage out of 158, or 82%. Again, the comparison is of interest since damage percentages are similar.

The 1989 Loma Prieta data did not have unreinforced brick masonry chimney information to allow comparisons with the 1906 San Francisco experience.

Photographs of 1906 San Francisco surface faulting showing wood frame structures rarely revealed severe damage for structures not astride ground rupture. See, for examples, Lawson (1908), v.1, part 1, plates 32C, 37A, 38D, 45B, 46B, 49A, and 52B. In no way was there total damage near the 1906 faulting.

Quantified loss information for the City of San Francisco after the 1906 earthquake is not available. Intensities and surficial geology on pages 17 and 19 in Lawson (atlas) are the best contemporary descriptions of damage to all classes of structures. Excluding the geohazard areas and the burned area (map 20), intensity D predominates. This intensity with respect to wood frame dwellings was defined in Lawson (v. 1, p. 225) as "comprises general but not universal fall of chimneys; .... a few isolated cases of lurching or listing of frame buildings built upon weak underpinning structures." Many photographs taken during and immediately after the ensuing fire bear out this observation; one may examine the photo collection at the Earthquake Engineering Research Center, Univ. of California, Berkeley.

Freeman (p. 282) concluded:

At San Francisco, not long after the quake and fire of 1906, the writer spent a week or more in a careful study of the ruins, and was again impressed with the number of buildings that had successfully resisted the earthquake shock, both inside and outside the limits of the conflagration. He found there was a lot to be learned about the general absence of serious earthquake effects west of Van Ness Avenue where the conflagration had not extended, and in the large cities across the bay.

Wood frame dwelling construction was the principal type west of Van Ness Avenue. This avenue is between 7 to 8 miles from the San Andreas fault.

In summary, the 6 mile PML zone is reasonable for moderate earthquakes based on current knowledge. It has limitations when applied to small magnitude earthquakes, but errors in aggregate dwelling losses for these small shaken areas are normally not significant for California loss estimation purposes compared to those from major shocks.

As a postscript, a repeat of the 1933 Long Beach earthquake on the San Andreas fault in the near vicinity of San Francisco would not cause as much damage as its repeat in the Los Angeles basin. This is because the San Andreas fault is partly offshore or in lightly populated areas while the opposite tends to be true for Long Beach.

## Estimation of Loss Over Deductible and PMLs for Other Magnitudes

### Post-1939 Construction

The model for loss over deductible in the PML zone varying as a function of magnitude has these broadly based assumptions:

(1) The amount of seismic energy released per unit length of the line source is uniform for the entire length of the rupture.
(2) The characteristics of energy release are sufficiently similar among earthquakes and are uniform despite differing geologic environments at depth.
(3) The short period components of ground motion are similar among earthquakes at similar distances from the energy release, providing that surficial geologic environments are similar.
(4) The 6 mile PML zone is reasonable for magnitudes greater than that for Loma Prieta.

The Loma Prieta subsurface rupture length was 40 kilometers (25 miles). A magnitude 8.25 earthquake such as a repeat of the 1906 San Francisco earthquake would likely cause 250 to 300 miles of faulting with an assumed uniform energy release along the entire length of the faulting. Should the earthquake be very great, such as the 1964 Alaskan earthquake, the duration of principally long period motions at distant sites may be in terms of minutes (Steinbrugge and others, 1967, v. 2, part A, p. 13, under "Duration of Shaking"). The shaking duration will increase damage. However in both of these examples, most of the energy would originate many miles away from any site near the fault and would be dominated at the site by long period motions. These long period motions would contribute very little to additional damage to dwellings at distant sites near the fault. This is not true at geohazard sites such as those with liquefiable soils.

Including magnitude as a variable in equation 1 is based on these continuing assumptions:

(5) Magnitude 5 approaches the threshold of damage and loss, wherein some dwelling damage can be expected.

(6) A linear relationship is reasonable for a first approximation between losses over deductibles and magnitudes.

(7) The PML for short period structures such as wood frame dwellings does not significantly increase beyond magnitude 7.75. The rupture length and the area of the PML zone increases with increased magnitude, the aggregate losses increase, but not the percent PML beyond 7.75. The upper limit is user-selectable to 8.5 for the purposes of the equations which follow.

Equations 1, 2, and 3 are appropriate only for Loma Prieta since the influence of Coalinga curve 3 was limited to the extrapolation of data from 10 to 0 percent. Equations applicable to other earthquakes must include Coalinga as well as Loma Prieta. Equation 4 is for Coalinga data:

$$L_D = 4.110062\, e^{-0.188686\, D} \qquad (4)$$

As might be expected, the exponent differs very little from that of equation 1. The PMLs differ since the magnitudes are different. It follows that curves with different magnitudes are offset by a constant determined by the ratio of the PMLs. For example, using equations 1 and 4, the offset ratio is 4.110062 divided by 6.520915, or 0.630. The visual effect of differing magnitudes may be seen in figure 10, discussed below and using equation 7.

Giving equal weight to both earthquakes, an averaged equation which locates its curve midway between the Watsonville study area and Coalinga curves becomes:

$$L_D = 5.315489\, e^{-0.188469\, D} \qquad (5)$$

applicable for magnitude 6.9, midway between the other earthquake magnitudes. The Watsonville exponent was chosen.

Curves for magnitudes smaller than 6.9 are based on a linear extrapolation to magnitude 5, which is the threshold of building damage. The threshold loss at magnitude 5 for California earthquakes is usually concentrated in a small area which is far smaller than its PML zone. As a result, the percentage loss over deductible is small for the PML zone. In the 1969 Santa Rosa earthquakes (magnitudes of 5.6 and 5.7), the damage was concentrated in about 3 percent of its PML zone (Steinbrugge, 1970, fig. 8). The 1957 Daly City (San Francisco) earthquake had similar results for its magnitude 5.3 earthquake (Steinbrugge and others, 1959). The threshold PML has been conservatively estimated at 0.5 percent.

A linear relationship is next determined between magnitude and loss over deductible at zero deductible (PML). The minimum value is 0.5 percent loss over deductible at zero deductible; the maximum value is the PML of 5.315 percent from equation 5. The relationship is:

$$PML = 2.534468\,(M - 5) + 0.5 \qquad (6)$$

where M = magnitude.

Replacing the PML value in equation 5 by equation 6, the variable deductible, magnitude, and uncertainty factor become:

$$L_D = [2.534468\,(M - 5) + 0.5]\, e^{-0.188469\, D} \times F \qquad (7)$$

where F = user-selected uncertainty factor, and where $L_D$ may be limited at magnitude 7.75 at the user's option.

An "uncertainty factor" (F) was introduced in equation 7. The equations for loss estimation purposes when applied for loss estimation purposes within California must be tempered by the many limitations which already

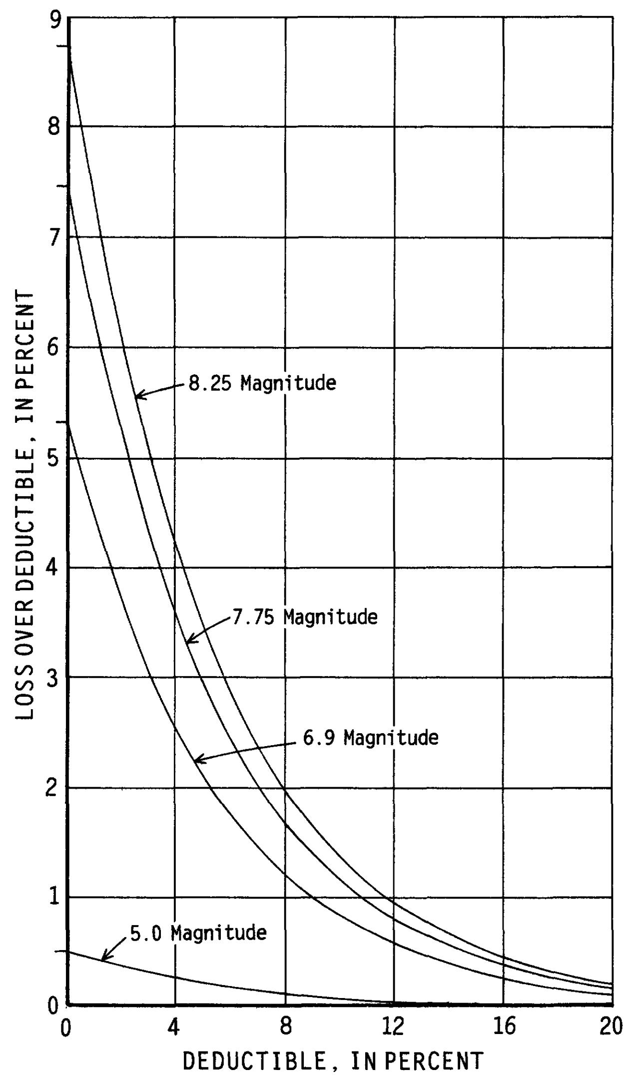



**Figure 10.** Loss over deductible for magnitudes 5 (threshold of building damage); magnitude 6.9 (equation 5, basis for equation 7); 7.75 (reasonable upper limit), and 8.25 (1906 San Francisco with no upper limit). Curves from equation 7 with uncertainty factor of 1.0.

**Table 15.** Percentage loss over deductible as a function of percent deductible for varying earthquake magnitudes.

[Uncertainty factor = 1. Applicable for post-1939 wood frame dwelling in California. Based on equation 7.]

| Percent Deductible | Magnitude | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5.00 | 5.25 | 5.50 | 5.75 | 6.00 | 6.25 | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 |
| 0 | 0.50 | 1.13 | 1.77 | 2.40 | 3.03 | 3.67 | 4.30 | 4.94 | 5.57 | 6.20 | 6.84 | 7.47 | 8.10 | 8.74 |
| 1 | 0.41 | 0.94 | 1.46 | 1.99 | 2.51 | 3.04 | 3.56 | 4.09 | 4.61 | 5.14 | 5.66 | 6.19 | 6.71 | 7.24 |
| 2 | 0.34 | 0.78 | 1.21 | 1.65 | 2.08 | 2.52 | 2.95 | 3.39 | 3.82 | 4.25 | 4.69 | 5.12 | 5.56 | 5.99 |
| 3 | 0.28 | 0.64 | 1.00 | 1.36 | 1.72 | 2.08 | 2.44 | 2.80 | 3.16 | 3.52 | 3.88 | 4.24 | 4.60 | 4.96 |
| 4 | 0.24 | 0.53 | 0.83 | 1.13 | 1.43 | 1.73 | 2.02 | 2.32 | 2.62 | 2.92 | 3.22 | 3.51 | 3.81 | 4.11 |
| 5 | 0.19 | 0.44 | 0.69 | 0.93 | 1.18 | 1.43 | 1.68 | 1.92 | 2.17 | 2.42 | 2.66 | 2.91 | 3.16 | 3.40 |
| 6 | 0.16 | 0.37 | 0.57 | 0.77 | 0.98 | 1.18 | 1.39 | 1.59 | 1.80 | 2.00 | 2.21 | 2.41 | 2.62 | 2.82 |
| 7 | 0.13 | 0.30 | 0.47 | 0.64 | 0.81 | 0.98 | 1.15 | 1.32 | 1.49 | 1.66 | 1.83 | 2.00 | 2.17 | 2.34 |
| 8 | 0.11 | 0.25 | 0.39 | 0.53 | 0.67 | 0.81 | 0.95 | 1.09 | 1.23 | 1.37 | 1.51 | 1.65 | 1.79 | 1.93 |
| 9 | 0.09 | 0.21 | 0.32 | 0.44 | 0.56 | 0.67 | 0.79 | 0.91 | 1.02 | 1.14 | 1.25 | 1.37 | 1.49 | 1.60 |
| 10 | 0.08 | 0.17 | 0.27 | 0.36 | 0.46 | 0.56 | 0.65 | 0.75 | 0.85 | 0.94 | 1.04 | 1.13 | 1.23 | 1.33 |
| 11 | 0.06 | 0.14 | 0.22 | 0.30 | 0.38 | 0.46 | 0.54 | 0.62 | 0.70 | 0.78 | 0.86 | 0.94 | 1.02 | 1.10 |
| 12 | 0.05 | 0.12 | 0.18 | 0.25 | 0.32 | 0.38 | 0.45 | 0.51 | 0.58 | 0.65 | 0.71 | 0.78 | 0.84 | 0.91 |
| 13 | 0.04 | 0.10 | 0.15 | 0.21 | 0.26 | 0.32 | 0.37 | 0.43 | 0.48 | 0.54 | 0.59 | 0.64 | 0.70 | 0.75 |
| 14 | 0.04 | 0.08 | 0.13 | 0.17 | 0.22 | 0.26 | 0.31 | 0.35 | 0.40 | 0.44 | 0.49 | 0.53 | 0.58 | 0.62 |
| 15 | 0.03 | 0.07 | 0.10 | 0.14 | 0.18 | 0.22 | 0.25 | 0.29 | 0.33 | 0.37 | 0.40 | 0.44 | 0.48 | 0.52 |
| 16 | 0.02 | 0.06 | 0.09 | 0.12 | 0.15 | 0.18 | 0.21 | 0.24 | 0.27 | 0.30 | 0.34 | 0.37 | 0.40 | 0.43 |
| 17 | 0.02 | 0.05 | 0.07 | 0.10 | 0.12 | 0.15 | 0.17 | 0.20 | 0.23 | 0.25 | 0.28 | 0.30 | 0.33 | 0.35 |
| 18 | 0.02 | 0.04 | 0.06 | 0.08 | 0.10 | 0.12 | 0.14 | 0.17 | 0.19 | 0.21 | 0.23 | 0.25 | 0.27 | 0.29 |
| 19 | 0.01 | 0.03 | 0.05 | 0.07 | 0.08 | 0.10 | 0.12 | 0.14 | 0.16 | 0.17 | 0.19 | 0.21 | 0.23 | 0.24 |
| 20 | 0.01 | 0.03 | 0.04 | 0.06 | 0.07 | 0.08 | 0.10 | 0.11 | 0.13 | 0.14 | 0.16 | 0.17 | 0.19 | 0.20 |

have been discussed. This factor may be viewed as being similar to the factor of safety found in building and airplane design, in fused electric systems, and the like. It differs in that this uncertainty factor involves only economic loss and does not involve life loss and injury. As a consequence, users have a wide latitude in the selection of an uncertainty factor. They are urged to examine the model and the data and to select an uncertainty factor to suit their need and their comfort level.

Figure 10 is a graphical representation of equation 7 with an uncertainty factor (F) equal to 1. Curves are shown for: magnitude 5, threshold of damage; magnitude 6.9, average of Watsonville study area and Coalinga; magnitude 7.75, optional limit based on rupture length; and magnitude 8.25, the 1906 San Francisco earthquake. Table 15 is a tabular representation of equation 7.

Equation 7 is simpler and quite different from its post-1939 counterpart found in Steinbrugge and Algermissen (1990, p. 60) because of the new Loma Prieta data. The previous PML for magnitude 8.25 with an uncertainty factor of 1 was 4.33 percent; here equation 7 increased the PML to 8.72 percent. Using magnitude 7.75 as the upper limit instead of 8.25, then the 8.72 percent PML would be reduced to 7.46 percent.

The precision of the equations exceed their accuracy. We judge the computational results to be reasonable to one and one-half significant figures, at best. The best reliability is between 5 and 15 percent deductibles and between magnitudes 6 and 7.5. It remains to be seen how future earthquakes will affect the equations.

### 1992 Landers Earthquake: California Residential Earthquake Recovery Plan Deductible

Subsequent to the Loma Prieta event, the Landers earthquake of June 28, 1992, provided a partial opportunity to examine equation 7 at low deductibles. Loss information came from the California Residential Earthquake Recovery [Insurance] Plan (CRER). This insurance program, enacted by the California legislature, was in existence for a short period of time before being repealed. Seventeen California earthquakes occurred during the operation of this plan, all in 1992. The Landers earthquake was the only one which contributed a useful amount of data.

Both the CRER deductible and maximum amount of the policy were low, thereby allowing first loss insurance coverage not available in the commercial market. The deductible was one-half of one percent of the amount of the homeowners fire insurance policy, but not less that $1,000. The maximum amount of CRER earthquake insurance was $15,000. A total of 4,341 post-1939 wood frame dwellings had losses over their deductible and with damage not exceeding the $15,000 policy limit. The dollar deductible when converted to a percentage ranged from 0.5 to 3 percent for almost all of these dwellings.

The number of insured dwellings having losses or losses under the deductible was not available. This meant that equation 7 could not be confirmed by Landers data at low deductibles, but the slope of both curves could be examined by normalization. Figure 11 shows the equation 7 curve and also the Landers data, normalized at one percent. Slope differences are substantial—see the upper right hand corner of this figure. One reason is apparently due to insurance adjustor practices regarding losses at or just over the deductible. About 66 percent of the claims were between 0.75 and 1.75 percent deductible. There are other problem areas when quantifying very small losses; see the last paragraph of "PMLs and Equations For Loss Over Deductible," above.

Referring again to the upper right hand corner of figure 11, the Landers normalized data were nearly identical for the range between the 0 to 6 mile PML zone to 0 to 40 miles from the fault. This suggests that the slope of the curve remains reasonably constant for this range of distances at low deductibles.

**Pre-1940 Construction**

The previous discussion under "Losses by Age Group" ruled out any meaningful loss over deductible equations for pre-1940 construction. In the absence of adequate new data, these and the PML may be estimated by using the PML ratio from equations 4 and 5 of Steinbrugge and Algermissen (1990, p. A60), being 2.3. An approximate pre-1940 estimate would be to double the values determined by equation 7 in the present study.

However, the need for pre-1940 information elsewhere throughout California is limited. Contemporary Department of Insurance records provided statewide information on the

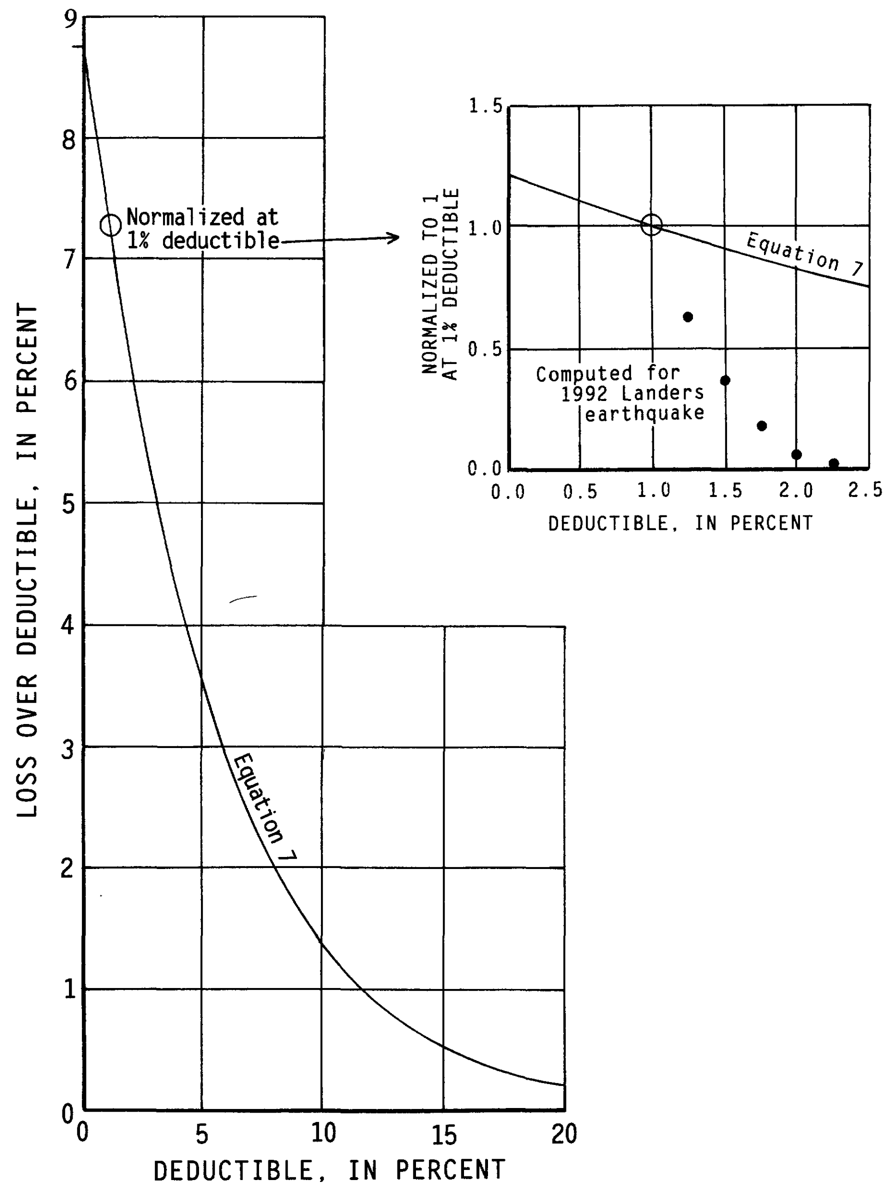



**Figure 11.** Equation 7 loss over deductible curve compared with Landers earthquake data. Upper right hand corner shows slope comparisons at 1 percent normalization.

building value of all fire insurance policies. The dividing age was post-1940 instead of post-1939. The percentage of value of the older (pre-1940) to total value was:

5.8 percent, source B,
7.1 percent, three largest companies, including source B.

These three companies had slightly over a 50 percent market share of California and represented values exceeding $250 billion. The value of the older housing stock as a percentage of the total value will be constantly decreasing. Earthquake retrofitting will effectively remove older housing from the more vulnerable category.

## Dwelling Contents Losses

While the paid contents losses are accurate, contents values are generally considered to be of poor quality. Building values can be reasonably determined on a square foot basis. No good counterpart exists for contents values unless they are scheduled items with appraised values.

The model used for estimating contents loss is based on the premise that contents damage and their losses have a relationship to the amount of building damage. Both building and contents are subjected to short period ground motions. Duration of strong shaking will produce increasing amounts of damage to both contents and building.

This model is appropriate while the building maintains its integrity. Decrease in structural integrity becomes increasingly common after 50 percent building losses; these losses are usually associated with geohazards in post-1939 construction. Damage below 50 percent generally indicates that large sections of ceilings did not fall. Chimney failure may not result in major contents damage, and very small permanent ground displacements probably will have little effect on building and contents damage.

Table 16 shows contents loss as a percentage of paid building loss, that is, as the percent loss over the building deductible. The data are most reliable in the deductible range of 5 to 10 percent. Those below 5 percent and over 10 percent had a rapidly decreasing number of dwellings in their data base. It will be recalled that source B deductibles were a variable dollar deductible which converted to a wide range of percent deductibles.

An example may give insight on how the information can be used. At 10 percent deductible for the nine-county study area, the contents loss as a percent of the paid building loss (loss over deductible) was 24.7 percent. Assume a $100,000 building with a $10,000 deductible and a loss over the deductible of $7,000. The contents loss would be 0.247×$7,000, or $1,729.

The percentages in each of the four study areas, particularly in the 5 to 10 percent of each range, indicate a uniform percentage. The bottom of the table shows building weighted averages for the entire range from 1 to 20

**Table 16.** Contents loss as percent of building loss as a function of percent deductible.

[Source B deductible data, in dollars, converted to percent deductible. Converted deductibles grouped plus or minus 0.5 percent.]

| | Contents Loss as Percent of Paid Building Loss | | | |
|---|---|---|---|---|
| Pct. Ded. | 9-County Study Area | PML Zone | PML Zone, Excluding ZIP 95030 | Within 10 Miles Of Fault, Excluding PML Zone |
| 1 | 27.3 | 83.3 | 130.2 | 11.5 |
| 2 | 33.3 | 51.3 | 24.2 | 44.6 |
| 3 | 22.8 | 27.1 | 24.6 | 18.0 |
| 4 | 33.4 | 44.1 | 35.0 | 23.5 |
| 5 | 25.1 | 33.2 | 25.0 | 15.6 |
| 6 | 21.4 | 26.3 | 24.4 | 21.2 |
| 7 | 17.6 | 21.8 | 19.9 | 16.5 |
| 8 | 19.7 | 22.4 | 23.5 | 29.6 |
| 9 | 20.8 | 21.4 | 19.1 | 18.2 |
| 10 | 24.7 | 25.2 | 23.3 | 22.2 |
| 11 | 21.5 | 25.6 | 25.7 | 32.8 |
| 12 | 24.7 | 30.5 | 25.0 | 23.1 |
| 13 | 20.0 | 19.9 | 20.3 | 19.4 |
| 14 | 42.7 | 65.4 | 50.6 | 3.4 |
| 15 | 24.6 | 24.1 | 33.0 | 29.8 |
| 16 | 29.8 | 284.2 | 284.2 | 100.9 |
| 17 | 101.9 | 16.0 | 16.0 | 0.0 |
| 18 | 47.2 | 6.5 | 6.5 | [1] |
| 19 | 85.7 | 0.0 | 0.0 | 143.1 |
| 20 | 12.1 | 12.1 | [1] | 0.0 |
| 1 thru 20 | 22.5 | 26.2 | 23.7 | 21.6 |
| 5 thru 10 | 20.8 | 23.7 | 21.9 | 20.6 |
| Number of buildings: | 2,612 | 1,096 | 772 | 463 |

[1]No buildings have this deductible.

percent and also those for 5 to 10 percent, with the latter containing the large majority of the data.

The effect of geohazards on values in table 16 values becomes apparent when comparing the percent contents losses in the 5 to 10 percent range at the bottom of the table. For example, use the nine-county study area (column 2) as the basis for comparisons. The PML zone has 23.7 percent loss while the nine-county study area has 20.8 percent; the geohazards in the PML zone account for this. Excluding ZIP 95030 (column 4) and thereby eliminating much of the geohazard losses will reduce the compared values as expected.

A comparison of the nine-county study area with the area within 10 miles of the fault but excluding the PML zone (column 5) has two interesting features. First, the percentage in column 5 is lower than that in column 2.

**Table 17.** Contents loss as a percent of building value for nine-county study area.

[Data source B. Limited to buildings having loss over deductible.]

| Building Value | Contents Loss As a Percent of Building Value | Number Of Buildings |
|---|---|---|
| Under $100,000 | 3.23 | 265 |
| $100,000 - 150,000 | 2.35 | 996 |
| $150,000 - 200,000 | 2.70 | 646 |
| $200,000 - 250,000 | 3.32 | 341 |
| $250,000 - 300,000 | 3.67 | 160 |
| Over $300,000 | 2.95 | 206 |

Column 2 percentages contain all geohazards, including those in the San Francisco Marina as well as those in the PML zone; therefore column 2 values should be higher than column 5 values. Of importance is the little difference in percentages, indicating that the spectacular geohazard building damage had little regional impact in the case of the Loma Prieta earthquake. Second and commingled with the first, it also suggests that loss attenuation with distance is not overly important and consistent with our model. The model assumes that magnitude increased the duration of shaking and the accelerations, but did not change the contents to building relationship.

Contents losses will be 20 to 25 percent of structure loss on the average. Many times there will be no structure loss, but contents losses. Similarly, it is possible to have heavy structure loss with minor contents losses. If the deductible is zero, there will be reported contents losses, but equation 8 will overestimate the contents losses, because there is usually no deductible applied to contents losses. Therefore, the amount of contents losses is independent of structure losses by deductible, in the aggregate. The 25 percent reported ratio was based on the reported losses for structure and contents.

Modifying equation 7 to include a user-selectable contents loss factor:

$$L_D = [2.534468\ (M - 5) + 0.5]\ e^{-0.188469\ D} \times F \times C$$

where the new term is:

C = factor for contents loss,

which if included as 1.25, the equation then becomes:

$$L_D = [3.168085\ (M - 5) + 0.625]\ e^{-0.188469\ D} \times F \qquad (8)$$

and previously defined terms are:

$L_D$ = percent loss over deductible,

D = deductible in percent,

M = magnitude, and

F = user-selected uncertainty factor.

**Table 18.** Ale loss as percent of building loss as a function of percent deductible.

[Source B deductible data, in dollars, converted to percent deductible. Converted deductibles grouped plus or minus 0.5 percent.]

| Pct. Ded. | Ale Loss as Percent of Paid Building Loss: 9-County Study Area | PML Zone | PML Zone, Excluding ZIP 95030 | Within 10 miles Of Fault, Excluding PML Zone |
|---|---|---|---|---|
| 1 | 0.9 | 8.0 | 11.4 | 0.0 |
| 2 | 4.4 | 8.2 | 5.0 | 0.0 |
| 3 | 5.1 | 5.6 | 3.1 | 0.0 |
| 4 | 11.0 | 13.8 | 12.4 | 3.6 |
| 5 | 6.1 | 7.5 | 3.9 | 4.9 |
| 6 | 6.8 | 9.4 | 6.4 | 8.1 |
| 7 | 7.4 | 10.0 | 4.8 | 4.3 |
| 8 | 7.9 | 9.9 | 9.8 | 9.7 |
| 9 | 9.1 | 9.9 | 6.4 | 7.9 |
| 10 | 10.9 | 15.8 | 12.2 | 3.3 |
| 11 | 9.1 | 15.1 | 10.9 | 0.4 |
| 12 | 14.2 | 16.5 | 14.6 | 10.0 |
| 13 | 14.5 | 23.3 | 14.0 | 0.1 |
| 14 | 10.1 | 13.3 | 10.7 | 8.1 |
| 15 | 19.0 | 22.3 | 11.5 | 14.7 |
| 16 | 8.2 | 0.0 | 0.0 | 58.9 |
| 17 | 8.3 | 18.8 | 18.8 | 0.0 |
| 18 | 30.9 | 0.0 | 0.0 | [1] |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 |
| 20 | 19.1 | 19.1 | [1] | [1] |
| 1 thru 20 | 8.4 | 10.8 | 8.0 | 6.0 |
| 5 thru 10 | 8.1 | 10.1 | 7.3 | 7.0 |
| Number of buildings: | 2,612 | 1,096 | 772 | 463 |

[1]No buildings have this deductible.

When settling earthquake claims, source B had a practice whereby contents and Ale losses were paid in full up to the earthquake insured limit and applied the deductible to the structure loss if the contents and Ale loss did not exhaust the limit. Not all companies followed this procedure. Comparisons showed that this variability was minor except where numerous large geohazard losses occurred.

Table 17 shows the variations of contents loss as a percent of building value. The lowest and highest value groupings are contrary to the ascending order of percentages in the second column.

**Table 19.** Building losses for selected ZIPs at distant locations.

[Data for source B. ZIP centroids are located 30 or more miles from the fault. Limited to ZIPs having 10 or more earthquake insured buildings. Also limited to ZIPs having average paid building losses of 1.0 percent or more.]

| ZIP | Fault Distance (miles) | Number of Eq. Insured Buildings All Ages | Number of Eq. Insured Buildings Post-1939 | Average Percent Loss Over Deductible All Ages | Average Percent Loss Over Deductible Post-1939 | Post Office |
|---|---|---|---|---|---|---|
| 93926 | 32.4 | 10 | 10 | 2.1 | 2.1 | Gonzales |
| 94401 | 32.4 | 210 | 193 | 2.3 | 2.5 | San Mateo |
| 94621 | 42.3 | 82 | 63 | 2.7 | 2.1 | Oakland |
| 94124 | 44.0 | 62 | 52 | 1.2 | 1.5 | San Francisco |
| 94607 | 46.8 | 22 | 15 | 3.8 | 0.0 | Oakland |
| 94122 | 48.0 | 351 | 246 | 1.7 | 0.8 | San Francisco |
| 94115 | 48.4 | 68 | 18 | 1.0 | 1.8 | San Francisco |
| 94608 | 48.6 | 45 | 36 | 1.0 | 1.2 | Oakland |
| 94118 | 48.7 | 142 | 44 | 1.2 | 1.4 | San Francisco |
| 94123 | 49.2 | 66 | 17 | 3.6 | 1.1 | San Francisco[1] |
| 94121 | 49.3 | 184 | 89 | 2.3 | 1.2 | San Francisco |

[1]Marina district in San Francisco

## Additional Living Expense (Ale) for Dwellings

Table 18 provides information on living expenses when a dwelling was damaged to such an extent that it was not habitable. Additional living expenses (Ale) were examined in the same manner as that for contents losses discussed in the previous section—compare tables 16 and 18. Ale losses could be due to building damage or due to causes not related to the structure, such as the loss of utilities and road closures in landslide areas. Inclement weather, such as below freezing, could radically change the Ale loss pattern. The Loma Prieta findings are presented here for information purposes. It may have limited application to homeless estimation algorithms.

## Geographic Distribution of Losses

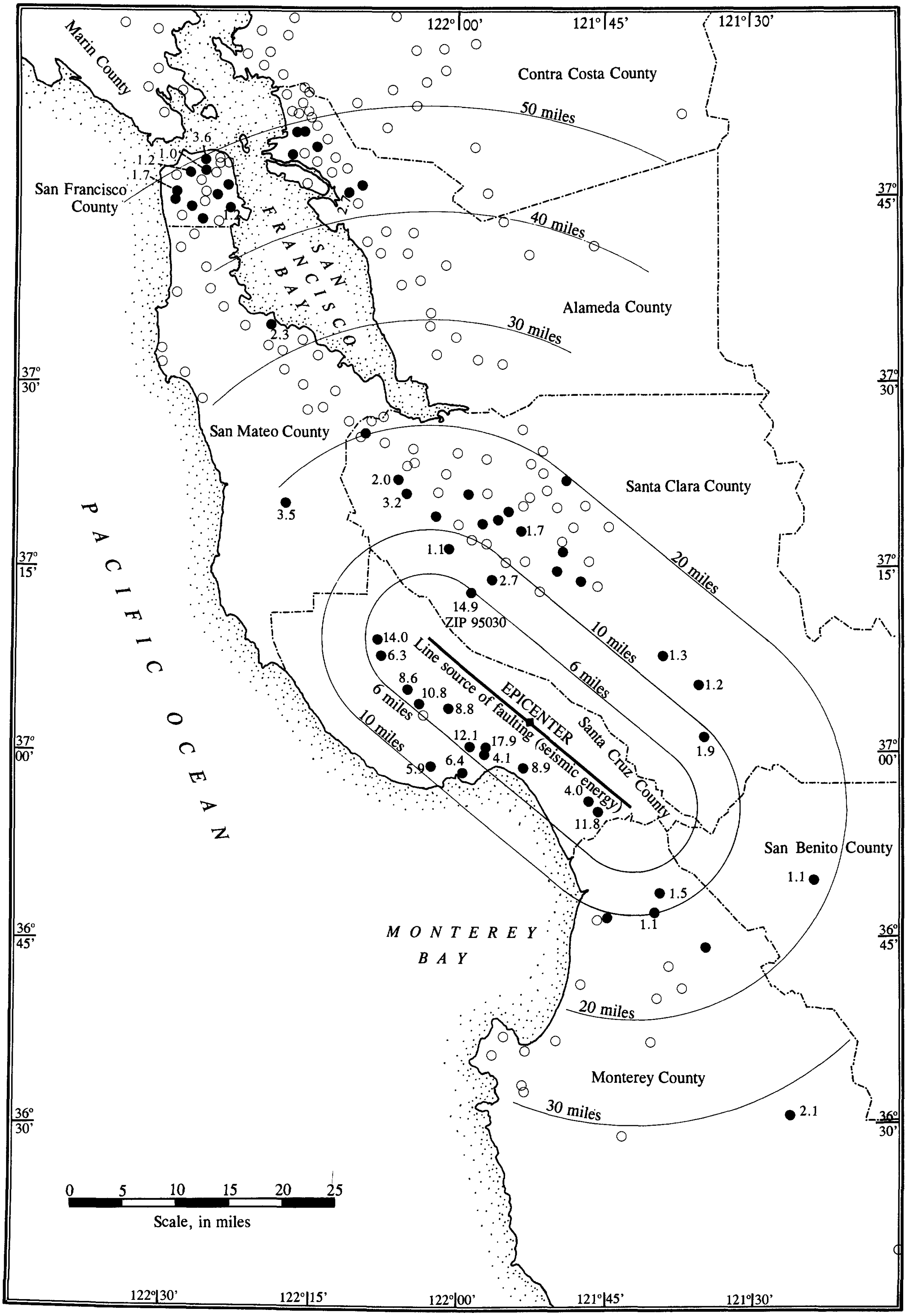
Figure 12 shows the geographic distribution of paid building loss plus deductible as a percentage of value by ZIP. Data were from source B, table 44, column 28. Plotted locations were limited to ZIPs with 10 or more earthquake insured buildings. Age was not considered. An open circle means that the average percent losses is less than 0.1 percent while a solid circle means over 0.1 percent. Solid circles with adjacent percentages are for losses over 1.0 percent.

Loss data become meager beyond 15 miles from the faulting. Examine column 16 of table 44 beginning at 15 miles (column 2). Twenty-seven is the largest number of buildings in any ZIP having paid losses. Indeed, the large majority of entries in this column is below 10 structures. Any conclusions to be made from the discussion which follows must keep this data distribution in mind. However, certain patterns emerge. Open circles prevail at distances from about 15 miles around the fault to about 40 miles to the northwest. Beyond 40 miles to the northwest, solid circles prevail—principally in San Francisco, Oakland, and Berkeley. This pattern is clearly evident in figure 13 which plots distance from the fault against average percent losses. ZIPs with losses below 0.5 percent were not plotted, thereby not plotting the large majority of ZIPs beyond 15 miles. The losses within the 6 mile PML zone are very high since geohazards were not eliminated.

Figure 13 is another perspective on figure 12 information. The losses beyond 30 miles in figure 13 warranted examination since they resemble those from 10 to 15 miles. Table 19 compares the influence of building age on average percent losses of 1.0 percent or over. Four of the eleven ZIPs in table 19 show increases in losses when older homes were deleted from the data set. Much of ZIP 94401 (San Mateo) is mapped as having low to high relative liquefaction susceptibility (Youd and Perkins, 1987). Paid losses in this ZIP were confined to 14 post-1939 buildings. Six of these in the liquefaction susceptibility area had losses ranging from over 20 percent to almost 90 percent. The USGS topographic map for San Mateo, dated 1915, shows the area to be underlain with sloughs and marshes. Geohazards seem to be one reason for this anomaly.

The three age anomalous San Francisco ZIPs in table 19 were dominated by four large losses, three of which were built between 1942 and 1954 and one in 1925. The small data set was a contributing factor to the problem.

A most likely factor which increased all losses in San Francisco was the construction. See previous discussion


Marin County
Contra Costa County
San Francisco County
SAN FRANCISCO BAY
Alameda County
San Mateo County
Santa Clara County
PACIFIC OCEAN
Santa Cruz County
San Benito County
MONTEREY BAY
Monterey County
EPICENTER
Line source of faulting (seismic energy)
ZIP 95030
50 miles
40 miles
30 miles
20 miles
10 miles
6 miles
122°00'
121°45'
121°30'
122°30'
122°15'
37°45'
37°30'
37°15'
37°00'
36°45'
36°30'
0
5
10
15
20
25
Scale, in miles

◄ **Figure 12.** Geographic distribution of average building loss as a percent of insured value using data source A information. Each open or solid circle represents the centroid of a postal ZIP having more than 10 wood frame earthquake insured buildings. Solid circles have, on an ZIP average basis, losses equalling or exceeding 0.5 percent. Open circles have lessor average losses or none. Solid circles with average losses equalling or exceeding 1.0 percent also show the percent loss. Data shown are from table 44 (at end of report) which differ slightly from those used in figure 5.

on San Francisco construction under "Earthquake Intensities and Monetary Losses."

No effective loss attenuation with distance algorithms were constructed from these data.

## Construction and Value as Variables

Source B contains considerable information on building values as they varied with building construction components

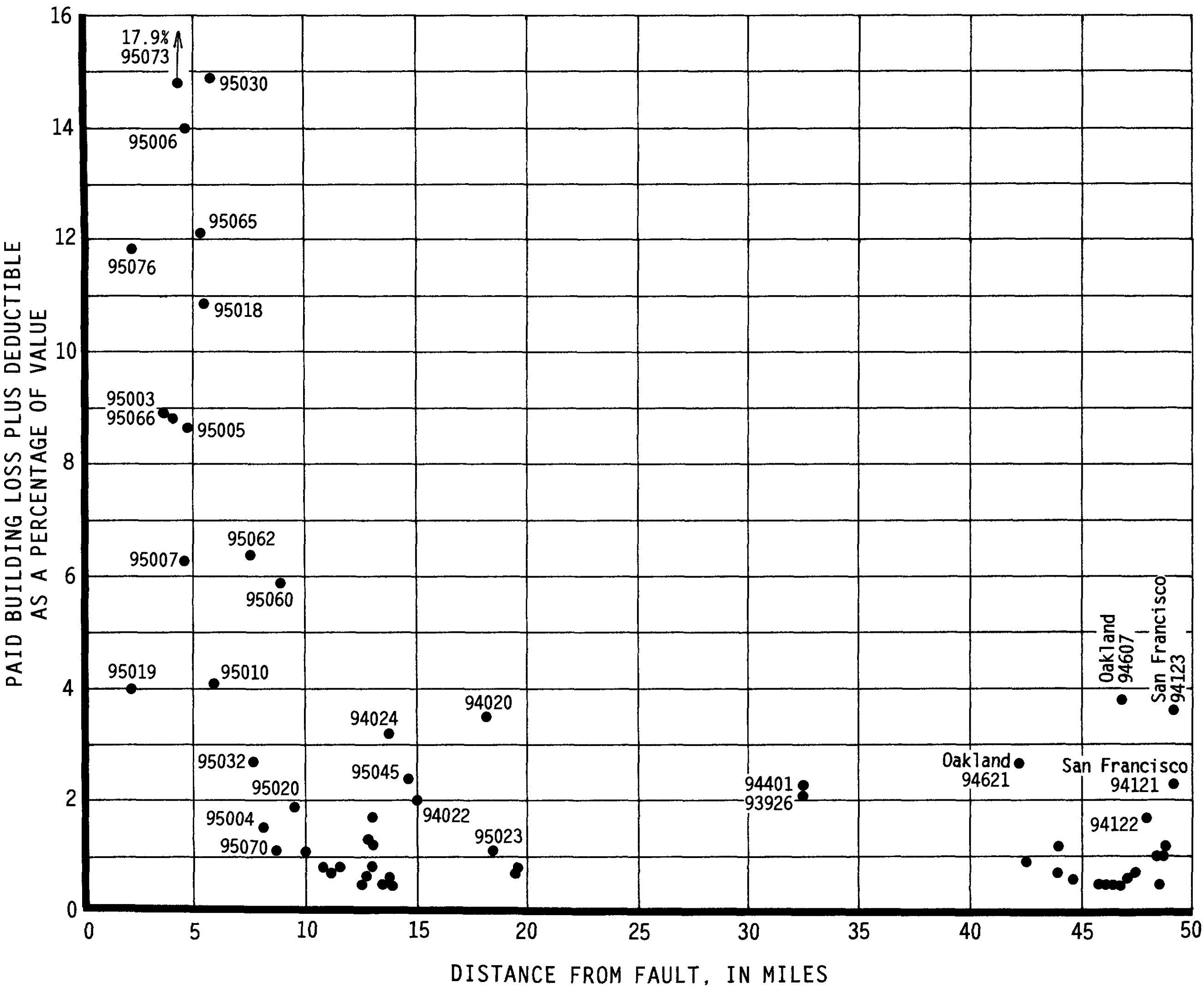



**Figure 13.** Another perspective on figure 12 data and those in table 44. The plot is paid building loss plus deductible as a percent of value against distance from the fault. Loss percentages less than 0.5 percent are not plotted.

**Table 20.** Number of stories as a function of building losses.

[Data from source B. ZIPs within 10 miles of the fault. Wood frame, post-1939 construction. Losses are before the deductible.]

| Number Stories | Number of Buildings | Bldg. Loss As Pct. Of Value |
|---|---|---|
| 1 | 428 | 18.5 |
| 2 | 258 | 17.3 |
| 3 | 3 | 11.1 |
| Bilevel | 9 | 15.0 |
| 1 & half | 121 | 19.0 |
| 2 & half | 1 | 8.0 |
| 3 level | 25 | 16.2 |
| Unknown | 538 | 20.0 |

such as type of roof and number of stories. Numerous combinations were examined, with the more interesting of these summarized below.

Tables 20, 21, 22, and 23 are limited to post-1939 dwellings within 10 miles of the surface projection of the fault. An important factor in all tables, except table 23, is that the column "Building Loss as a Percent of Value" is based only on dwellings having paid losses, excluding dwellings which did not have losses over the deductible. Therefore, the percentages are not PML values and are only useful as relative values.

Table 20 shows the percent building loss as a function of the number of stories. The table clearly demonstrates that two story structures performed as well as one story structures. This observation does not apply to dwellings in San Francisco; see discussion under "Monetary Loss," above.

Tile roofs are often considered to be both a life hazard and to be vulnerable to damage. Table 21 may be surprising with respect to dollar loss. Type of tile anchorage to its supporting members, if any, is unknown. Dollar loss is not necessarily indicative of life hazard, such as tile over exit doorways.

Masonry chimneys are especially vulnerable to damage when they are unreinforced. Fewer fail when they are reinforced, and essentially none fail when the shaking is not severe. Table 22 shows data for losses over the deductible in the heavily shaken area. There was no breakdown on reinforced and nonreinforced chimneys. The loss percentages in the last column indicate that building losses over the deductible, if anything, tend to decrease with an increase in the number of chimneys.

Table 23 relates dwelling value to the percentage of owners who chose earthquake insurance in addition to their fire coverage. The percentages increase from the

**Table 21.** Type of roof as a function of building losses.

[Data from source B. ZIPs within 10 miles of the fault. Wood frame, post-1939 construction. Losses are before the deductible.]

| Roof Type | Number of Buildings | Bldg. Loss As Pct. Of Value |
|---|---|---|
| Tile[1] | 61 | 17.3 |
| Other | 538 | 20.0 |
| Unknown | 784 | 18.0 |

[1]Clay or concrete

**Table 22.** Masonry chimneys as a function of building losses.

[Data from source B. ZIPs within 10 miles of the fault. Wood frame, post-1939 construction. Losses are before the deductible.]

| Number Masonry Chimneys | Number of Buildings | Bldg. Loss As Pct. Of Value |
|---|---|---|
| None | 178 | 20.1 |
| 1 | 513 | 17.9 |
| 2 | 129 | 15.4 |
| 3 | 21 | 15.7 |
| 4 | 4 | 30.2 |

**Table 23.** Value as a function of earthquake insurance coverage.

[Data from source B. ZIPs within 10 miles of the fault. Wood frame, post-1939 construction. Losses are before the deductible.]

| Building Value x$1000 | Number of Buildings | Pct. With Eq. Insurance |
|---|---|---|
| Less $100 | 6,804 | 19.5 |
| $101-150 | 13,237 | 36.4 |
| $151-200 | 7,107 | 48.5 |
| $201-250 | 2,812 | 54.6 |
| $251-300 | 1,193 | 58.8 |
| $301-350 | 522 | 61.5 |
| $351-400 | 227 | 56.8 |
| $401-450 | 106 | 53.8 |
| $451-500 | 63 | 57.1 |
| $501-550 | 47 | 59.6 |
| $551-600 | 45 | 68.9 |
| $601-650 | 24 | 75.0 |
| $651-700 | 10 | 70.0 |
| $701-750 | 12 | 75.0 |
| Over $750 | 36 | 55.6 |

under $100,000 dwellings to about $300,000, then tend to erratically increase. This indicates that the homeowner's economic status is an important factor in the purchase of earthquake insurance.

## Modified Mercalli Intensity

Shown in figure 14 are the boundaries of the 6-mile PML zone and a portion of the Modified Mercalli intensity map including the epicentral area. The isoseismal line is from a portion of figure 2 in Stover and others (1990). The correlation between the theoretic PML zone and the isoseismal map is reasonable in the populated areas. The absence of dwellings and other structures in much of the Santa Cruz Mountains leaves the northeastern boundaries mostly undocumented (see fig. 3).

One comparison between intensity VIII and quantified dwelling losses for post-1939 construction is:

| | *Percent PML* |
|---|---|
| 1989 Loma Prieta (equations 1, 2, and 3) | |
| PML zone, including geohazards | 17.5 |
| PML zone, excluding geohazards | 12.4 |
| Watsonville study area | 6.5 |
| 1983 Coalinga | 4.6 |

Correlations between mapped intensity and actual losses are not simple.

Other comparisons from other earthquakes show wide variations among intensities and losses (table 28 in Steinbrugge and Algermissen, 1990) and should be examined in the context of the above tabulation.

The definitions and interpretations of Modified Mercalli intensities commingled incompatible factors such as (1) human response, (2) functional impairments, (3) degree of building damage, and (4) geologic effects. The definitions use nonquantified as well as subjective terminology: "few," "many," "slight," "considerable," "good," and "frightened all." These terms are summarized by an intensity. A single intensity may be assigned to a specific site or more often to a large area (Steinbrugge, 1986).

There is a role for specialized equivalents to intensity maps intended for specific purposes such as monetary loss and life safety estimates. Such maps require data bases of structures by construction class, occupancy types, and occupant loads. These data bases must include values and losses sustained as well as a measure of local dynamic soil conditions. These data are often found in geographically scattered computerized systems compiled by governmental, academic, and private entities.

While one of the authors (Steinbrugge) has used Modified Mercalli intensities in previous studies, alternatives have also been examined. One alternative is contained in this paper. On the other hand and much in the maps' favor, they provide an excellent overview of overall effects and are vital to the historic record.

# MOBILE HOMES (MANUFACTURED HOUSING)

## Introduction

Information on mobile home damage and losses from the Loma Prieta earthquake came from three sources: source B (previously discussed), source C (new), and the California Department of Housing and Community Development (new). Additionally, a retrospective study of previous California mobile home experience is included for the following earthquakes: 1971 San Fernando, 1978 Santa Barbara, 1979 El Centro (Imperial Valley), 1980 Livermore (Greenville), and 1983 Coalinga. Other earthquakes provided little useful information for monetary loss estimation. Although data for the 1984 Morgan Hill earthquake are only minimally useful, 17 mobile homes representing 2 percent of the mobile home units in the Morgan Hill and Gilroy areas fell. No damage was found to coaches having a proprietary earthquake bracing system although nearby unbraced ones fell (Kensler, 1985). Monetary losses were not estimated.

The number of spaces available for mobile homes is listed in some data bases. Since mobile home parks are normally at capacity, or very close thereto, the number of coaches in a park is considered to be the same as the number of spaces. Mobile homes, coaches, and manufactured housing have the same meanings in this study. They may or may not include contents and appurtenances, depending upon context.

## Definition Of Mobile Home (Manufactured Housing)

A mobile home (manufactured housing) is defined here to mean a coach unit which is transported (towed) on wheels to a site where it can be jacked or raised off its wheels and leveled. The wheels, but not the axle spindles and drum unit to which the wheels and tires fasten, may be removed and stored.

The typical set-up technique for a mobile home is to roll the coach into place and use one of several types of piers placed at intervals of about 6 feet along the main frame. A screwjack on the top of each metal pier is then brought up into contact with the undercarriage and positioned until the coach is level and steady on the mounts.

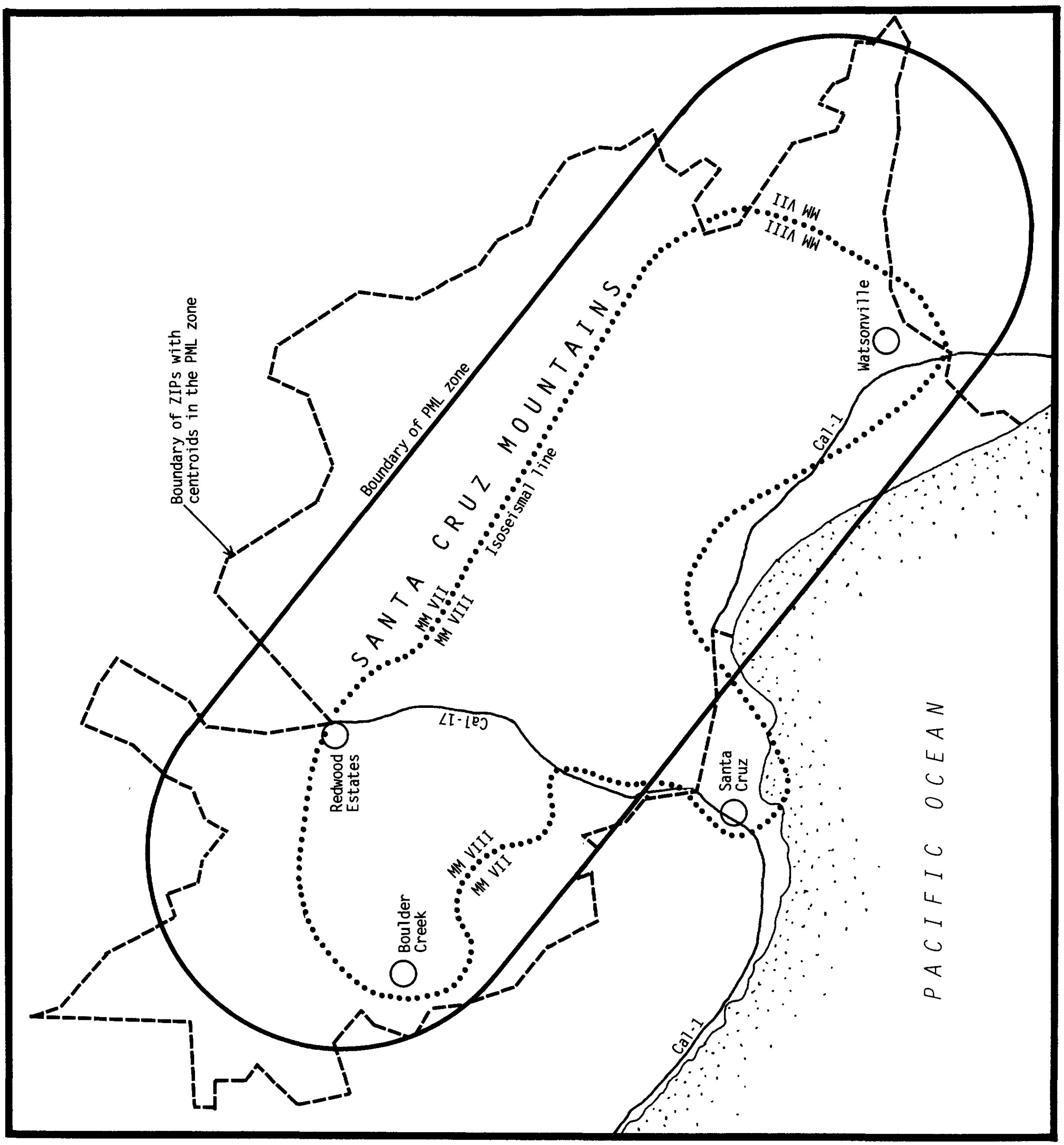



**Figure 14.** PML zone and its relationships to the Modified Mercalli intensity zone VIII. Also shown is the boundary of the ZIPs with centroids within the PML zone.

Other types of piers may exist such as hollow concrete block and sometimes treated wood blocks. Piers rest on concrete slabs or in some cases directly on soil. When soft soils are encountered, concrete block masonry or flat (cement) patio type blocks are used to spread the load and prevent settling. Utilities are then hooked up, an aluminum skirt is applied around the base, and stairs are placed at the doorway. Commonly, an aluminum patio cover is found on the door side of the coach. If the yoke-tongue at the forward end of the coach is left on (sometimes cut-off for aesthetic reasons), it is vertically supported and skirted.

## Characteristic Damage

Structural damage to mobile homes is the result of a lack of earthquake bracing beneath them. Supports comprise steel piers, concrete piers, or unreinforced hollow concrete block (or cinder block) in almost all instances. These piers are intended to support vertical loads, but they have very little resistance to lateral loads such as imposed by earthquakes. These unstable conditions cause mobile homes to fall when the supports topple. Other instability problems arise on a sloping site when, to provide a 12-inch minimum clearance under the frame at one end of the unit, the other end may be 36 to 40 inches above the surrounding grade.

Excluding coach contents, coaches are essentially undamaged when they do not fall from their supports. Generally, recaulking of roofs where double-wide units join or where the patio/porch roof joins the coach is the extent of needed repairs. When they do fall, the skirt is normally severely damaged, the frame may be bent, and holes may be punched through the floor by the fallen coach supports. Also, damage often will be severe to the adjacent porches and attached patio awnings which are separately supported on the ground.

It is important to note that once a coach falls off its supports, damage and losses will not significantly increase beyond the initial damage. This remains true even for great earthquakes of long duration. Total losses are normally not expected without ensuing fire or a geohazard problem such as landsliding.

## Loma Prieta Earthquake

### Source B Data

Source B insured 8,620 mobile homes in the 14 county study area. It contained information on each insured mobile home in similar detail to that provided for dwellings. Table 24 shows a breakdown of these mobile homes in parks as well as those not located within parks, with the latter listed as "isolated." Earthquake insurance policies covered the coaches, their contents, and additional living expenses. The deductible was 10 percent of the coach value and was applicable to coach and contents losses. Additional living expenses were not subject to the deductible, but they reduced the amount available for paid coach and contents losses. The last column in table 24 shows that 268 mobile homes located in parks had losses over the 10 percent deductible. Essentially all mobile homes with paid losses were in the four counties of Monterey, San Benito, Santa Clara, and Santa Cruz. Santa Cruz dominated. Isolated mobile homes are not significant in this study since they were so few in number.

**Table 24.** Mobile home (manufactured housing) losses in 14 counties.

[Data from source B.]

| County | Number of Mobile Homes: In a Park | Number of Mobile Homes: Isolated[1] | Number of Paid Losses[2] |
|---|---|---|---|
| Alameda | 557 | 55 | 2 |
| Contra Costa | 682 | 70 | 1 |
| Marin | 87 | 8 | 0 |
| Monterey | 450 | 183 | 18 |
| Napa | 507 | 40 | 0 |
| Sacramento | 1,101 | 197 | 1 |
| San Benito | 60 | 27 | 24 |
| San Francisco | 2 | 0 | 0 |
| San Joaquin | 511 | 174 | 1 |
| San Mateo | 207 | 8 | 1 |
| Santa Clara | 1,414 | 26 | 43 |
| Santa Cruz | 607 | 44 | 177 |
| Solano | 574 | 35 | 0 |
| Sonoma | 822 | 172 | 0 |
| Totals | 7,581 | 1,039 | 268 |

[1]"Isolated" normally means not in a mobile home park.
[2]After a 10 percent deductible based on coach value.

Table 25 lists mobile home losses in the PML zone and also those up to 10 miles from the fault. Column 3 lists the number of mobile homes carrying earthquake insurance and column 4 lists those with paid losses. Columns 7, 8, and 9 show the paid losses. The last column shows the average loss over the deductible for each ZIP. The 3.8 percent loss over the deductible for the PML zone suggests that, despite coaches falling off their supports, most losses were far from being total. This subject will be further examined.

Figure 15 is based on table 25 and shows the relationship between loss over deductible and distance from a ZIP centroid to the fault. ZIPs with fewer than 37 insured mobile homes were not plotted. Except ZIP 95020 (Gilroy),

**Table 25.** Mobile home losses 10 miles or less from the fault.

[Data from source B, excluding ZIP 95030. Deductible is 10 percent of coach value and applies to coach plus contents losses. ZIP to fault distances are to the ZIP centroid and not to centroid of parks. Only ZIPs with earthquake insurance are included.]

| ZIP | ZIP to Fault Distance (miles) | Number of Mobile Homes With Eq. Insur. | Number of Mobile Homes With Paid Loss | Value x$1000 Coach | Value x$1000 Conts. | Paid Loss x$1000 Coach | Paid Loss x$1000 Conts. | Paid Loss x$1000 Ale | Percent Coach Loss Over Deductible |
|---|---|---|---|---|---|---|---|---|---|
| PML zone | | | | | | | | | |
| 95076 | 2.1 | 159 | 69 | 7,024 | 5,735 | 328 | 166 | 59 | 4.7 |
| 95003 | 3.5 | 63 | 14 | 3,136 | 2,559 | 69 | 85 | 8 | 2.2 |
| 95066 | 3.9 | 79 | 17 | 5,121 | 4,486 | 183 | 62 | 12 | 3.6 |
| 95073 | 4.3 | 82 | 26 | 3,421 | 3,019 | 135 | 47 | 17 | 4.0 |
| 95006 | 4.7 | 3 | 0 | 61 | 48 | 0 | 0 | 0 | 0.0 |
| 95005 | 4.8 | 4 | 2 | 90 | 68 | 6 | 3 | 1 | 6.7 |
| 95065 | 5.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 95018 | 5.5 | 6 | 2 | 143 | 106 | 2 | 1 | 0 | 1.2 |
| Totals PML zone | | 396 | 130 | 18,996 | 16,021 | 723 | 365 | 96 | 3.8 |
| Beyond PML zone but within 10 miles of the fault | | | | | | | | | |
| 95062 | 7.5 | 168 | 32 | 5,553 | 4,536 | 51 | 30 | 4 | 0.9 |
| 95060 | 8.9 | 38 | 4 | 1,962 | 1,601 | 7 | 2 | 0 | 0.4 |
| 95020 | 9.6 | 37 | 11 | 1,422 | 1,127 | 48 | 9 | 1 | 3.4 |
| 93907 | 10.0 | 140 | 6 | 4,482 | 3,722 | 34 | 4 | 2 | 0.8 |
| 95124 | 10.0 | 1 | 0 | 37 | 28 | 0 | 0 | 0 | 0.0 |
| Totals, all of above | | 780 | 183 | 32,452 | 27,035 | 864 | 410 | 103 | 2.7 |

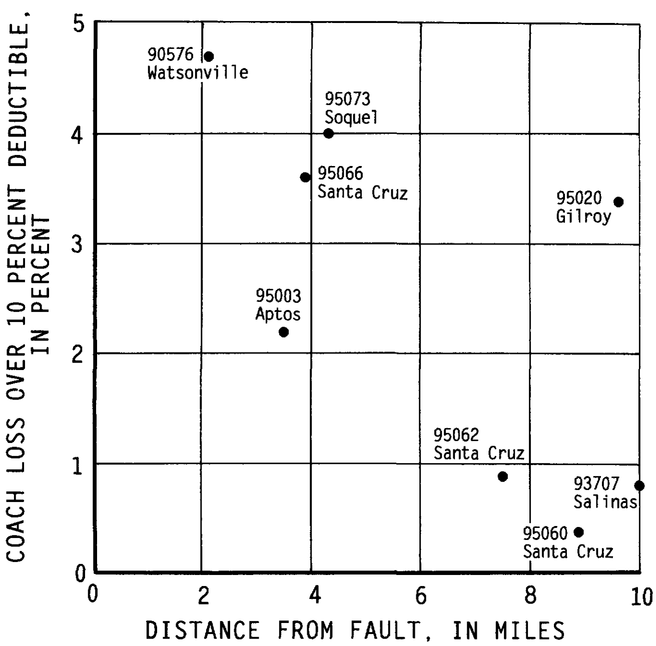



**Figure 15.** Loma Prieta earthquake. Mobile home loss over 10 percent deductible as a function of distance from the fault for parks are grouped by ZIP; in figure 16, parks are individually plotted. Excluded are ZIPs with no losses or fewer than 10 mobile homes. Names are post office names and may include large rural areas. Data from source B.

the data are well-behaved and suggest a curve for the upper limit of distance versus coach losses. This relationship would be limited to the 10 percent deductible.

An alternate viewpoint of loss versus distance is figure 16 where the distances from individual mobile home parks to the fault are shown. Distances are those from the parks and not from ZIP centroids. The triangles are for the Watsonville ZIP; these parks are also those closest to the fault. Solid circles are those parks along Monterey Bay plus those westerly of the fault. Open circles are for parks east of the fault from the Santa Clara Valley southward to Hollister. Data scatter among parks can be attributed to local soil conditions and also to type of piers supporting the coach (see a following discussion under "California Department of Housing and Community Development"). Directionality of seismic waves and soil amplification of ground motions may have contributed in some instances. Parks with fewer than 10 insured mobile homes were excluded. Some contiguous parks were combined. The large loss of 5.2 percent at distance 14 miles (San Jose) is due to heavy damage to one coach out of 12.

Information additional to figure 16 losses in Watsonville, Corralitos, Gilroy, and Hollister is shown in table 26. The Watsonville and near vicinity mobile home information is presented as a comparison to dwellings in the Watsonville study area (fig. 7). The number adjacent to each mobile home park in figure 7 can be associated with the park name and its data in table 26. Two parks, Rancho Corralitos in Corralitos and Portola Heights in Watsonville, are located on steep slopes. Interestingly, neither of these had losses over the deductible exceeding 8.1 percent, the average for Watsonville and near vicinity. Rancho Cerritos in Watsonville was near the steep slopes of Struve Slough and this probably influenced its high loss shown in table 26.

One mobile home park, the Riverside in Watsonville (fig. 7), was located adjacent to the dike for the Pajaro River and also within the river's flood plain. This park was also adjacent to the heavily damaged central commercial district. Only one coach fell in this small park of 28 coach spaces. All other parks within the Watsonville city limits were on higher and apparently firmer ground. These other parks had higher percentages of fallen coaches; the reason for this anomaly is not clear.

Loss variations within Watsonville may not be overly meaningful when considering the amount of available data. On the other hand, the comparative damage between the two parks in and near Hollister is significant and can be attributed to soils. Mission Oaks mobile home park in Hollister is located on quite soft alluvial soil on the bank of the San Benito River. The very low losses at Fairview Mobile Manor are in contrast. This latter park is located 3.2 miles to the east of Mission Oaks, on higher ground, and about 3 miles from the San Benito River. Soils seem to be firmer. In any event, the difference in losses does not appear to be associated with construction and is most likely due to geohazards.

The foregoing data do not differentiate between earthquake braced and nonbraced mobile homes. Table 27 displays the number and type of bracing within various geographic areas. Earthquake bracing, when it occurs, exists between the coach floor and the ground surface. Four different kinds of bracing were identified, often by insurance agents. Undoubtedly "wind" bracing was confused with earthquake bracing in many cases, probably because the persons making the decisions were normally not technically oriented. However, it is evident that coaches without

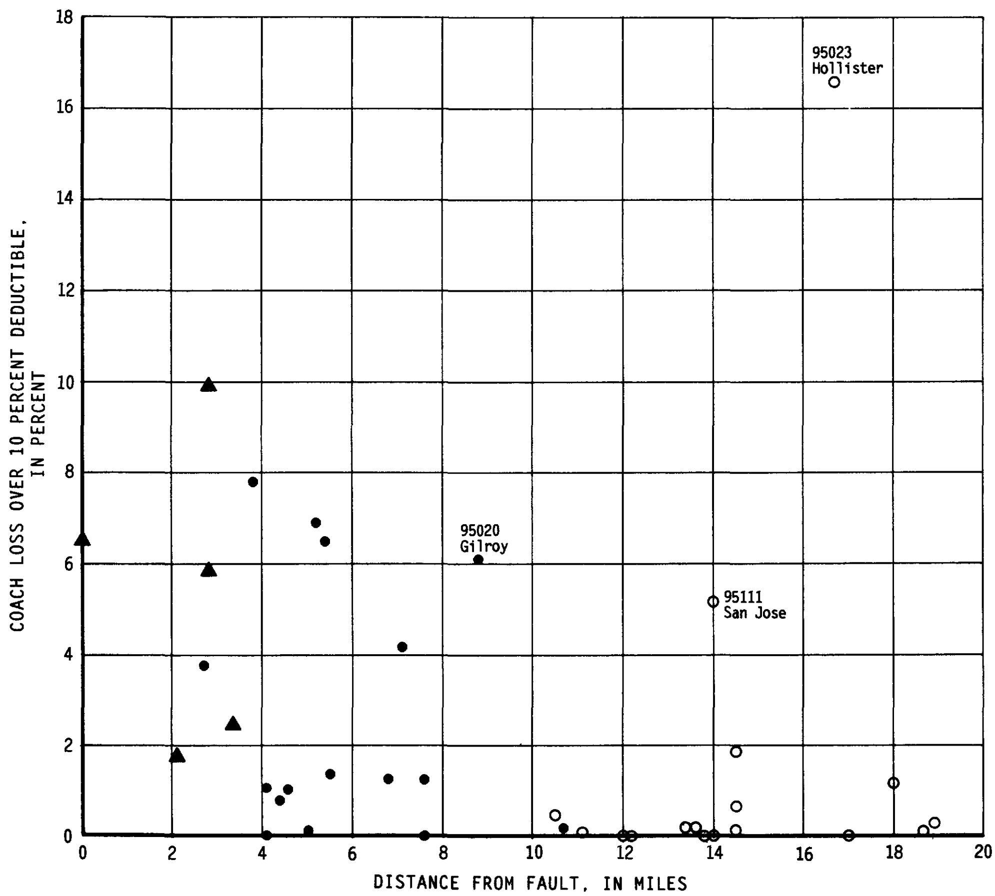



**Figure 16.** Loma Prieta earthquake. Percent loss over 10 percent deductible as a function of distance from the fault for individual mobile home parks; in figure 15, parks are grouped by ZIP. Solid triangles are parks located in Watsonville ZIP 95076. Solid circles are parks in a coastal community, or nearby. Open circles are parks to the east of the fault, ranging from the Santa Clara Valley to Hollister. Data from source B.

**Table 26.** Coach loss data on selected mobile home parks.

[Data from source B. Losses are after the 10 percent deductible.]

| Location and Park Name | Fault Dist. (miles) | Spaces in Park[1] | Insured Coaches Number Coaches | Insured Coaches Value (x$1000) | Paid Loss (x$1000) | Pct. Loss Over Deduct. |
|---|---|---|---|---|---|---|
| Watsonville and near vicinity:[2] | | | | | | |
| 1 Meadows Mobile Manor | 2.1 | 276 | 13 | 623 | 11.1 | 1.8 |
| 2 Portola Heights | 2.8 | 119 | 12 | 691 | 40.5 | 5.9 |
| 3 Green Valley Village | 2.8 | 105 | 18 | 800 | 78.9 | 9.9 |
| 4 Colonial Manor | 2.9 | 71 | 4 | 133 | 5.6 | 4.2 |
| 5 Rancho Cerritos | 3.3 | 144 | 9 | 476 | 124.4 | 26.1 |
| 6 Monterey Vista | 3.3 | 122 | 15 | 713 | 18.1 | 2.5 |
| 7 Riverside | 3.5 | 28 | n.a. | n.a. | n.a. | n.a. |
| 8 Freedom | 2.0 | 14 | n.a. | n.a. | n.a. | n.a. |
| 9 Pinto Lake | 0.3 | 174 | n.a. | n.a. | n.a. | n.a. |
| Watsonville subtotal | | 1,053 | 71 | 3,436 | 278.6 | 8.1 |
| Corralitos: | | | | | | |
| Rancho Corralitos | 0.0 | -- | 10 | 573 | 37.3 | 6.5 |
| Gilroy: | | | | | | |
| Pacific Mobile Estates | 8.8 | 178 | 18 | 688 | 41.7 | 6.1 |
| Hollister and near vicinity: | | | | | | |
| Mission Oaks | 16.7 | 225 | 39 | 1,279 | 215.2 | 16.6 |
| Fairview Mobile Manor | 18.7 | -- | 15 | 448 | 0.7 | 0.1 |

n.a. means not available.

[1]California Department of Housing and Community Development (1989?), p. 2.
[2]Numbers against park names identify locations on figure 13.

**Table 27.** Type of foundation anchorage for mobile homes.

[Data from source B. Includes all coaches, with or without earthquake insurance.]

| Type of Foundation | 14 Counties (Note 1) Numbr. | Pct. | 4 Counties (Note 2) Numbr. | Pct. | PML Zone (Note 3) Numbr. | Pct. | ZIP 95076 (Note 4) Numbr. | Pct. |
|---|---|---|---|---|---|---|---|---|
| Dug in | 15 | 0.2 | 4 | 0.1 | 0 | 0.0 | 0 | 0.0 |
| EQ braced | 70 | 0.8 | 31 | 1.1 | 7 | 1.8 | 2 | 1.3 |
| Permanent fdn. | 406 | 4.7 | 107 | 3.8 | 24 | 6.0 | 6 | 3.8 |
| "Wind" braced | 740 | 8.6 | 303 | 10.8 | 15 | 3.8 | 6 | 3.8 |
| No bracing | 7,389 | 85.7 | 2,366 | 84.2 | 352 | 88.4 | 145 | 91.2 |
| Totals | 8,620 | | 2,811 | | 398 | | 159 | |

Note 1: Alameda, Contra Costa, Marin, Monterey, Napa, Sacramento, San Benito, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties. Total of 14.

Note 2: Monterey, San Benito, Santa Clara, and Santa Cruz counties. These were the counties with the largest number of losses.

Note 3: ZIPs 95003, 95005, 95006, 95018, 95065, 95066, 95073, and 95076. All are in the PML zone. ZIP 95030 was excluded.

Note 4: ZIP 95076, Watsonville.

**Table 28.** Relationships among losses and values for mobile home coaches, contents, and Ale.

[Data from source B. Losses are before the deductible. All mobile homes having paid coach losses.]

| | Coach Value | | | Geographic Distribution | | |
|---|---|---|---|---|---|---|
| Percentages | Under $40,000 | $40,000-$70,000 | $70,000 And up | Paid Claims[1] | PML Zone | ZIP 95076[2] |
| Contents loss as percent of coach loss: | 19.6 | 49.0 | 33.4 | 33.9 | 43.9 | 45.9 |
| Contents loss as percent of contents value: | 3.8 | 4.8 | 3.1 | 4.2 | 5.8 | 5.6 |
| Contents loss as percent of coach value: | 3.1 | 4.2 | 2.9 | 3.6 | 5.0 | 4.6 |
| Coach loss as percent of coach value: | 15.9 | 8.6 | 8.7 | 10.7 | 11.4 | 10.1 |
| Ale loss as percent of coach value: | 1.2 | 1.0 | 0.5 | 1.0 | 1.5 | 1.8 |
| Contents value as percent of coach value: | 88.2 | 86.5 | 92.6 | 88.6 | 86.6 | 83.2 |
| Ale loss as percent of coach loss: | 7.3 | 12.2 | 6.2 | 9.1 | 12.9 | 17.3 |
| Number of coaches: | 123 | 115 | 30 | 268 | 131 | 69 |

[1]All coaches having paid losses in the Loma Prieta earthquake.
[2]Watsonville ZIP.

any kind of recognized bracing hovered between 85 and 90 percent.

Source B had 28 paid losses for coaches having some form of earthquake or lateral force bracing. A stricter interpretation of earthquake bracing probably would have greatly reduced this number (see following section "California Department of Housing and Community Development").

Eleven coaches in parks had losses over 60 percent of coach value when the deductible was added to the paid loss. Of these 11 coaches, 6 were located in the Mission Oak Park in Hollister (see table 26). As previously mentioned, high losses in this park were most likely due to a soil related geohazard. Of the remaining 5 coaches, their percent losses in descending order were: 91.7, 90.8, 79.0, 64.5, and 63.4 percent. None had recognized earthquake bracing systems of any sort. Locations were widely scattered: Hollister, Scotts Valley, and the contiguous coastal communities of Capitola-Aptos-Soquel. In summary when excluding fire and geohazards, no coaches in parks were total losses: 2 had losses over 80 percent, and 5 had losses over 60 percent. These 11 high loss coaches are a very small number of the 7,581 coaches in the 14 county study area (table 24).

In the PML zone, the 5 highest contents losses in percentages of their insured values were 36.6, 36.2, 29.8, 28.2, and 25.5 percent. Contents losses exceeding 50 percent of insured contents value are not expected when geohazards and fire following the event are excluded. Single-wide coach losses were compared with double-wide and larger coaches. Excluded were braced coaches. Single-wide coaches performed marginally better than the others out of a population of 231 coaches (5.9 versus 6.2 percent, respectively). Coach age and its loss were examined. The percent coach loss over deductible for coaches with paid losses by decade are as follows:

| *Decade* | *Number Coaches* | *Percent Loss over Deductible* |
|---|---|---|
| 1960-69 | 49 | 11.7 |
| 1970-79 | 179 | 11.2 |
| Post-79 | 39 | 8.2 |

This suggests that buyers of new or moved mobile homes may have chosen to include earthquake bracing.

Table 28 shows the relationships among losses and values among mobile homes. This will be discussed along with source C information in the next section, "Source C Data."

## Source C Data

Source C, which is also a significant writer of earthquake insurance for mobile homes, provided both pre- and post-deductible loss information on each coach, its contents,

**Table 29.** Mobile homes with paid losses in the PML zone.

[Data from sources B and C. ZIP 95030 excluded.]

| ZIP | Post office | Mobile Homes With Paid Losses | |
|---|---|---|---|
| | | Source B | Source C |
| 95076 | Watsonville | 69 | 54 |
| 95003 | Aptos | 14 | 17 |
| 95066 | Santa Cruz | 17 | 31 |
| 95073 | Soquel | 26 | 5 |
| 95006 | Boulder Creek | 0 | 0 |
| 95005 | Ben Lomond | 2 | 0 |
| 95065 | Santa Cruz | 0 | 0 |
| 95018 | Felton | 2 | 0 |
| | Totals | 130 | 107 |

and Ale (loss due to additional living expenses). Source C information was by ZIP code and not by address. It lacked information on insured mobile homes not having paid losses. This lack precluded an analysis of loss over deductible and of PML values.

Source C had 228 paid mobile home claims, 3 with ensuing fire loss. Of these, 179 had a 5 percent deductible; 29 had a 2 percent deductible; and 17 had other deductibles. Of the fire losses, one was a total loss, the second had a 70 percent loss before the deductible, and the third was under 50 percent. There were 107 paid claims within the PML zone, excluding ZIP 95030. By comparison, source B had 268 paid claims over the 10 percent deductible. A more detailed comparison on a ZIP basis for the PML zone is shown in table 29.

Ratios in the form of percentages among coaches, contents, and Ale are given in tables 28 and 30. These

**Table 30.** Relationships among losses and values for mobile home coaches, contents, and Ale.

[Data from source C and combined sources B and C. Losses are before the deductible. All mobile homes having paid coach losses.]

| Percentages | Coach Value | | | Geographic Distribution | | |
|---|---|---|---|---|---|---|
| | Under $40,000 | $40,000- $70,000 | $70,000 And Up | Paid Claims[1] | PML Zone | ZIP 95076[2] |
| **SOURCE C** | | | | | | |
| Contents loss as percent of coach loss: | 30.1 | 30.8 | 52.6 | 34.7 | 34.6 | 27.4 |
| Contents loss as percent of contents value: | 8.6 | 8.5 | 12.6 | 9.4 | 12.5 | 15.3 |
| Contents loss as percent of coach value: | 4.9 | 4.6 | 6.8 | 5.1 | 6.8 | 8.1 |
| Coach loss as percent of coach value: | 16.3 | 15.0 | 12.9 | 14.7 | 19.7 | 29.4 |
| Ale loss as percent of coach value: | 1.2 | 0.9 | 0.5 | 0.9 | 1.3 | 2.3 |
| Contents value as percent of coach value: | 56.8 | 54.3 | 53.8 | 54.4 | 54.6 | 52.7 |
| Ale loss as percent of coach loss: | 7.3 | 6.1 | 3.7 | 5.8 | 6.5 | 7.7 |
| Number of coaches: | 37 | 151 | 30 | 218 | 104 | 53 |
| **WEIGHTED AVERAGES OF SOURCES B AND C** | | | | | | |
| Contents loss as percent of coach loss: | 22.5 | 36.1 | 45.1 | 34.4 | 38.2 | 32.7 |
| Contents loss as percent of contents value: | 4.8 | 6.6 | 6.7 | 6.2 | 8.3 | 9.0 |
| Contents loss as percent of coach value: | 3.6 | 4.4 | 4.9 | 4.4 | 5.9 | 6.2 |
| Coach loss as percent of coach value: | 16.0 | 12.3 | 10.9 | 12.7 | 15.4 | 19.1 |
| Ale loss as percent of coach value: | 1.2 | 1.0 | 0.5 | 0.9 | 1.4 | 2.0 |
| Contents value as percent of coach value: | 75.4 | 67.7 | 72.7 | 70.2 | 70.7 | 69.0 |
| Ale loss as percent of coach loss: | 7.3 | 7.9 | 4.7 | 7.2 | 8.9 | 10.4 |
| Number of coaches: | 160 | 266 | 60 | 486 | 235 | 122 |

[1]All coaches having paid losses in the Loma Prieta earthquake.
[2]Watsonville ZIP.

percentages fall into two categories: (1) coach value, and (2) geographic distribution. The percentages give insights into data comparisons and thereby indicate the variations which may be expected among various data sources. Secondly, they provide a basis for loss estimation applications. For example, visual inspections may allow quick estimates on the amount of coach damage and thereby coach loss; the contents loss to coach loss percentage allows a quick estimate on the amount of contents loss when visual inspections must be limited to the exteriors. This will be further discussed under "Test of Rapid Loss Estimation, El Centro." Thirdly and for loss estimation for postulated earthquakes, the percentages allow for estimates on other losses when the PML has been determined. Tables 28 and 30 are pilot in nature and should be used with considerable care and judgment.

A detailed example of one application is examined. Columns 5 and 6 of tables 28 and 30 may be the more significant of those in these tables. Compare contents loss as a percent of coach loss for both sources B and C—first line in each table. Source C values (table 30) are essentially identical: 34.7 percent and 34.6 percent; those for source B are 33.9 percent and 43.9 percent. This is better agreement than might be expected. The weighted averages of these are found on the bottom half of table 30: 34.4 percent and 38.2 percent, respectively. For applications, one may reasonably judge an average of 1/3, that is, on an aggregate basis the contents loss will be 1/3 of that for the coach. A similar approach was used for wood frame dwellings where, in table 16, the average was about 1/4 instead of 1/3. The commentary on the dwelling percentage also largely applies here and should be referred to for additional information. In the case of mobile homes where coaches can readily fall from their vertical supports, contents losses may be large for items such as overturned refrigerators which may not overturn in dwellings remaining on their foundations. This is one seeming explanation for the mobile home percentages averaging around 30 to 35 percent while those for wood frame dwellings were about 20 to 25 percent (table 16). Only experience from future earthquakes will provide definitive percentages for tables 28 and 30.

Not all comparisons are as good. Potential sources of errors inherent in all comparisons are company market shares which differ among parks and their geohazards.

### California Department of Housing and Community Development

The California Department of Housing and Community Development (acronym HCD) has the primary responsibility for mobile homes (manufactured housing) in California. Local jurisdictions may assume this responsibility if they so choose. Since 1985, this state agency has certified earthquake bracing systems and has made this certification generally known to mobile home owners. However, for years prior to 1985, there were sales of non-certified systems. Also, owners sometimes had installed their own bracing, or left inflated tires on the coaches to minimize the amount of coach drop during an earthquake.

After the Loma Prieta earthquake, the department made a field examination of damage found in mobile home parks (California Department of Housing and Community Development, 1989?). Pertinent information has been abstracted:

> Within San Benito, Santa Clara, and Santa Cruz counties there are 193 mobile home parks containing 24,438 manufactured homes. Seventy-five (75) of the parks (39%) and 9,243 of the spaces (38%) are subject to HCD enforcement jurisdiction with the balance subject to local government jurisdiction. There were reportable damages to manufactured homes in approximately twenty-seven (14%) of the parks within these counties. The Division's initial assessment of the performance of manufactured home support systems was conducted within these twenty-seven (27) parks. ....(p. 2)
>
> Of the 592 homes that went down in the 27 parks surveyed, 301 were homes installed on steel piers (51%), 223 were installed on concrete piers (38%) and 68 were installed on concrete blocks (11%). All of these support systems for manufactured homes are approved under HCD regulations, ...... (p. 4)

Their findings from this initial assessment are found in columns 3, 4, and 5 of table 31.

> Following the initial assessment, as time permitted, Division staff conducted a more detailed evaluation of the 12 parks where damage was the heaviest. Within these 12 parks were 479, or 81%, of the 592 homes down. .....(p. 8)

Their findings of this second assessment are found in columns 5 through 11 in table 31. Their report concludes:

> A clear result of the evaluation of performance from different types of manufactured home support systems is that there are substantial differences. It is also clear that the prior observance of Division inspectors in smaller earthquakes that concrete block support systems performed better than others can be statistically proven. .....(p. 14)
>
> Additionally, we have observed the performance of HCD Certified Earthquake Resistant Bracing systems (ERBS) for the first time under more than theoretical considerations..... It was observed by inspectors that homes equipped with HCD Certified ERBS sustained considerably less than noncertified systems although both types of systems performed adequately. .....(p. 14)

Figure 17 plots the percentage of fallen coaches as a function of distance from the fault. Only parks with 25 or more coaches were included. The numbers beside the solid circles are the same as those found by the park name in column 1 of table 31. No strict relationship should be drawn between figures 15 and 17 since fault distances are, respectively, by ZIP centroid and by park centroid. The 6 mile boundary for the PML zone remains valid for mobile homes in this earthquake.

The department also found two mobile homes destroyed by fire following the earthquake. They may be the same as those previously cited for source C.

**Table 31.** Mobile home performance in the 1989 Loma Prieta earthquake, insurance and non-insurance data.

[Data mostly from California Department of Housing and Community Development (1989(?)).]

| | County and Park Names | Fault Dist. (miles) | Number Spaces | Coaches Fallen Number | Coaches Fallen Pct. | Type of Vertical Supports for Coaches: Steel Piers Number | Steel Piers Pct. Fell | Concrete Piers Number | Concrete Piers Pct. Fell | HCB Piers Number | HCB Piers Pct. Fell | Number Certif. Bracing Systems | Data Source B Losses Over 10 Pct. Ded. Insured Coaches | Data Source B Losses Over 10 Pct. Ded. Pct. Loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN BENITO COUNTY: | | | | | | | | | | | | | |
| 1 | Mission Oaks | 16.0 | 225 | 120 | 53 | 75 | 81 | 39 | 46 | 111 | 37 | 5 | 39 | 9.0 |
| | River Oaks | - | 12 | 8 | 67 | - | - | - | - | - | - | - | - | - |
| | Hollister Park | - | 10 | 7 | 70 | 6 | 100 | 0 | 0 | 4 | 25 | 0 | - | - |
| | O'Bannon's | - | 11 | 4 | 36 | - | - | - | - | - | - | - | - | - |
| | Banning | - | 16 | 2 | 13 | - | - | - | - | - | - | - | - | - |
| | Country Trailer Estates | - | 4 | 1 | 25 | 4 | 100 | 0 | 0 | 0 | 0 | 0 | - | - |
| | Mission Vineyard | - | 7 | 1 | 14 | - | - | - | - | - | - | - | - | - |
| | Fairview Mobile Manor | 18.7 | - | - | - | - | - | - | - | - | - | - | 15 | 0.1 |
| | SANTA CLARA COUNTY: | | | | | | | | | | | | | |
| 2 | Pacific Mobile Estates | 8.8 | 178 | 36 | 20 | - | - | - | - | - | - | - | 18 | 3.5 |
| 3 | Hacienda Valley | 13.6 | 165 | 14 | 8 | - | - | - | - | - | - | - | - | - |
| | Morgan Hill | - | 25 | 12 | 48 | - | - | - | - | - | - | - | - | - |
| 4 | Wagon Wheel | 9.8 | 121 | 9 | 7 | - | - | - | - | - | - | - | - | - |
| 5 | Madrone Estates | 13.6 | 173 | 8 | 5 | - | - | - | - | - | - | - | - | - |
| 6 | Hill Haven | 12.5 | 44 | 2 | 5 | - | - | - | - | - | - | - | - | - |
| | Dalys | - | 24 | 1 | 4 | 24 | 4 | 0 | 0 | 0 | 0 | 0 | - | - |
| | SANTA CRUZ COUNTY: | | | | | | | | | | | | | |
| 7 | Rancho Cerritos | 3.3 | 144 | 92 | 64 | 33 | 67 | 106 | 64 | 5 | 40 | 13 | 9 | 17.0 |
| 8 | Pinto Lakes Estates | 0.2 | 174 | 82 | 47 | 85 | 59 | 73 | 42 | 16 | 6 | 4 | - | - |
| 9 | Monterey Vista | 3.3 | 122 | 70 | 57 | 87 | 69 | 27 | 33 | 8 | 13 | 15 | 15 | 1.8 |
| 10 | Green Valley Estates | 2.8 | 105 | 57 | 54 | 36 | 58 | 66 | 53 | 3 | 33 | 2 | 18 | 6.8 |
| 11 | Colonial Manor | 2.9 | 71 | 8 | 11 | 5 | 40 | 49 | 8 | 17 | 12 | 3 | 4 | 2.9 |
| 12 | Old Mill | 5.2 | 39 | 14 | 36 | 0 | - | 32 | 38 | 7 | 29 | 4 | 11 | 4.0 |
| 13 | Meadow Manor | 2.1 | 276 | 14 | 5 | 10 | 100 | 0 | 0 | 266 | 2 | 0 | 13 | 1.1 |
| 14 | Freedom Mobilehome | 2.0 | 45 | 13 | 29 | 9 | 78 | 31 | 19 | 5 | 0 | 0 | - | - |
| 15 | Portola Heights | 2.8 | 119 | 10 | 8 | - | - | - | - | - | - | - | 12 | 3.3 |
| 16 | Mountain Brook | 2.6 | 44 | 4 | 9 | - | - | - | - | - | - | - | - | - |
| 17 | Vista Del Lago | 4.6 | 202 | 1 | <1 | - | - | - | - | - | - | - | 23 | 0.6 |
| | Riverside | 3.5 | 28 | 1 | 4 | - | - | - | - | - | - | - | - | - |
| 18 | Clearview Court | 4.4 | 50 | 1 | 2 | - | - | - | - | - | - | - | - | - |
| | Rancho Corralitos | 0.0 | - | - | - | - | - | - | - | - | - | - | 10 | 3.7 |
| | Totals | | 2,434 | 592 | 24 | 374 | 64 | 423 | 43 | 442 | 12 | 46 | 1,533 | |
| | | | | | | 214 fell | | 183 fell | | 55 fell | | None fell | | |

## Experience From Previous Earthquakes

Experience from other California earthquakes is first summarized by earthquake, followed by an analysis and summary of all California experience. Whenever available, previously published data have been updated with additional source material.

### 1971 San Fernando Earthquake

Published loss experience from this magnitude 6.4 earthquake may be found in Steinbrugge and others (1971). Some of the detailed source data for that study is no longer extant. Available summary sheets were used in these instances.

Table 32 presents the insured loss information gathered from one major insurance carrier. This table is confined to parks where insurance losses were reported and/or claims made. Information was not available on policies where no claims were made. Loss information was also not gathered on parks where no claims occurred. Information was available for 225 coaches out of 4,192 (slightly more than 5 percent) in the parks under consideration. No information was available on the kind of damage, such as that from having fallen from supporting piers. The table also shows that this company's market share varied significantly from park to park.

Loss data were examined on 117 out of the 225 insured coaches (52 percent). A $50 deductible applied to each policy and therefore claims with losses under this amount were usually not submitted and are not included in our tabulations. The deductible is much lower than those examined for 1987 Loma Prieta and is valuable information in this respect.

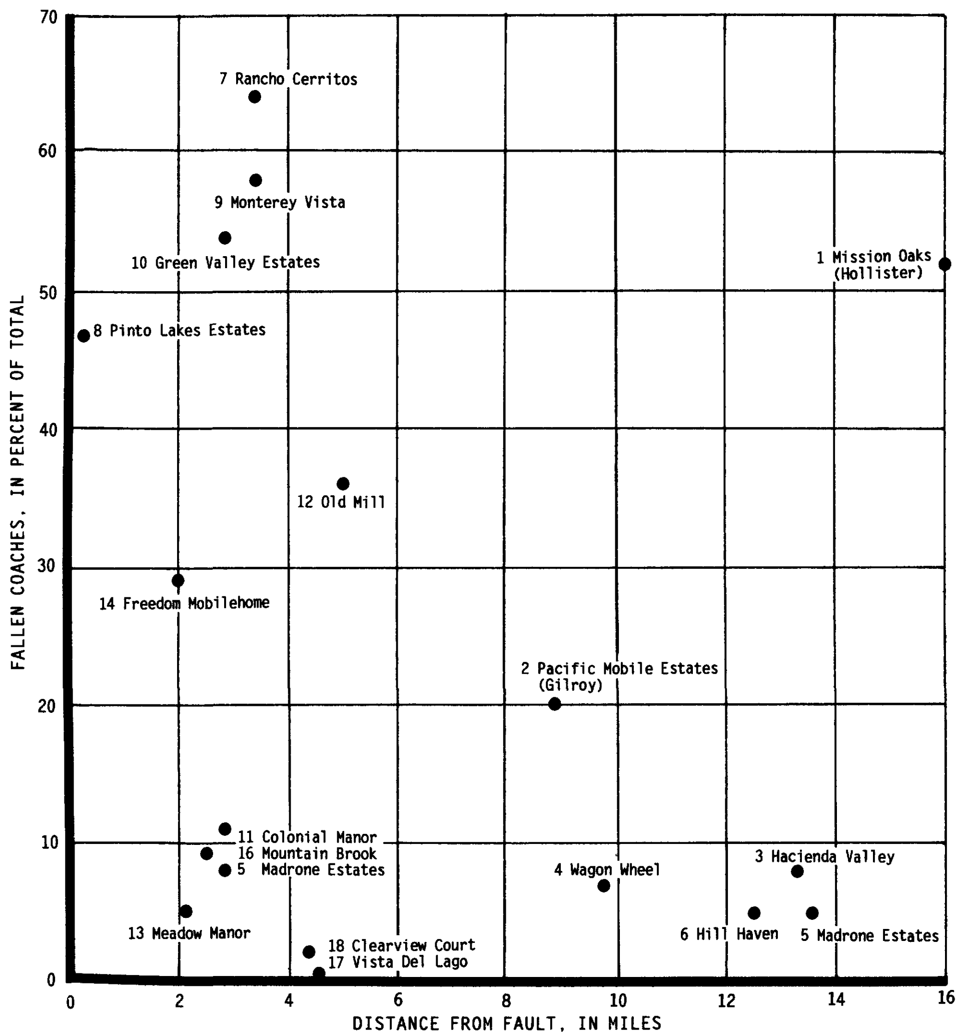



**Figure 17.** Loma Prieta earthquake. Percent of fallen mobile homes as a function of distance from the fault. Numbers beside the solid circles are the park numbers identified in table 31. Source is California Department of Housing and Community Development (1989?, p. 2).

**Table 32.** Mobile home loss experience from 1971 San Fernando earthquake, magnitude 6.4.

[Only parks with submitted insurance claims. Loss data provided by one major insurance carrier.]

| | | | Insured Loss Data | | | |
|---|---|---|---|---|---|---|
| Park No. | City or Community | Park Name | Total Coaches In Park[1] | Insured Coaches In Park | Coaches With Loss Over $50 | Average Percent Loss |
| 1 | Chatsworth | Indian Hills | 138 | 8 | 1 | 0.0 |
| 2 | Chatsworth | Chatsworth | 198 | 14 | 2 | 1.6 |
| 3 | Chatsworth | Imperial Gardens | 184 | 12 | 4 | 6.7 |
| 4 | Canoga Park | Canoga Country | 155 | 12 | 3 | 3.2 |
| 5 | Canoga Park | Kona Kai | 116 | 11 | 5 | 3.6 |
| 6 | Canoga Park | Eaton | 111 | 12 | 3 | 2.0 |
| 7 | Northridge | Walnut | 62 | 4 | 1 | 6.6 |
| 8 | Northridge | Northridge | 168 | 12 | 9 | 5.2 |
| 9 | Sylmar | Tahitian | 175 | 1 | 1 | 30.0 |
| 10 | Sylmar | Sylmar | 66 | 1 | 1 | 25.4 |
| 11 | Sylmar | Lumark | 101 | 4 | 4 | 19.7 |
| 12 | Mission Hills | Monterey Manor | 71 | 10 | 7 | 8.0 |
| 13 | Mission Hills | Mission Manor | 95 | 9 | 6 | 19.8 |
| 14 | Sun Valley | Laurel Canyon | 60 | 3 | 1 | 11.3 |
| 15 | Pacoima | Shelter Isle | 260 | 6 | 3 | 7.7 |
| 16 | Pacoima | Shadow Hills | 96 | 2 | 2 | 5.4 |
| 17/18 | Pacoima | Blue Star/Mission | 240 | 3 | 1 | 13.5 |
| 19 | Pacoima | Skyland Terrace | 69 | 1 | 1 | 39.1 |
| 20 | Sunland | Sherman Grove | 76 | 3 | 3 | 3.5 |
| 21 | Sunland | Monte Vista | 71 | 5 | 2 | 11.6 |
| 22 | Newhall | Mulberry Park | 108 | 8 | 2 | 7.0 |
| 23 | Newhall | Polynesian | 144 | 6 | 4 | 14.6 |
| 24 | Saugus | Parklane | 330 | 26 | 17 | 20.1 |
| 25 | Saugus | Cordova | 280 | 9 | 8 | 23.1 |
| 26 | Saugus | Granada Villa | 92 | 2 | 2 | 7.4 |
| 27 | Saugus | Desert Gardens | 60 | 3 | 3 | 7.8 |
| 28 | Saugus | Sierra Trailer | 76 | 3 | 3 | 8.6 |
| 29 | Saugus | Royal Oaks | 85 | 5 | 5 | 9.9 |
| 30 | Saugus | Caravilla | 84 | 7 | 4 | 9.9 |
| 31 | Saugus | Blackburns | 50 | 2 | 1 | 7.5 |
| 32 | Saugus | Sand Canyon | 70 | 2 | 2 | 8.3 |
| 33 | Saugus | Canyon Breeze | 90 | 4 | 2 | 0.0 |
| 34 | Saugus | Lilly of Valley | 112 | 10 | 3 | 8.5 |
| 35 | Simi Valley | Santa Susana | 99 | 5 | 1 | 2.1 |
| | Totals | | 4,192 | 225 | 117 | |

[1]Based on the number of spaces available for mobile homes. Parks are normally at or close to capacity. As a result, the number of coaches are slightly overstated for some parks.

Earthquake bracing in any form was very rare.

Figure 18 shows the locations of all but two of the mobile home parks for which loss data were available; park 35 in Simi Valley is slightly west of the map boundary, and the other park (not listed in table 32) is in Gardena, about 35 miles from the source of the earthquake's energy, where a 24 percent loss occurred to one of fifty coaches. Undoubtedly there were many mobile home parks between 10 miles (park 35 in Simi Valley) and 35 miles (Gardena) with very small damage and no reported insurance claims. The Gardena loss was not considered to be meaningful and was not included in further study.

Thrust faulting, such as that which occurred during the 1971 San Fernando earthquake, creates ground fractures and other surface disturbances over a wide zone (Barrows and others, 1973; Steinbrugge and others, 1971). Ground fractures and displacements scattered intensified damage to wood frame dwellings as shown in figure 14 of Steinbrugge and Algermissen (1990). They also intensified damage in the mobile home tracts.

Figure 19 plots percent losses against distance from the earthquake's energy source. The loss in the percent loss computations includes a $50 deductible. The park's distance is not from the epicenter, but rather from the energy release at depth along the fault rupture. The San Fernando thrust fault dips about 45 degrees to the north from its poorly defined surface expression in the San Fernando Valley. The focal depth of the earthquake was about 8 kilometers beneath the epicenter shown in figure 18. The model for the location of the energy release is a line source on the 45-degree fault plane, at a depth midway between the focus and the generalized surface expression of the fault. The horizontal length and strike of the line source is taken to be the same as the generalized surface expression of the fault. The San Fernando model is similar in concept to 1989 Loma Prieta in figure 2.

Mobile home parks in figure 18 were separated into three groups: (1) those on the upper plate of the thrust fault, (2) on the lower plate, and (3) on the ground disturbed areas on maps (Barrows and others, 1973; Steinbrugge and others, 1971). Figure 14, Steinbrugge and Algermissen (1990), shows portions of the same area where damage can be identified with ground disturbances.

In figures 18 and 19, parks numbered 9, 10, 11, 17, 18, and 19 are close to the faulting and had abnormally high losses (table 32). Disturbed ground conditions were also a factor. Park 19 had significant faulting across the rear portion of the park. Park 11 was very close to faulting. Losses at these parks do not qualify under the PML definition since the damage was not due to shaking alone.

Thirteen parks in Newhall and Saugus are on the upper plate and away from the disturbed areas. Nine of the

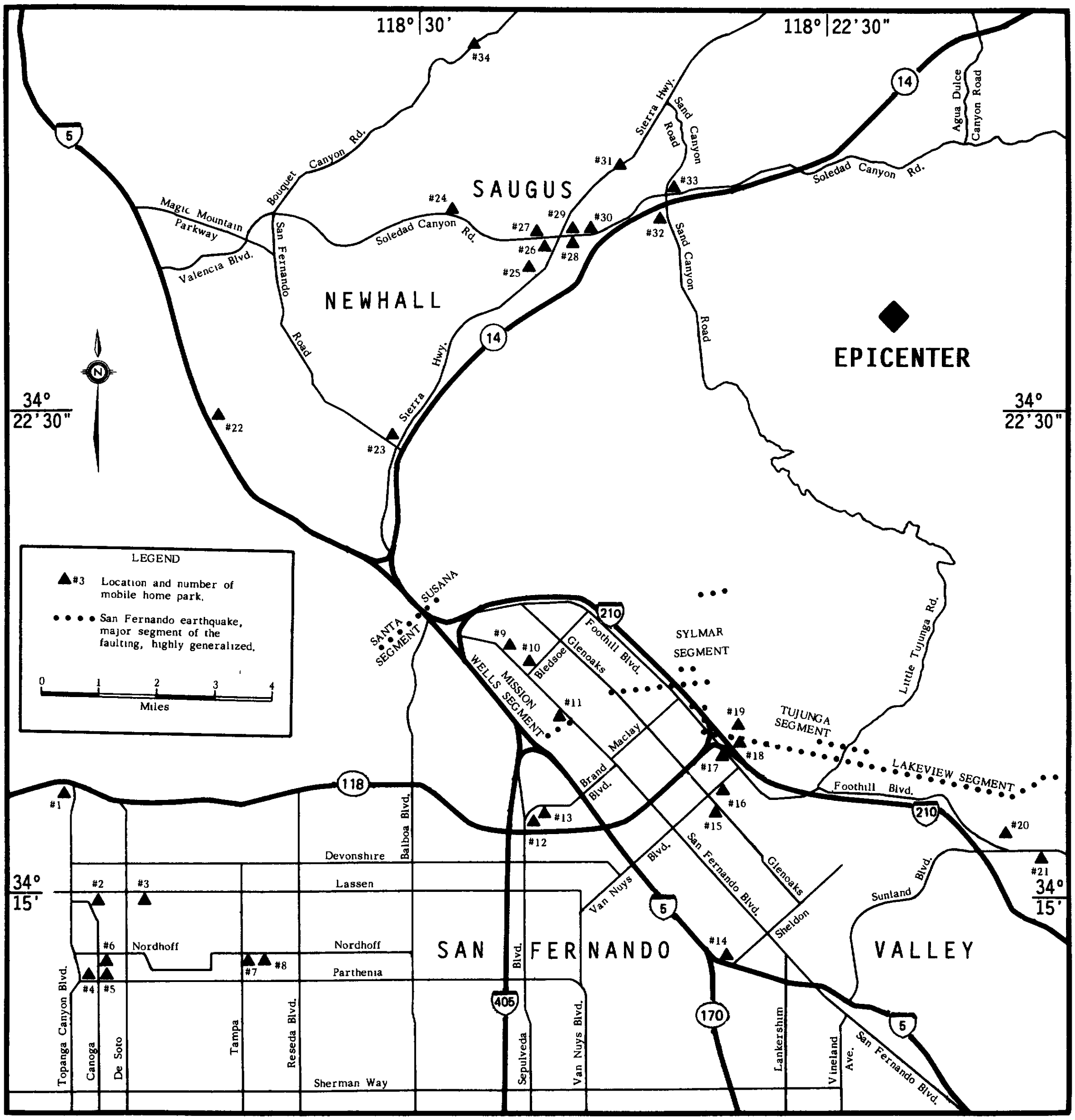



**Figure 18.** 1971 San Fernando earthquake region showing the locations of mobile home parks. Numbers adjacent to the solid triangles are park numbers found in table 32.

thirteen are concentrated in a 4 mile stretch along, or close to, the Soledad Canyon Road. This road closely follows the Santa Clara River. Park 25, in a former flood plain of this river, sustained abnormally high losses, an average of 23 percent per unit. Several of the nine parks near the Santa Clara River were located on the unconsolidated gravels and sands of its flood plain. Nearly 95 percent of the coaches were shaken off their supports in park 26, while park 24, about a mile and a half away, experienced displacement of 280 coaches. It is likely that soil conditions increased the losses, similar to Mission Oaks Park in the 1989 Loma Prieta earthquake (table 26).

### Observations on San Fernando

Figure 19, a plot of losses versus fault distance, is of interest for the loss attenuation component in loss estimation programs. This will be further examined in a following section.

Table 33 shows a loss breakdown by construction components as a percentage of value. Excluded are coaches located in disturbed ground areas and parks with incomplete loss breakdowns. This kind of information is useful for visual loss estimation purposes during field inspections.

Three mobile home parks (9, 10, 11) were adjacent to or in areas where losses for conventional dwellings have been determined—see figure 18 herein along with figure 14 in Steinbrugge and Algermissen (1990). The right hand column in table 34 is the ratio between the average loss for mobile homes to wood frame dwellings. These ratios indicate that a San Fernando type earthquake may produce 2 to 4 times more damage to a mobile home than to a conventional wood frame dwelling in the more heavily shaken areas. These comparisons are at zero deductible, that is, at PML values.

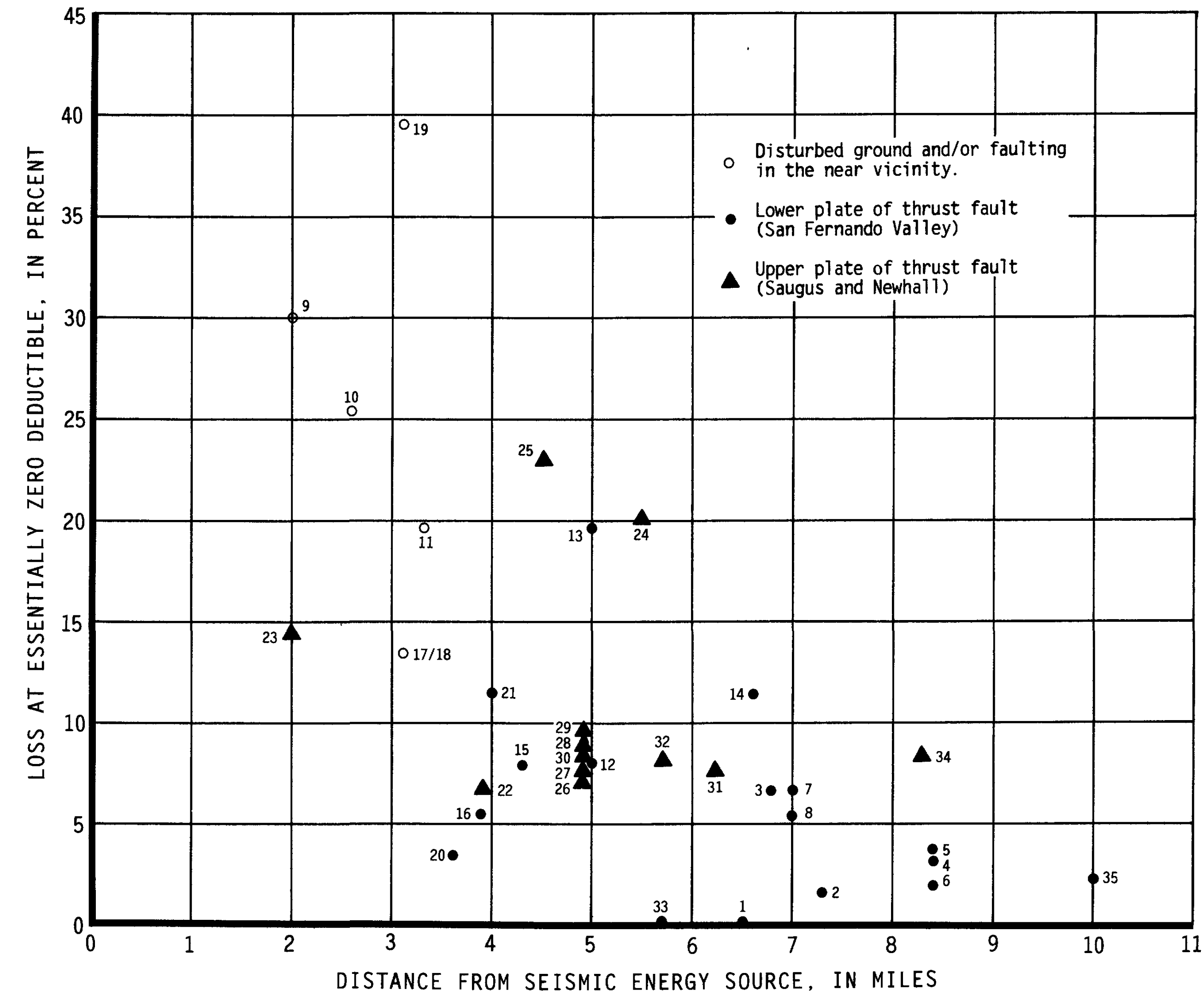



**Figure 19.** 1971 San Fernando earthquake. Percent loss over deductible as a function of distance for individual mobile home parks. Numbers are park numbers identified in table 32.

**Table 33.** Average loss to mobile home components, 1971 San Fernando earthquake, magnitude 6.4.

[Losses at zero deductible as a percentage of insured value. Adapted from table 1, Steinbrugge and others (1980).]

| District or Community | Number Insured Coaches | Number Paid Claims | Loss, in Pct. of Insured Value: Coach[1] | Awning and Skirt | Relevel | Contents | Total | Modified Mercalli Intensity[2] |
|---|---|---|---|---|---|---|---|---|
| Sylmar | 8 | 6 | 18.4 | 3.8 | 3.8 | 5.9 | 31.9 | X |
| Sunland | 8 | 5 | 1.2 | 2.5 | 0.9 | 1.4 | 6.0 | VII |
| San Fernando | 17 | 15 | 4.8 | 1.4 | 1.4 | 2.0 | 9.6 | X |
| Pacoima | 6 | 3 | 3.2 | 0.3 | 1.9 | 1.8 | 7.2 | VII |
| Newhall | 40 | 23 | 4.4 | 2.6 | 2.5 | 3.1 | 12.6 | VIII |
| Mission Hills | 10 | 7 | 3.9 | 1.8 | 1.7 | 1.3 | 8.7 | VIII |
| Saugus | 45 | 30 | 5.1 | 1.9 | 1.6 | 3.3 | 11.9 | VIII |
| Northridge | 16 | 10 | 1.5 | 1.2 | 1.1 | 0.9 | 4.7 | VII |
| Canoga Park | 35 | 10 | 0.5 | 0.3 | 1.0 | 1.3 | 3.1 | VI |
| Chatsworth | 34 | 5 | 1.2 | 0.0 | 1.1 | 0.9 | 3.2 | VI |
| Totals | 219 | 114 | | | | | | |
| Weighted average | | | 2.3 | 0.9 | 0.9 | 1.3 | 5.4 | |

[1]Coach, excluding awing, skirt, and contents.
[2]Then NOAA publications, now USGS.

**Table 34.** Wood frame dwelling versus mobile home losses for 1971 San Fernando earthquake, magnitude 6.4, zero deductible.

| Park No. | In or Adjacent to Tracts in Figure 14[1] | Average Percent Loss per Unit: Dwellings | Mobile Homes[2] | Ratio -- Mobile Homes To Dwellings |
|---|---|---|---|---|
| 9 | 10, 18 | 6.9 | 30.0 | 4.3 |
| 10 | 18, 21, 30 | 5.7 | 25.4 | 4.5 |
| 11 | 33, 43 | 8.7 | 19.7 | 2.3 |

[1]Steinbrugge and Algermissen (1990).
[2]$50 deductible added to insured loss.

### 1978 Santa Barbara Earthquake

Loss experience on eight mobile home parks from this magnitude 5.1 earthquake is found in Steinbrugge and Schader (1979), summarized as follows:

| | Number of mobile homes |
|---|---|
| In 8 parks | 1,392 |
| With reported damage | 476 |
| With earthquake insurance | 1,344 |
| With paid claims | 118 |

Locations of the mobile home parks (solid triangles) and the earthquake epicenter are shown in figure 20.

Most of the claims and insurance policies had a mandatory deductible of $350 to be applied to the aggregate loss of coach and contents. Additional living expense losses were very seldom encountered and were not included in this examination. A few of the claims had a one percent or $250 deductible, whichever was greater; in each case, the deductible amount was included in the analysis. When a claim was made and the loss did not reach the deductible, the claim data were not included in the tabulations.

Loss information was available on 35 percent (494) of the mobile homes of which 24 percent (118) had losses over the deductible (see table 35). Not included were claims with incomplete information. The $250 and $350 deductibles for 1978 Santa Barbara were higher than the $50 deductible for 1971 San Fernando, thereby reducing the comparative data quality for the lesser losses. These lesser losses increased for 1989 Loma Prieta because of its 10 percent deductible.

None of the Santa Barbara parks were located in ground disturbed areas or in fault zones. On the other

**Table 35.** Average loss to mobile home components from 1978 Santa Barbara earthquake, magnitude 5.1.

[Loss at zero deductible as a percentage of insured value. Data supplied by two major insurance carriers. Adapted from table 1 of Steinbrugge and Schader (1979).]

| | | | | Analyzed as Part of This Study | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Loss, in Pct. of Insured Value | | | | | |
| Park No. | Dist. to Epicenter (mi.) | Mobile Homes In Park | Total Insured Mobile Homes[1] | Insured Mobile Homes | Number Paid Claims | Coach[2] | Awning and Skirt | Relevel | Contents | Total | Modified Mercalli Intensity[3] |
| 1 | 6 | 234 | 230 | 48 | 16 | 2.1 | 0.3 | 1.6 | 0.7 | 4.6 | VII |
| 2 | 6 | 332 | 330 | 173 | 11 | 0.7 | 0.6 | 0.6 | 2.2 | 4.1 | V |
| 3 | 6 | 150 | 145 | 64 | 13 | 1.0 | 1.3 | 2.1 | 0.7 | 5.1 | V |
| 4 | 6 | 105 | 100 | 51 | 4 | 3.1 | 1.5 | 0.9 | 0.5 | 6.0 | VI |
| 5 | 7 | 200 | 198 | 52 | 12 | 0.8 | 0.4 | 1.0 | 1.7 | 3.9 | VI |
| 6 | 10 | 225 | 200 | 45 | 12 | 2.8 | 1.4 | 2.2 | 0.5 | 7.1 | V |
| 7 | 11 | 146 | 141 | 61 | 50 | 1.7 | 1.2 | 1.7 | 1.1 | 5.7 | V |
| Totals | | 1,392 | 1,344 | 494 | 118 | | | | | | |
| Weighted average | | | | | | 1.7 | 1.0 | 1.6 | 1.1 | 5.4 | |

[1]Determined by park manager. See next column for mobile homes included in this study.
[2]Coach, excluding awning, skirt, and contents.
[3]Determined by the authors for each park site.

hand, soils at some parks did vary considerably from those found in other parks as did the topography. This may explain why park 6 at nearly the farthest distance from the epicenter had the highest losses—much more than those at half the distance. It is not clear why park 7 had the highest ratio of paid claims to existing policies, yet the average loss for the park was not the highest.

The earthquake's small magnitude of 5.1 indicates a small horizontal rupture length. The epicenter was therefore used as a point source for seismic energy. As a result,

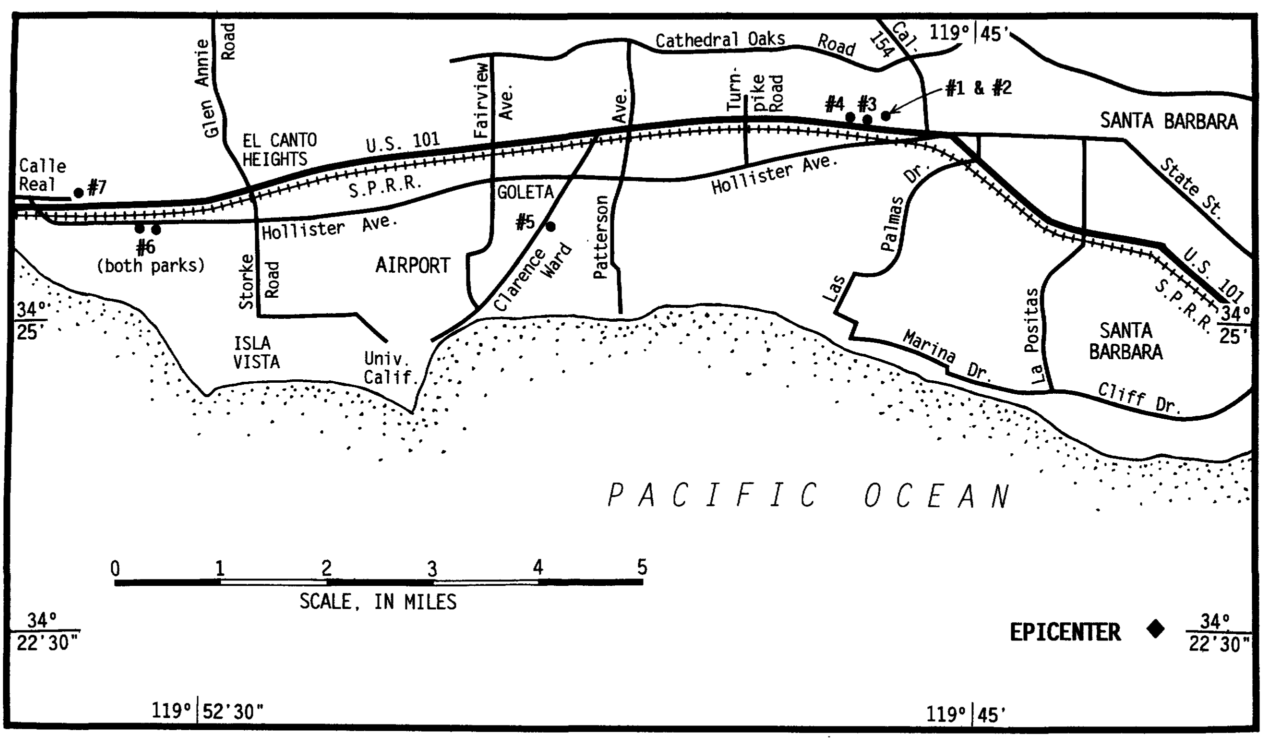



**Figure 20.** 1978 Santa Barbara earthquake region showing epicenter and approximate location of the mobile home parks (solid circles). Numbers beside the circles are identified in table 35.

**Table 36.** Average loss to mobile home components from 1979 El Centro (Imperial Valley) earthquake, magnitude 6.4.

[Losses at zero deductible as a percentage of insured value. Adapted from table 3, Steinbrugge and others (1980).]

| Park No. | Approx. Dist. to Epicenter (mi.) | Total No. of Mobile Homes | No. of Damaged Mobile Homes[1] | Analyzed as Part of This Study: No. of Claims Studied | Loss, in Pct. of Insured Value: Coach[2] | Awning and Skirt | Relevel | Contents | Total | Modified Mercalli Intensity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.5 | 116 | 79 | 14 | 2.6 | 2.3 | 1.8 | 2.8 | 9.5 | VII+ |
| 2 | 2.5 | 117 | 100 | 18 | 2.2 | 2.0 | 1.9 | 1.0 | 7.1 | VII+ |
| 3[3] | 1(?) | 85 | 76 | 5 | 1.4 | 1.4 | 2.6 | 0.0 | 5.4 | VII+ |
| Totals | | 318 | 255 | 37 | | | | | | |
| Weighted average | | | | | 2.4 | 2.1 | 1.9 | 1.8 | 8.2 | |

[1]Defined as the number of coaches where releveling was required. Assessment made by authors.
[2]Coach, excluding awning, skirt, and contents.
[3]Data questionable, and not included in weighted average.

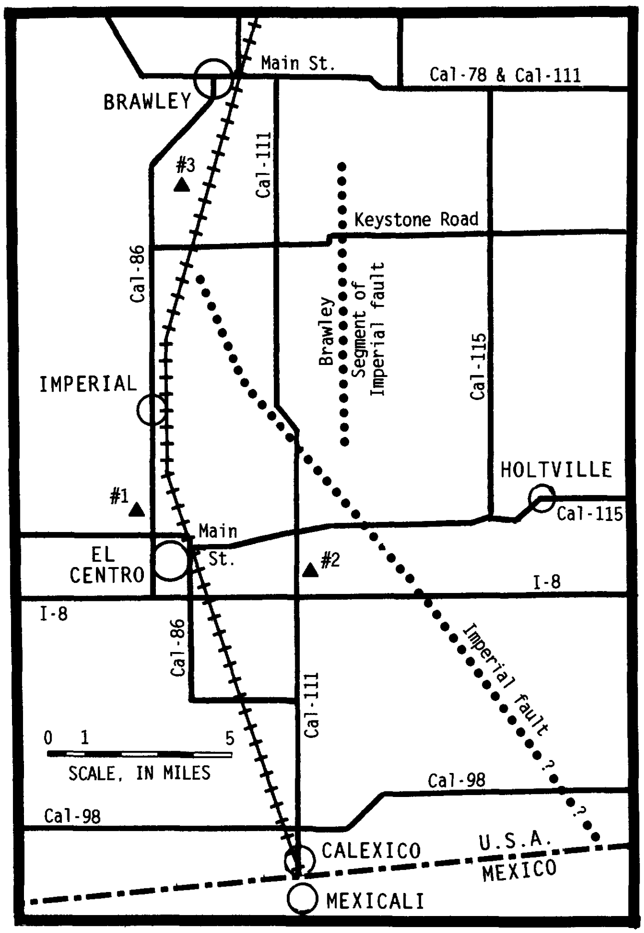



**Figure 21.** 1979 El Centro earthquake region showing mobile home parks (solid triangles). Numbers by the triangles are park numbers identified in table 36.

distances to the epicenter were used instead of fault distances in table 35.

Observations on Santa Barbara

No loss attenuation relationships are possible since four of the seven parks were in the PML zone and the three remaining are close to the zone boundary.

Table 35 losses to 1978 Santa Barbara coach components should be examined in the context of table 33 (San Fernando components), thereby improving loss estimation techniques. Similar information will be presented for the 1979 El Centro earthquake.

### 1979 El Centro (Imperial Valley) Earthquake

Loss experience for three mobile home parks in this magnitude 6.4 earthquake is found in Steinbrugge and others (1980). Figure 21 shows the locations of these parks with respect to the generalized surface traces of the faulting. Extensive damage occurred in these parks. As usual, observed wood frame dwelling damage was comparatively much less.

At the time of the earthquake, insurance policies had a deductible of $250 for the coach (which included losses to skirts, awnings, and the cost to relevel) and a separate $250 deductible for contents losses. All losses in table 36 were adjusted to a zero deductible, consistent with table 35 (Santa Barbara) and table 33 (San Fernando).

The then recently constructed park 1 (Gio's) was located in El Centro on Lincoln Avenue and a little more than one mile northwest of downtown El Centro. It was approximately 4.5 miles southwest of the faulting. There were 116 coaches in the park: 88 double-wide and 28 single-wide, some with add-on units.

Park 2 (KOA Country Life) was also of relatively new construction. There were 117 new coaches, all appearing to be supported on steel piers. The park contained 49 double-wide and 68 single-wide coaches. The park's location was east of El Centro on Ross Road near State Route 111. This location is approximately 2.5 miles southwest of the fault trace. Despite apparent severe shaking, pavements and concrete parking slabs in the park were undamaged. Nearby wood frame dwellings appeared undamaged.

Park 3 (Tangerine Gardens), with 85 coaches, was located 3 miles south of downtown Brawley on Legion Road. It consisted of 42 double-wide and 43 single-wide coaches, with some being older than those found in the other parks. The location was approximately 1 mile northwest from a zone of fresh cracking on a pre-existing fault scarp.

Table 36 is similar to table 33 for San Fernando and to table 35 for Santa Barbara. Previous comments also apply here.

#### Test of Rapid Loss Estimation, El Centro

The time necessary to acquire loss data from insurance sources is very long and the process can be tedious. There is usually a long wait during the insurance adjustment period, including the settlement of difficult claims, and the company's processing time toward the last completed and closed claim. It is often desirable to make a quick postearthquake field survey of damage to develop an estimated aggregate loss.

A pilot method used for this earthquake was a word grading system which summarized observed damage and assigned percentage losses to these word gradings. The definitions of degrees of damage are found in Appendix B, and these definitions can be supplemented by representative photographs. The observed damage to skirt and awnings, coaches off or partially off supports, and needs for releveling were quickly determined. The location of coaches in each park can be noted by space numbers usually available from the park manager's coach location map. This check allowed for future correlation with adjusters' information.

All coaches in the three parks in table 36 were externally inspected using the damage descriptions in Appendix B. Insurance loss data were then correlated with field observations in all three parks. Damage descriptions in Appendix B showed in table 37 the relationships to percent loss. The column "Percent Loss" is based on insurance loss (including contents) to insured value. Where there was no observed coach damage, any loss would be due to contents falling.

**Table 37.** Mobile home damage from 1979 El Centro (Imperial Valley) earthquake, magnitude 6.4.

| Coach damage | Number of Coaches | Percent Loss |
|---|---|---|
| None | 3 | 2.2 |
| Slight | 6 | 2.4 |
| Moderate | 5 | 5.0 |
| Severe | 23 | 10.8 |

### 1980 Livermore (Greenville) Earthquakes

Two mobile home parks were in the more heavily shaken area of two earthquakes which occurred one day apart. Figure 22 is a vicinity map showing the location of these parks and also the approximate locations of some of the ground breakage associated with possible faulting. "The surface faulting was discontinuous .... and in places was difficult to separate from downslope gravity movements .... and may have extended as far as the vicinity of Interstate Highway 580... "(Bonilla and others, 1980, p.15). Magnitudes were, respectively, 5.5 and 5.6. Park 1 (Sunrise) was located northeast of Livermore and immediately north of Interstate 580 in the community of Springtown. Every coach was exterior inspected in accordance with the methods given in Appendix B. Damage of some kind was almost universal to the coaches. Insured values were obtained from insurance sources, but no followup was made to obtain the results of adjusted claims. A summary of the field inspections is given in table 38.

Park 2 (Vineyard Mobile Villa), located 3 miles west of park 1 and also on Interstate 580, received no damage to any of its 159 coaches—mostly single-wide. Park occupants reported 5 to 10 percent of their shelf items fell. The damage contrast between these two parks was remarkable and was not attributed to construction.

Two story wood frame apartment houses adjacent to park 1 were interior and exterior inspected for comparison

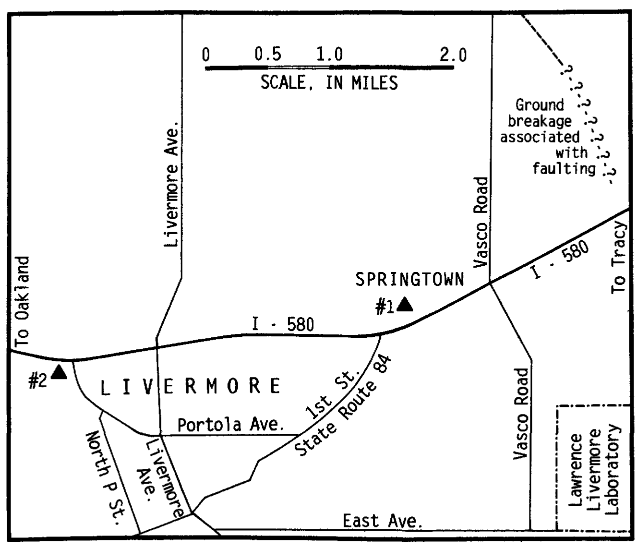



**Figure 22.** 1980 Livermore (Greenville) earthquake region showing approximate location of surface breakage associated with faulting. Numbers by the solid triangles are park numbers identified in the text.

**Table 38.** Mobile home damage in park 1 from 1980 Livermore (Greenville) earthquakes, magnitudes 5.5 and 5.6.

[Summary of field inspections using Appendix B damage classifications.]

| Type of coach | Number Coaches Having Damage: None | Slight | Moderate | Severe | Total Coaches |
|---|---|---|---|---|---|
| Single-wide | 4 | 6 | 5 | 19 | 34 |
| Double-wide | 1 | 14 | 10 | 57 | 82 |
| Single-wide w/expansion | 0 | 4 | 5 | 6 | 15 |
| Double-wide w/expansion | 1 | 0 | 0 | 0 | 1 |
| Triple-wide | 0 | 0 | 0 | 1 | 1 |
| Totals | 6 | 24 | 20 | 83 | 133 |

**Table 39.** Mobile home damage from 1983 Coalinga earthquake, magnitude 6.7.

[Summary of field inspections using Appendix B damage classifications.]

| Type of coach | Number Coaches Having Damage: None | Slight | Moderate | Severe | Total Coaches |
|---|---|---|---|---|---|
| Single-wide | 4 | 7 | 7 | 38 | 56 |
| Double-wide | 1 | 1 | 2 | 2 | 23 |
| Single-wide w/expansion | 2 | 2 | 18 | 0 | 22 |
| Totals | 7 | 10 | 27 | 40 | 101 |

**Table 40.** Performance of mobile home supports in 1983 Coalinga earthquake, magnitude 6.7.

[Type of coach support versus coach stability.]

| Did Coach Shift Or Fall? | Vertical Supports: Metal Piers | Wood Blocks | Hollow Concrete Blocks |
|---|---|---|---|
| Yes | 71 (92%) | 0 | 14 (56%) |
| No | 6 (8%) | 2 | 11 (44%) |

with the mobile home damage. No exterior damage was noted to the apartment houses. Very slight movements on interior gypsum board joints were found in some instances. Occupants and the apartment managers estimated that 30 to 50 percent of the shelf items fell when not in cabinets. Lamps were knocked over. Electric water heaters shifted, breaking flexible water hose connections. All windows in the eight buildings housing a total of 42 units were unbroken.

Within a quarter mile west of park 1, 60 percent of the shelf stock fell at an undamaged liquor store. There were several statements after the event that the earthquake stability of the unbraced mobile homes was little more than that of stock on shelves!

The Lawrence Livermore Laboratory reported the following for their coach units which were structurally similar to mobile homes:

> .....[there were] approximately 975 individual trailer [coach] units organized into 216 complexes. At the time of the earthquake, 87 of these complexes had a lateral force tiedown system. In general, there was very little damage to trailers. In complexes not tied down, one trailer was badly damaged (walls cracked, etc.) and four were moderately damaged (interior ceiling tiles and light fixtures were displaced). Some complexes moved slightly and some foundations jacks fell...... However, no structural damage occurred to trailers that were tied down..... (Lawrence Livermore Laboratory, 1980, p. 20).

The laboratory is about 2 to 3 miles south of the poorly established southern end of the surface expression of faulting.

### 1983 Coalinga Earthquake

The one mobile home park in Coalinga experienced a nearby earthquake having a magnitude of 6.7 and a Modified Mercalli intensity of VIII. This intensity applied to the city as well as to the park. The park was located in the eastern section of the city, adjacent to Olson Park, and south of Roosevelt Avenue (Steinbrugge, Fowkes, and others, 1990, p. 360). Coaches were field inspected for (a) width (single-wide, double-wide, and single-wide with expansion units), (b) whether or not the coach fell or shifted on its supports, (c) type of supports (metal piers, hollow concrete block, wood, or other), (d) damage to skirt, (e) damage to coach, and (f) add-on porch (if any) and its separation from the main unit. Damage evaluations were made using the criteria found in Appendix B.

Information from the field inspections is found in table 39. Unfortunately, insurance losses were not obtained, and thus correlations between observed damage and actual losses are not available. Field survey data were complete for 101 of the 105 units in the park, summarized in table 39.

**Table 41.** Mobile home loss over deductible in PML zone.

[Limited to coaches with paid losses.]

| | Percent Loss Over Percent Deductible | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Loma Prieta PML Zone MAG = 7.1 263 Coaches | | Watsonville ZIP 95076 MAG = 7.1 81 Coaches | | Loma Prieta PML Excl. ZIP 95076 MAG = 7.1 182 Coaches | | 1971 San Fernando MAG = 6.4 70 Coaches | 1978 Santa Barbara MAG = 5.1 56 Coaches |
| Pct. Ded. | Coach Only | Coach+ Conts. | Coach Only | Coach+ Conts. | Coach Only | Coach+ Conts. | Coach+ Conts. | Coach+ Conts. |
| 0 | ... | ... | ... | ... | ... | ... | 11.27 | 1.18 |
| 1 | ... | ... | ... | ... | ... | ... | 10.59 | 1.02 |
| 2 | ... | ... | ... | ... | ... | ... | 9.90 | 0.86 |
| 3 | ... | ... | ... | ... | ... | ... | 9.23 | 0.71 |
| 4 | ... | ... | ... | ... | ... | ... | 8.61 | 0.57 |
| 5 | ... | ... | ... | ... | ... | ... | 8.02 | 0.45 |
| 6 | ... | ... | ... | ... | ... | ... | 7.46 | 0.35 |
| 7 | ... | ... | ... | ... | ... | ... | 6.94 | 0.27 |
| 8 | ... | ... | ... | ... | ... | ... | 6.44 | 0.21 |
| 9 | ... | ... | ... | ... | ... | ... | 5.98 | 0.17 |
| 10 | 4.67 | 1.43 | 7.88 | 2.06 | 3.38 | 1.17 | 5.53 | 0.13 |
| 11 | 4.32 | 1.31 | 7.24 | 1.87 | 3.15 | 1.08 | 5.08 | 0.11 |
| 12 | 4.01 | 1.20 | 6.69 | 1.68 | 2.94 | 1.01 | 4.65 | 0.09 |
| 13 | 3.74 | 1.11 | 6.17 | 1.53 | 2.76 | 0.94 | 4.27 | 0.07 |
| 14 | 3.49 | 1.04 | 5.69 | 1.42 | 2.61 | 0.88 | 3.94 | 0.06 |
| 15 | 3.27 | 0.97 | 5.26 | 1.33 | 2.47 | 0.82 | 3.64 | 0.06 |
| 16 | 3.05 | 0.91 | 4.85 | 1.24 | 2.33 | 0.77 | 3.36 | 0.05 |
| 17 | 2.86 | 0.85 | 4.51 | 1.16 | 2.19 | 0.73 | 3.12 | 0.04 |
| 18 | 2.68 | 0.80 | 4.20 | 1.09 | 2.07 | 0.68 | 2.90 | 0.04 |
| 19 | 2.53 | 0.74 | 3.94 | 1.03 | 1.96 | 0.63 | 2.70 | 0.03 |
| 20 | 2.39 | 0.69 | 3.69 | 0.96 | 1.86 | 0.58 | 2.51 | 0.02 |

The kinds of vertical supports for the coaches were compared with damage in table 40. This comparison suggests that hollow concrete block supports performed better than steel piers. This was strongly confirmed in the 1989 Loma Prieta earthquake where 64 percent of coaches on steel piers fell while only 12 percent with hollow concrete block supports fell (table 31).

## Synthesis and Overview

To this point, partial analyses and findings have been made by individual earthquakes. In this section, these are synthesized and organized by subject rather than by earthquake.

### PML Zone

The 6 mile (10 kilometer) boundary of the PML zone from the surface projection of the line source of the earthquake energy is a reasonable model for mobile homes (figures 15, 16, and 17) as well as for wood frame dwellings. The model uses the average of all losses in the PML zone, excluding geohazards; this average is the PML, expressed in percent or in dollars. It is likely that this model will be substantially changed and improved when better near-field loss and seismic data are eventually obtained.

### Loss Over Deductible in the PML Zone

As is the case for wood frame dwellings, determining the loss over deductible for the PML zone has two necessary requirements. The value of each mobile home in the entire study area (or insurance company's book of business) must be known, whether a mobile home suffered losses or not. Second, the losses and deductibles, if any, must be known for each mobile home. The first criteria is met by all mobile homes included in table 41. Only data from the 1971 San Fernando and the 1978 Santa Barbara earthquake come adequately close to satisfying the second criteria with their average deductibles of 0.2 percent and 1.2 percent, respectively. In these latter two cases, the dollar deductible was very low, being $50 for 1971 San Fernando and $250 or $350 for 1978 Santa Barbara.

Unfortunately, the 1979 Santa Barbara loss over deductibles may be incorrect by a large amount. At the damage threshold of magnitude 5, experience indicates that the 6 mile PML boundary is too large. The Santa Barbara parks are at this 6 mile boundary and these data are not used.

With few variants, mobile home loss over deductible analysis follows that for wood frame dwellings. Table 41 shows all known loss over deductible information. Analysis was restricted to the 1989 Loma Prieta PML zone (columns 2 and 3) and to the 1971 San Fernando experience (column 8). The Loma Prieta PML zone was chosen for

**Table 42.** Loss over deductible as a function of deductible, in percent.

[Uncertainty factor = 1. Applicable to mobile home coaches, excluding contents.]

| Percent | Magnitude | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deductible | 5.00 | 5.25 | 5.50 | 5.75 | 6.00 | 6.25 | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 |
| 0 | 0.50 | 1.61 | 2.73 | 3.84 | 4.95 | 6.06 | 7.18 | 8.29 | 9.40 | 10.51 | 11.63 | 12.74 | 13.85 | 14.96 |
| 1 | 0.46 | 1.49 | 2.52 | 3.55 | 4.58 | 5.61 | 6.65 | 7.68 | 8.71 | 9.74 | 10.77 | 11.80 | 12.83 | 13.86 |
| 2 | 0.43 | 1.38 | 2.34 | 3.29 | 4.25 | 5.20 | 6.15 | 7.11 | 8.06 | 9.02 | 9.97 | 10.92 | 11.88 | 12.83 |
| 3 | 0.40 | 1.28 | 2.16 | 3.05 | 3.93 | 4.82 | 5.70 | 6.58 | 7.47 | 8.35 | 9.23 | 10.12 | 11.00 | 11.88 |
| 4 | 0.37 | 1.19 | 2.00 | 2.82 | 3.64 | 4.46 | 5.28 | 6.10 | 6.91 | 7.73 | 8.55 | 9.37 | 10.19 | 11.01 |
| 5 | 0.34 | 1.10 | 1.86 | 2.61 | 3.37 | 4.13 | 4.89 | 5.64 | 6.40 | 7.16 | 7.92 | 8.68 | 9.43 | 10.19 |
| 6 | 0.32 | 1.02 | 1.72 | 2.42 | 3.12 | 3.82 | 4.53 | 5.23 | 5.93 | 6.63 | 7.33 | 8.03 | 8.74 | 9.44 |
| 7 | 0.29 | 0.94 | 1.59 | 2.24 | 2.89 | 3.54 | 4.19 | 4.84 | 5.49 | 6.14 | 6.79 | 7.44 | 8.09 | 8.74 |
| 8 | 0.27 | 0.87 | 1.47 | 2.08 | 2.68 | 3.28 | 3.88 | 4.48 | 5.08 | 5.69 | 6.29 | 6.89 | 7.49 | 8.09 |
| 9 | 0.25 | 0.81 | 1.36 | 1.92 | 2.48 | 3.04 | 3.59 | 4.15 | 4.71 | 5.27 | 5.82 | 6.38 | 6.94 | 7.49 |
| 10 | 0.23 | 0.75 | 1.26 | 1.78 | 2.30 | 2.81 | 3.33 | 3.84 | 4.36 | 4.88 | 5.39 | 5.91 | 6.42 | 6.94 |
| 11 | 0.21 | 0.69 | 1.17 | 1.65 | 2.13 | 2.60 | 3.08 | 3.56 | 4.04 | 4.52 | 4.99 | 5.47 | 5.95 | 6.43 |
| 12 | 0.20 | 0.64 | 1.08 | 1.53 | 1.97 | 2.41 | 2.85 | 3.30 | 3.74 | 4.18 | 4.62 | 5.07 | 5.51 | 5.95 |
| 13 | 0.18 | 0.59 | 1.00 | 1.41 | 1.82 | 2.23 | 2.64 | 3.05 | 3.46 | 3.87 | 4.28 | 4.69 | 5.10 | 5.51 |
| 14 | 0.17 | 0.55 | 0.93 | 1.31 | 1.69 | 2.07 | 2.45 | 2.83 | 3.21 | 3.59 | 3.97 | 4.35 | 4.72 | 5.10 |
| 15 | 0.16 | 0.51 | 0.86 | 1.21 | 1.56 | 1.92 | 2.27 | 2.62 | 2.97 | 3.32 | 3.67 | 4.02 | 4.38 | 4.73 |
| 16 | 0.15 | 0.47 | 0.80 | 1.12 | 1.45 | 1.77 | 2.10 | 2.42 | 2.75 | 3.08 | 3.40 | 3.73 | 4.05 | 4.38 |
| 17 | 0.14 | 0.44 | 0.74 | 1.04 | 1.34 | 1.64 | 1.94 | 2.25 | 2.55 | 2.85 | 3.15 | 3.45 | 3.75 | 4.05 |
| 18 | 0.13 | 0.40 | 0.68 | 0.96 | 1.24 | 1.52 | 1.80 | 2.08 | 2.36 | 2.64 | 2.92 | 3.20 | 3.47 | 3.75 |
| 19 | 0.12 | 0.37 | 0.63 | 0.89 | 1.15 | 1.41 | 1.67 | 1.93 | 2.18 | 2.44 | 2.70 | 2.96 | 3.22 | 3.48 |
| 20 | 0.11 | 0.35 | 0.59 | 0.83 | 1.07 | 1.30 | 1.54 | 1.78 | 2.02 | 2.26 | 2.50 | 2.74 | 2.98 | 3.22 |

analysis over the Watsonville study area since geohazards were not as important for mobile homes as they were for wood frame dwellings. The 1971 San Fernando losses over deductible data are for coach plus contents; 1989 Loma Prieta breaks these down by coach and by coach plus contents. Plotting normalized coach plus contents data for Loma Prieta (column 3) and San Fernando (column 8) showed a good match. As a consequence, the shape of the San Fernando curve was used for Loma Prieta. From there on, the methods used for wood frame dwellings were largely followed.

The San Fernando loss over deductible equation is based on column 8 of table 41:

San Fernando coaches plus contents:

$$L_D = 11.65912\ e^{-0.0768237\ D}$$

where

$L_D$ = percent loss over deductible, and

$D$ = deductible in percent.

The variables have the same meaning as those for wood frame dwellings. The equations for the Loma Prieta earthquake become:

Loma Prieta coaches:

$$L_D = 9.845945\ e^{-0.0768237\ D} \quad (9)$$

and

Loma Prieta coaches plus contents:

$$L_D = 3.014925\ e^{-0.0768237\ D} \quad (10)$$

Next including a variable magnitude and a user-selected uncertainty factor as was done for wood frame dwellings:

Coaches only, for general use:

$$L_D = [4.450450\ (M - 5) + 0.5]\ e^{-0.0768237\ D} \times F \quad (11)$$

where

$M$ = magnitude, and

$F$ = user-selected uncertainty factor,

and for:

Coaches plus contents, for general use:

$$L_D = [1.197583\ (M - 5) + 0.5]\ e^{-0.0768237\ D} \times F \quad (12)$$

where $L_D$ may be user-limited to magnitude 7.75 in equations 11 and 12.

Table 42 shows loss over deductible as a function of the deductible in 0.25 percent increments for coaches only. This a counterpart to table 15 for wood frame dwellings.

Figure 23 graphically shows the loss over deductible for coaches and for coaches plus their contents. These curves are for a magnitude 7.75 earthquake.

### Maximum Losses in the PML Zone

Table 43 shows maximum losses for four earthquakes, with differing magnitudes for three of them. The average loss for the upper 10 percent of mobile homes decreases with decreasing earthquake magnitude—column 4 of table 43.

With rare exception, individual coach plus contents losses before the deductible are not expected to exceed 2/3 of their combined values when ensuing fire and geohazards are excluded.

**Table 43.** Comparison of losses to mobile homes.

[Data restricted to mobile homes in parks located in the PML zone, but excluding those in the geohazard areas (ground disturbed areas) of the 1989 Loma Prieta and 1971 San Fernando earthquakes. Also excluded are losses due to ensuing fire.]

| Earthquake | Magnitude | Highest 10 Pct. of Mobile Homes with Losses: Number of Mobile Homes[1] | Highest 10 Pct. of Mobile Homes with Losses: Average Pct. Loss[2] | Highest Single Pct.Loss |
|---|---|---|---|---|
| 1989 Loma Prieta | 7.1 | 13 | 37.0 | 60.3 |
| 1971 San Fernando | 6.4 | 6 | 36.6 | 50.4 |
| 1979 El Centro | 6.4 | 4 | 22.3 | 26.0 |
| 1978 Santa Barbara | 5.1 | 6 | 19.9 | 33.4 |

[1]10 percent of total.
[2]Loss to coach and contents (before deductible) divided by insured value for every mobile home, then the highest 10 percent of mobile home losses are averaged.

It has been previously shown from source B mobile home data for Loma Prieta that contents losses as a percent of contents values are not likely to exceed 50 percent when geohazards and fire following are excluded.

### Loss Attenuation with Distance

Information on loss attenuation with distance is incomplete and the discussion which follows has limited utility. Figures 15 and 17 show very few loss data beyond the 6 mile PML boundary. While loss attenuation with distance is apparent, its quantification in equation format poses difficulties. Figure 15 is based on a 10 percent deductible, and quantification at zero deductible is questionable. Figure 17 is based on fallen coaches and is not monetarily quantified.

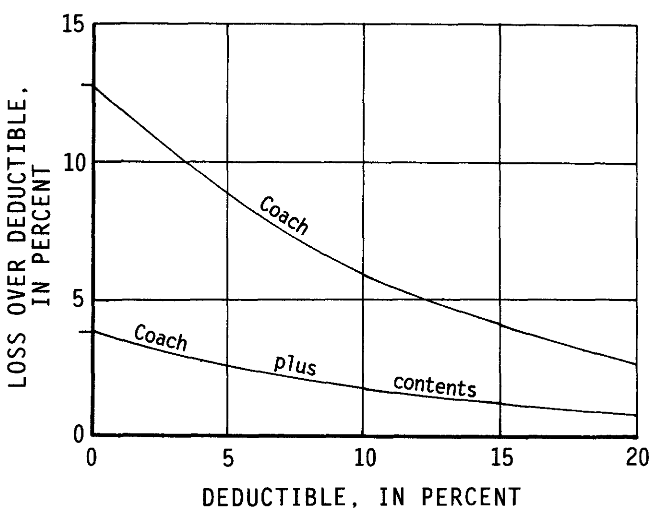



**Figure 23.** Percent loss over deductible as a function of percent deductible. Curve for coaches is based on equation 11 for magnitude 7.75. That for coach and contents is based on equation 12, also for magnitude 7.75.

Within the PML zone, there is some Loma Prieta evidence of loss attenuation between Watsonville and the coastal communities of Capitola, Aptos, and Soquel (see fig. 15). Six of the seven parks in the Watsonville ZIP were located about 2.5 miles from the fault, and the seventh was approximately on the fault. Fifteen others outside of this ZIP and in the PML zone were 4 to 6 miles from the fault, mostly in the coastal Capitola-Aptos-Soquel area. All source B mobile home parks in the PML zone were inspected for major geohazard losses and none were found. A reasonable inference is that losses in the PML zone were not uniform and decreased with distance from the fault.

Figure 16 shows each park's losses and its distance from the fault. The data for this figure provides a better approach despite the mentioned limitations. We prefer a logarithmic equation for loss attenuation since it is consistent with most strong motion attenuation curves. An alternate straight line equation is also given:

Logarithmic:

$$L_D \text{ at } 10\% \text{ deduct.} = 2.78897\, e^{-0.16566\,X} \quad (13)$$

Straight line:

$$L_D \text{ at } 10\% \text{ deduct.} = 2.78897 - 0.16566\,X \quad (14)$$

where X is the distance in miles. These equations apply only for the Loma Prieta magnitude and for a 10 percent deductible.

The 1971 San Fernando earthquake provided the only other usable information on loss attenuation with distance from the fault (see fig. 19 and table 32). Various attenuation equations were examined from the standpoints of (a) straight line versus exponential, (b) with or without the inclusion of parks located in the disturbed ground areas, (c) contiguous parks combined into one data entry, and other possibilities. It appears that a straight line function which excludes the parks in disturbed areas and also combines contiguous parks will best represent reality up to 10 miles from the surface projection of the line source of seismic energy:

$$L_D = 16.2986 - 1.3853\,X \qquad (15)$$

where X is the distance in miles. This equation applies only to the San Fernando earthquake with its essentially zero deductible.

#### Earthquake Bracing

It is clearly evident that earthquake bracing systems are very effective. State certified systems have performed excellently, and none have been known to fail. There is no reason to believe that older pre-certification systems are necessarily inferior, but a qualified person such an engineer should be the judge.

When no earthquake bracing is present, steel piers which support a coach are more likely to allow coach toppling than other types. On the other hand, steel piers as well as other types of vertical supports are expected to perform well upon installation of a certified earthquake bracing system, or equal as many seemed to be.

#### Coach Size and Damage

Coaches may be classified by size such as single-wide, double-wide, triple-wide, and with variants. Loma Prieta experience from 258 coaches showed that single-wide coaches performed marginally better than did two- or multiple-wide. The comparison was made on an average coach plus contents loss basis (7.0 and 7.8 percent, respectively). In the 1980 Livermore earthquake (table 38), single-wide performed better than double-wide "severe" damage. The reverse was true for the 1983 Coalinga earthquake (table 39). No doubt, the type of coach supporting piers is more important than coach size for unbraced coaches, but correlation data were unavailable.

No conclusions can be drawn from this mixed experience on coach size.

#### Loss Estimation From Rapid Field Inspections

The length of time needed to acquire insurance loss information may be excessive for many disaster response activities. The concept of a rapid field inspection introduced after the 1979 El Centro earthquake has promise. See tables 33 and 35 for information useful for field investigations.

The methodology has not gone beyond the pilot stage.

## SUMMARY, MAJOR FINDINGS, AND CONCLUSIONS

### Wood Frame Dwellings

#### Dwelling Loss Versus Other Losses

Within the nine county study area (fig. 1), wood frame dwelling losses amounted to 18.5 percent of the insured economic loss (table 1). Clearly, wood frame dwelling losses did not dominate over those to commercial and industrial properties.

In social and political senses, dwelling losses and dwelling habitability are of great importance to the general public, to disaster response entities such as the Red Cross, and to the Federal Emergency Management Agency and its state counterparts.

#### PML Zone and Modified Mercalli Intensities

Although damage extended throughout many counties around the San Francisco Bay, including those to the south around Monterey Bay (fig. 1), the heaviest shaken area was in the lightly inhabited regions within the Santa Cruz Mountains (fig. 3). This heaviest shaken area within 6 miles of the earthquake's energy release is defined as the PML zone shown in figure 3. The PML zone reasonably coincided with Modified Mercalli intensity VIII (fig. 14).

Average percentage losses within the MM VIII isoseismal boundary can be estimated by losses within the PML zone (see below under "Deductibles)." Other studied earthquakes have had significantly different percent losses for this same intensity. In general, comparisons among earthquakes show poor correlations between intensities and actual losses.

Many regions within the United States do not have earthquake insurance loss data available. They may be many decades away from obtaining such information. Transferability of California loss experience to different geologic environments may involve great uncertainties. The use of intensities in dwelling loss estimation is useful only when suitable loss data are not available.

#### Dwelling Age and Loss

Dwellings constructed prior to 1940 suffered much more damage than did subsequent construction. This has also been observed in all California earthquakes since 1971. There was insufficient Loma Prieta data on older homes to adequately quantify comparisons. The most recent quantified comparison was the 1983 Coalinga earthquake which showed that the pre-1940 wood frame dwellings had twice the percentage loss as did the more recent construction. There is some reason to believe that the Coalinga experience is not entirely applicable to the more seismic areas of California. The ratio between old and new is expected to be greater than two for non-retrofitted older houses.

Pre-1940 dwellings constituted only 8.8 percent of the fire insured dwellings in the study area, and this percentage has been constantly decreasing (table 7). A few of the pre-1940 dwellings have since been earthquake retrofitted and this practice is continuing. Demolition for other land-use purposes is also reducing the number. While many individual older dwellings will have large losses, the aggregate loss for all dwellings including those of all ages will not be greatly increased.

It is usually practical for aggregate loss estimation purposes to disregard dwelling age. The losses to older communities and/or cities within a large damage area can be exceptions. San Francisco, having a large number of older houses and with its relatively uncommon type of two story dwellings, will be prone to heavier than average damage. It will also be more vulnerable to ensuing fire. See table 3 and section "Source B Data".

Retrofitting is strongly recommended. This may not always be cost effective from a purely financial standpoint (including insurance), but personal safety and peace of mind are valid and strong homeowner concerns.

### Geohazards

Geohazard sites are defined as those in geologic hazard areas having a landslide potential and those with unstable ground such as liquefiable soils. Also included are dwellings on steeply sloping sites where construction characteristics create hazards on otherwise stable sites. This definition also applies to postearthquake losses. Dwelling losses due to geohazards amounted to about 27 percent of the total losses in the study area (see section "Elimination of Major Geohazard Losses"). This high percentage must be understood in the context of the epicenter and number of dwellings in the Santa Cruz Mountains.

### Deductibles

Source data on losses invariably included a deductible which varied in amount and sometimes in restrictions on its application. The process in developing generalized loss over deductible equations from Loma Prieta and those from other earthquakes are discussed. Equation 7 is the generalized result which includes magnitude and a user-selectable uncertainty factor and is intended for computer use. It is applicable to large groups of dwellings such as those found in a postal ZIP.

After earthquake losses have been compiled, geohazard losses can be eliminated. The loss algorithm is then usable for postulated earthquakes elsewhere having the same magnitude and geologic environments. Geohazards in the new study area are then included.

When excluding geohazard sites, examples of average dwelling loss to post-1939 construction in the PML zone with zero deductible are for a repeat of:

| | |
|---|---|
| Loma Prieta earthquake: | 6.5 percent, equation 1, Watsonville data |
| Loma Prieta earthquake: | 5.8 percent, equation 7, form for general use |
| 1906 San Francisco: | 8.7 percent, equation 7, form for general use |

Table 15 may be used instead of equation 7. Local geohazards must be included in the loss estimation algorithm. The discussion on the limitations and uncertainties surrounding these percentages should be heeded.

### Loss Attenuation With Distance

Losses reduce rapidly with distance. In the Loma Prieta earthquake, the average percent loss becomes low at 10 miles from the fault (fig. 6). At distances beyond 10 miles, losses became very small except at geohazard sites (figs. 12 and 13). The 1992 Landers earthquake provided information on losses up to 3 percent of value at distances as far as 40 miles (see section "1992 Landers Earthquake"). Bear in mind that deductibles apply, with those for Landers being much less that the other two.

Losses up to 5 percent of value have not been well studied due to the sparsity of reliable data. Indications are that the aggregate losses would be very large if damage was not repaired and paid for by the homeowner.

### Contents Losses

When dwellings were not destroyed, losses to their contents were about 20 to 25 percent of the building loss (table 16). For aggregate loss estimating purposes, the average percent dwelling loss can be increased by 25 percent, admitting wide variations in valuations and susceptibilities among building and contents.

### Ensuing Fire

While the news media immediately showed fires burning in San Francisco, the losses attributed directly to fire were only 7.5 percent of the homeowner losses in the study area. This percentage is expected to be higher for an earthquake of similar magnitude located within a highly populated area under weather conditions such as those at the time of the Loma Prieta earthquake. Adding adverse climatic conditions such as strong, dry, and hot winds, then widespread conflagrations are possible in a number of major residential areas. Experience from recent wind-driven conflagrations without earthquake in the San Francisco Bay area and in metropolitan Los Angeles with its Santa Ana winds are examples of the problems. The fire departments were almost overwhelmed from these conflagrations. With their added responsibilities after a great earthquake such as a repeat of 1906 San Francisco, the totality of the disaster is difficult to estimate. Fortunately, the simultaneous occurrence of a great earthquake and these severe climatic conditions has a very low probability.

### Research Needs

The fundamental needs for improved predictive loss estimation require an improved integration of three major components:

(1) Actual loss statistics in place of the subjective Modified Mercalli intensities.
(2) Strong motion records for attenuation characteristics which correlate with losses.
(3) Site or area quantification of geohazards which correlates with both of the above.

Subsequent algorithms should include other measurable quantities and clearly identified criteria which include magnitude, type of faulting, focal depth, characteristics of the energy release volume, and regional geology. Some work on this already exists and progress would likely be incremental over many years.

Nondwelling construction types are normally more complicated since the dynamic characteristics and the design/construction qualities are added variables.

## Mobile Homes (Manufactured Housing)

### Nonbraced Mobile Homes

Mobile homes which lack earthquake bracing are very vulnerable to falling off their supports. Within 20 miles of the Loma Prieta earthquake, about 25 percent of the approximately 2,500 mobile homes fell from their supports (table 31). Similar experience occurred in the 1971 San Fernando, 1978 Santa Barbara, 1979 El Centro, 1980 Livermore, and 1983 Coalinga earthquakes.

The percent of fallen mobile homes in nearby parks may vary by large margins. In the city of Watsonville which is in the PML zone, the percent of fallen coaches ranged from 5 to 64 percent, with the upper limit probably influenced by a steep nearby slope (table 31 and fig. 7). However, the percent loss for the upper limit was only 17 percent. The reason is that once fallen, little additional damage is the general rule. This effectively put the maximum loss considerably under the total loss for a fallen coach.

### Earthquake Bracing

Commercially available earthquake bracing performed excellently. None of the 46 known mobile homes with bracing fell from their supports (table 31). More limited experience in other earthquakes showed similar excellent results. While perfect performance is not to be expected in the future, there is certainly no doubt of the effectiveness of earthquake bracing.

Retrofitting mobile homes is quite simple, inexpensive, and cost effective. It would seem reasonable public policy to require retrofitting or new bracing whenever ownership changes, a new mobile home is acquired, or one is moved to a new site.

### Loss Attenuation

Excluding geohazards, percent losses for mobile homes per park were under 10 percent at 20 miles (fig. 16). This compares with 10 miles for wood frame dwellings (fig. 5). A different loss attenuation algorithm is required for each.

### Research Needs

The research needs for mobile homes are similar to those for wood frame dwellings but are not as needy or expensive. Emphasis should be placed on implementing retrofitting before spending time and resources on nonbraced mobile homes.

### Comparative Losses: Wood Frame and Mobile Homes

The 9.8 percent loss for Loma Prieta mobile homes is about twice the 5.3 percent for wood frame dwellings (equations 9 and 5, respectively). For 1971 San Fernando, table 34 shows that mobile homes were from 2 to 4 times more vulnerable to loss than were wood frame dwellings. This observation is limited to nonearthquake braced mobile homes.

## REFERENCES


Applied Technology Council, 1989, Field manual: postearthquake safety evaluation of buildings: Redwood City, California, ATC-20-1, p. 114.

Barrows, A.G., Kahle, J.E., Weber, Jr., F.H., and Saul, R.B., 1973, Map of surface breaks resulting from the San Fernando, California, earthquake of February 9, 1971", *in* San Fernando, California, earthquake of February 9, 1971: NOAA, U.S. Department of Commerce, v. 3, p. 127-135, plus map in pocket.

Benuska, L., ed., 1990, Loma Prieta earthquake reconnaissance report, *in* supplement to v. 6: Earthquake Spectra, May 1990.

Bonilla, M.G., Lienkaemper, J.J., and Tinsley, J.C., 1980, Surface faulting near Livermore, California, associated with the January, 1980, earthquake: U.S. Geological Survey Open-File Report 80-523.

California Department of Housing and Community Development, 1989(?), Evaluation of manufactured housing support system performance in the Loma Prieta earthquake: Sacramento, California, 14 p.

California Department of Insurance, 1981 [and annually thereafter], California earthquake zoning and probable maximum loss program: 54 p.

Cloud, W.K., and Perez, V., 1967, Accelerograms—Parkfield earthquake: Seismological Society Bulletin, v. 57, p. 1179-1192.

Earthquake Engineering Research Institute, Newsletter, September, 1992: p. 6.

Housner, G.W., and Trifunac, M.D., 1967, Analysis of accelerograms—Parkfield Earthquake: Seismological Society Bulletin, v. 57, p. 1193-1220.

Kensler, C.D., 1985, The Morgan Hill earthquake of April 24, 1984—effects on mobile homes: Earthquake Spectra, v. 1, p. 607-613.

Lawrence Livermore Laboratory, 1980, The LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980: Lawrence Livermore Laboratory, Univ. of Calif., Livermore, California, 107 p.

Lawson, A.C., ed., 1908, The California earthquake of 1906, report of the State Earthquake Investigation Commission: Carnegie Institution of Washington, 2 volumes plus atlas, Washington, D.C.

McNutt, S.R., and Toppozada, T.R., 1990, Seismological aspects of the 17 October 1989 earthquake, *in* The Loma Prieta (Santa Cruz Mountains), California earthquake of October 17, 1989: California Division of Mines and Geology, Special Publication 104, Sacramento, California.

Plafker, G., and Gallaway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California, earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 48 p.

Steinbrugge, K.V., 1970, Engineering aspects of the Santa Rosa, California, earthquakes, October 1, 1969, *in* The Santa Rosa earthquakes of October 1, 1969: U.S. Coast and Geodetic Survey, ESSA, Dept. of Commerce, Washington, D.C.

Steinbrugge, K.V., 1986, Comment on the use and misuses of Modified Mercalli intensities, *in* Proceedings of Conference XXXII, Workshop on Future Directions in Evaluating Earthquake Hazards of Southern California: U.S. Geological Survey Open-File Report 86-401.

Steinbrugge, K.V., 1990, Earthquake losses to 1- to 4-family California dwellings: who pays?, *in* Hearings before the Subcommittee on Policy Research and Insurance Committee on Banking, Finance and Urban Affairs: House of Representatives, Sept. 11 and 12, 1990, Serial No. 101-168, p. 798-808.

Steinbrugge, K.V., and Algermissen, S.T., 1990, Earthquake losses to single-family dwellings: California experience: U.S. Geological Survey Bulletin 1939.

Steinbrugge, K.V., Algermissen, S.T., and Lagorio, H.J., 1984, Determining monetary losses and casualties for use in earthquake mitigation and disaster response planning, *in* Proceedings, 8th World Conference on Earthquake Engineering, San Francisco, California, July 21-28, 1984: Prentice-Hall, v. VII, p. 615-622.

Steinbrugge, K.V., Bush, V.R., and Zacher, E.G., 1959, Damage to buildings and other structures by the San Francisco earthquake of March 22, 1957, *in* Oakeshott, Gordon B., ed., San Francisco earthquakes of March 1957: California Division of Mines, Special Report 57.

Steinbrugge, K.V., Fowkes, E.J., Lagorio, H.J., and Algermissen, S.T., 1990, Dwelling monetary losses, *in* The Coalinga, California, earthquake of May 2, 1983: U.S. Geological Survey Professional Paper 1487.

Steinbrugge, K.V., Manning, J.H., and Degenkolb, H.J., 1967, Building damage in Anchorage, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks: ESSA, U.S. Department of Commerce, v. II, part A, p. 7-217, plus map in pocket.

Steinbrugge, K.V., and Schader, E.E., 1979, Mobile home damage and losses, Santa Barbara earthquake, August 13, 1978: California Seismic Safety Commission, Sacramento, California, SSC 79-06, 19 p.

Steinbrugge, K.V., Schader, E.E., and Algermissen, S.T., 1980, Mobile homes and earthquake damage in California: California Seismic Safety Commission, Sacramento, California, SSC 79-07, 29 p.

Steinbrugge, K.V., Schader, E.E., Bigglestone, H.C., and Weers, C.A., (n.d., but 1971), San Fernando earthquake, February 9, 1971: Pacific Fire Rating Bureau, San Francisco, California, 93 p., plus map in pocket.

Stover, C.W., and others, 1990, Preliminary isoseismal map for the Santa Cruz (Loma Prieta), California, earthquake of October 18, 1989, UTC: U.S. Geological Survey Open-File Report 90-18.

Youd, T.L., and Perkins, J.B., 1987, Map showing liquefaction susceptibility of San Mateo County, California: U.S. Geological Survey Miscellaneous Investigation Series, Map I-1257-G.

## APPENDIX A.—SENSITIVITY: LOSS OVER DEDUCTIBLE VERSUS DWELLING PML CHANGES

The term "percent PML" is frequently misunderstood. For convenience, discussion found in Steinbrugge and Algermissen (1990, p. A65) has been updated and reproduced here.

The commercial/industrial underwriters emphasize individual risks in their aggregate loss evaluations, whereas personal lines underwriters emphasize large numbers of risks. Commonly stated, the percent PML minus the percent deductible is the percent loss over the deductible. In a mathematical sense:

(percent PML) − (percent deductible) =
(percent loss over the deductible)

These terms may be rearranged:

(percent PML) =
(percent loss over the deductible) + (percent deductible)

This latter form is used in the following discussion. The percent PML for wood frame dwellings is not a fixed value since it is always in the context of a deductible plus the loss over the deductible. For example, consider a damaging earthquake during which 1,000 wood frame dwellings in a small area are subjected to the same severe ground motion. First, assume that two dwellings are total losses and the others have losses distributed between 0 percent and 100 percent. With a 10 percent deductible and using the current State of California's 1.7 percent loss over this deductible, the result is an 11.7 percent PML. Next assume a highly improbable deductible of 95 percent. There still would be at least two dwelling losses over the 95 percent deductible. The percent PML for the 1,000 houses would therefore have to be the 95 percent deductible plus a very small loss over the deductible to reflect the two total losses plus any other losses between 95 percent and 100 percent. In summary, the percent PML varies as a function of the percent deductible and may never be less than the percent deductible.

If the percent PML is close to the percent deductible as in the case for wood frame dwellings, the percent loss over the deductible is very sensitive to any change in the percent PML. Consider a 10 percent deductible with an 11.7 percent PML for wood frame dwellings. For $1 billion in wood frame dwelling liabilities, the loss over the deductible would be 1.7 percent of $1 billion, or $17 million. On the other hand should the maximum credible earthquake actually produce a 12.7 percent PML instead of 11.5 percent, then the loss over the deductible would be 2.5 percent, or $25 million. In this case, a 1 percent increase in the percent PML creates a 47 percent increase in the aggregate dollar PML.

## APPENDIX B.—DEFINITIONS OF DEGREE OF DAMAGE TO MOBILE HOMES

The following definitions of degree of damage require a physical inspection of each coach consisting of an examination of not less than the front and two sides. Except occasionally, interiors are not inspected. Minor exterior damage such as disturbed caulking and slightly bent skirting may escape observation from these rapid inspections.

Contents damage is usually not evaluated during these inspections. However, such information may be eventually obtained when the degree of coach damage is correlated with the closed insurance claims.

NONE is defined as a coach which has no visible exterior damage upon a quick three-sided inspection of the unit. Often minor damage can be found during a detailed inspection which includes crawling under the unit.

SLIGHT damage is defined as a coach which has skirting damage principally on one side, indicating that relative minor movement took place. Skirting is normally metal although masonry or fiberboard are sometimes observed. Replacement of the damaged portion of the skirting, slight releveling, and recaulking of roof seams at the joint line are the anticipated repairs.

MODERATE damage is defined as a coach which has skirting damage on several sides, and possibly on all sides. Releveling and caulking problems are significantly greater than for "slight" damage. Minor permanent offsets of the coach and porch may be observed upon careful inspection.

SEVERE damage is defined as a coach which is totally or partially off its supports. Alternatively, the coach may have substantially shifted with respect to its supports which may be bent or rotated. Skirting is severely damaged. Awnings and porches are damaged, with displacements commonly observed between coaches and porches. Unobserved damage may include holes punched through the floor when the coach leaves its supports. We now believe that SEVERE should be divided into two categories: (1) partly off supports and (2) completely off supports.

The technique used in the past to apply these guidelines has been:

(1) For all parks within a reasonable distance from the earthquake, field inspect all coaches in each park using a damage classification system such as that found in Appendix B. If practical, a more sophisticated system should be used. From a time standpoint the surveys probably should be restricted to external inspections with interiors examined only when convenient.

(2) Determine from the mobile home park manager, or others, an estimate of the average value of each coach in the park on some consistent basis, such as the replacement value or current resale

value. Preferably, the valuations should be on a single-wide, double-wide, and so forth basis. This should be eventually related to insured values and to paid claims in order to improve the methodology.

(3) Compute the loss using loss percentages such as those found in previous sections if the damage classification system described in Appendix B is used.

Refinements to this system can include type of foundation such as steel or concrete piers, wood blocks, or hollow concrete blocks. Data tabulation can include information on the bracing, if any, be it state certified or not. This latter refinement is the more important of the two.

## Table 44. Building, contents, and Ale losses, before and after deductible.

[See text under "Dwelling Losses Before and After Deductible" for explanation]

DATA FILE STATE-6A.DAT     DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP     DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | <==EQ+HO COVER==> | | | <=== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ===> | | | | | | | | | | <=== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ===> | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | <==DERIVED DATA==> | | | |
| ZIP (1) | ZIP FAULT DIST. (2) | NO. DWEL. (3) | DWEL. VALUE x$Mil. (4) | CONTS. VALUE x$Mil. (5) | NO. DWEL. (6) | PCT. DWEL. (7) | DWEL. x$1000 (8) | CONTS. x$1000 (9) | ALE x$1000 (10) | NO. DWEL. (11) | PCT. DWEL. (12) | DWEL. x$1000 (13) | CONTS. x$1000 (14) | ALE x$1000 (15) | NO. DWEL. (16) | BLDG. (17) | CONTS. (18) | ALE (19) | NO. DWEL. (20) | BLDG. (21) | CONTS. (22) | ALE (23) | NO. DWEL. (24) | BLDG. (25) | CONTS. (26) | ALE (27) | BLDG. %LOSS (28) | CONTS. RATIO (29) | ALE RATIO (30) | PO (31) |
| 95019 | 2.0 | 14 | 1 | 1 | 3 | 21.4 | 27 | 9 | 0 | 1 | 7.1 | 1 | 0 | 0 | 3 | 57 | 9 | 0 | 1 | 1 | 0 | 0 | 3 | 59 | 9 | 0 | 4.0 | 0.161 | 0.007 | FREEDOM |
| 95076 | 2.1 | 422 | 58 | 42 | 150 | 35.5 | 3,884 | 1,044 | 278 | 16 | 3.8 | 157 | 3 | 1 | 150 | 6,698 | 1,044 | 278 | 16 | 157 | 3 | 1 | 150 | 6,854 | 1,046 | 278 | 11.8 | 0.153 | 0.041 | WATSONVILLE |
| 95026 | 2.7 | 1 | 0 | 0 | 1 | 100.0 | 39 | 0 | 17 | 0 | 0.0 | 0 | 0 | 0 | 1 | 55 | 0 | 17 | 0 | 0 | 0 | 0 | 1 | 55 | 0 | 17 | 100.0 | 0.005 | 0.318 | REDWOOD ESTATES |
| 95044 | 2.7 | 5 | 0 | 0 | 3 | 60.0 | 85 | 44 | 2 | 1 | 20.0 | 0 | 2 | 0 | 3 | 101 | 44 | 2 | 0 | 0 | 2 | 0 | 3 | 101 | 45 | 2 | 21.1 | 0.449 | 0.020 | REDWOOD ESTATES |
| 95001 | 3.5 | 1 | 0 | 0 | 1 | 100.0 | 71 | 19 | 30 | 1 | 100.0 | 13 | 0 | 0 | 1 | 216 | 19 | 30 | 1 | 13 | 0 | 0 | 1 | 229 | 20 | 30 | 73.5 | 0.086 | 0.131 | APTOS |
| 95003 | 3.5 | 475 | 76 | 57 | 201 | 42.3 | 3,849 | 885 | 211 | 19 | 4.0 | 126 | 19 | 45 | 201 | 6,592 | 885 | 211 | 15 | 126 | 19 | 45 | 201 | 6,718 | 903 | 257 | 8.9 | 0.134 | 0.038 | APTOS |
| 95066 | 3.9 | 294 | 47 | 35 | 115 | 39.1 | 2,246 | 540 | 156 | 9 | 3.1 | 133 | 76 | 30 | 115 | 3,995 | 540 | 156 | 8 | 133 | 76 | 30 | 115 | 4,128 | 616 | 186 | 8.8 | 0.149 | 0.045 | SANTA CRUZ |
| 95073 | 4.3 | 165 | 26 | 19 | 81 | 49.1 | 2,702 | 579 | 370 | 9 | 5.5 | 77 | 28 | 2 | 81 | 4,557 | 579 | 370 | 9 | 77 | 28 | 2 | 81 | 4,634 | 607 | 372 | 17.9 | 0.131 | 0.080 | SOQUEL |
| 95007 | 4.6 | 11 | 1 | 1 | 2 | 18.2 | 60 | 2 | 5 | 0 | 0.0 | 0 | 0 | 0 | 2 | 80 | 2 | 5 | 0 | 0 | 0 | 0 | 2 | 80 | 2 | 5 | 6.3 | 0.021 | 0.060 | BROOKDALE |
| 95006 | 4.7 | 216 | 29 | 21 | 92 | 42.6 | 2,542 | 411 | 203 | 14 | 6.5 | 142 | 10 | 2 | 92 | 3,963 | 411 | 203 | 14 | 142 | 10 | 2 | 92 | 4,104 | 421 | 206 | 14.0 | 0.103 | 0.050 | BOULDER CREEK |
| 95005 | 4.8 | 159 | 21 | 15 | 62 | 39.0 | 1,049 | 194 | 44 | 4 | 2.5 | 13 | 2 | 0 | 62 | 1,817 | 194 | 44 | 2 | 13 | 2 | 0 | 62 | 1,829 | 196 | 44 | 8.6 | 0.107 | 0.024 | BEN LOMOND |
| 95065 | 5.3 | 129 | 20 | 15 | 59 | 45.7 | 1,351 | 434 | 131 | 3 | 2.3 | 7 | 11 | 0 | 59 | 2,467 | 434 | 131 | 2 | 7 | 11 | 0 | 59 | 2,474 | 445 | 131 | 12.1 | 0.180 | 0.053 | SANTA CRUZ |
| 95018 | 5.5 | 156 | 19 | 13 | 66 | 42.3 | 1,224 | 213 | 114 | 5 | 3.2 | 33 | 0 | 0 | 66 | 2,017 | 213 | 114 | 5 | 33 | 0 | 0 | 66 | 2,050 | 213 | 114 | 10.8 | 0.104 | 0.056 | FELTON |
| 95030 | 5.7 | 883 | 188 | 141 | 348 | 39.4 | 16,300 | 4,574 | 2,058 | 80 | 9.1 | 1,328 | 274 | 36 | 348 | 27,274 | 4,574 | 2,058 | 76 | 877 | 274 | 36 | 348 | 28,151 | 4,848 | 2,094 | 14.9 | 0.172 | 0.074 | LOS GATOS |
| 95010 | 5.9 | 62 | 8 | 6 | 16 | 25.8 | 143 | 38 | 9 | 2 | 3.2 | 5 | 0 | 0 | 16 | 317 | 38 | 9 | 2 | 5 | 0 | 0 | 16 | 322 | 38 | 9 | 4.1 | 0.117 | 0.027 | CAPITOLA |
| 95041 | 5.9 | 13 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MOUNT HERMON |
| 95031 | 6.5 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | LOS GATOS |
| 95061 | 7.5 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SANTA CRUZ |
| 95062 | 7.5 | 273 | 33 | 24 | 72 | 26.4 | 1,191 | 343 | 57 | 2 | 0.7 | 18 | 0 | 0 | 72 | 2,086 | 343 | 57 | 2 | 18 | 0 | 0 | 72 | 2,104 | 343 | 57 | 6.4 | 0.163 | 0.027 | SANTA CRUZ |
| 95032 | 7.6 | 576 | 114 | 87 | 70 | 12.2 | 1,515 | 608 | 79 | 6 | 1.0 | 40 | 3 | 0 | 70 | 3,087 | 608 | 79 | 6 | 40 | 3 | 0 | 70 | 3,127 | 610 | 79 | 2.7 | 0.195 | 0.025 | LOS GATOS |
| 95004 | 8.3 | 42 | 5 | 4 | 5 | 11.9 | 33 | 30 | 2 | 0 | 0.0 | 0 | 0 | 0 | 5 | 85 | 30 | 2 | 0 | 0 | 0 | 0 | 5 | 85 | 30 | 2 | 1.5 | 0.350 | 0.025 | AROMAS |
| 95070 | 8.5 | 1,372 | 313 | 237 | 85 | 6.2 | 1,756 | 312 | 149 | 5 | 0.4 | 44 | 0 | 0 | 85 | 3,461 | 312 | 149 | 5 | 44 | 0 | 0 | 85 | 3,506 | 312 | 149 | 1.1 | 0.089 | 0.043 | SARATOGA |
| 95064 | 8.6 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SANTA CRUZ |
| 95060 | 8.9 | 504 | 76 | 56 | 132 | 26.2 | 2,708 | 291 | 161 | 11 | 2.2 | 54 | 1 | 0 | 132 | 4,431 | 291 | 161 | 10 | 54 | 1 | 0 | 132 | 4,485 | 292 | 161 | 5.9 | 0.065 | 0.036 | SANTA CRUZ |
| 95020 | 9.6 | 489 | 72 | 54 | 45 | 9.2 | 768 | 230 | 51 | 0 | 0.0 | 0 | 0 | 0 | 45 | 1,353 | 230 | 51 | 0 | 0 | 0 | 0 | 45 | 1,353 | 230 | 51 | 1.9 | 0.170 | 0.038 | GILROY |
| 95141 | 9.6 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 93907 | 10.0 | 186 | 24 | 18 | 11 | 5.9 | 136 | 14 | 6 | 2 | 1.1 | 2 | 0 | 0 | 11 | 255 | 14 | 6 | 2 | 2 | 0 | 0 | 11 | 257 | 14 | 6 | 1.1 | 0.055 | 0.023 | SALINAS |
| 95120 | 10.0 | 1,798 | 321 | 243 | 52 | 2.9 | 745 | 217 | 32 | 1 | 0.1 | 0 | 0 | 0 | 52 | 1,419 | 217 | 32 | 1 | 0 | 0 | 0 | 52 | 1,419 | 217 | 32 | 0.4 | 0.153 | 0.023 | SAN JOSE |
| 95124 | 10.0 | 1,096 | 149 | 112 | 20 | 1.8 | 178 | 75 | 3 | 0 | 0.0 | 0 | 0 | 0 | 20 | 437 | 75 | 3 | 0 | 0 | 0 | 0 | 20 | 437 | 75 | 3 | 0.3 | 0.172 | 0.006 | SAN JOSE |
| 95130 | 10.0 | 322 | 39 | 30 | 6 | 1.9 | 9 | 9 | 0 | 0 | 0.0 | 0 | 0 | 0 | 6 | 72 | 9 | 0 | 0 | 0 | 0 | 0 | 6 | 72 | 9 | 0 | 0.2 | 0.129 | 0.000 | SAN JOSE |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | | <==EQ+HO COVER==> | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | <==DERIVED DATA=> | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | | | | |
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 95008 | 10.2 | 572 | 75 | 57 | 13 | 2.3 | 126 | 23 | 36 | 0 | 0.0 | 0 | 0 | 0 | 13 | 318 | 23 | 36 | 0 | 0 | 0 | 0 | 13 | 318 | 23 | 36 | 0.4 | 0.073 | 0.113 | CAMPBELL |
| 95012 | 10.4 | 23 | 2 | 2 | 1 | 4.3 | 8 | 0 | 2 | 0 | 0.0 | 0 | 0 | 0 | 1 | 18 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 18 | 0 | 2 | 0.8 | 0.011 | 0.085 | CASTROVILLE |
| 95129 | 10.8 | 1,033 | 141 | 106 | 31 | 3.0 | 182 | 88 | 2 | 4 | 0.4 | 14 | 0 | 0 | 31 | 552 | 88 | 2 | 4 | 14 | 0 | 0 | 31 | 566 | 88 | 2 | 0.4 | 0.156 | 0.003 | SAN JOSE |
| 95039 | 10.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MOSS LANDING |
| 95118 | 11.1 | 626 | 79 | 59 | 7 | 1.1 | 23 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 7 | 111 | 4 | 0 | 0 | 0 | 0 | 0 | 7 | 111 | 4 | 0 | 0.1 | 0.032 | 0.000 | SAN JOSE |
| 95014 | 11.3 | 1,482 | 236 | 178 | 77 | 5.2 | 718 | 303 | 19 | 1 | 0.1 | 1 | 0 | 0 | 77 | 1,721 | 303 | 19 | 1 | 1 | 0 | 0 | 77 | 1,721 | 303 | 19 | 0.7 | 0.176 | 0.011 | CUPERTINO |
| 95017 | 11.5 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | DAVENPORT |
| 95117 | 11.8 | 295 | 40 | 30 | 12 | 4.1 | 176 | 21 | 4 | 0 | 0.0 | 0 | 0 | 0 | 12 | 325 | 21 | 4 | 0 | 0 | 0 | 0 | 12 | 325 | 21 | 4 | 0.8 | 0.066 | 0.013 | SAN JOSE |
| 95123 | 12.6 | 1,284 | 168 | 126 | 35 | 2.7 | 369 | 70 | 16 | 1 | 0.1 | 0 | 0 | 0 | 35 | 760 | 70 | 16 | 1 | 0 | 0 | 0 | 35 | 761 | 70 | 16 | 0.5 | 0.093 | 0.022 | SAN JOSE |
| 95128 | 12.7 | 366 | 46 | 34 | 5 | 1.4 | 113 | 22 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 328 | 22 | 0 | 0 | 0 | 0 | 0 | 5 | 328 | 22 | 0 | 0.7 | 0.067 | 0.000 | SAN JOSE |
| 95037 | 12.9 | 745 | 138 | 103 | 41 | 5.5 | 1,059 | 140 | 57 | 1 | 0.1 | 8 | 1 | 0 | 41 | 1,848 | 140 | 57 | 1 | 8 | 1 | 0 | 41 | 1,856 | 141 | 57 | 1.3 | 0.076 | 0.031 | MORGAN HILL |
| 95046 | 13.0 | 78 | 15 | 11 | 8 | 10.3 | 61 | 44 | 0 | 1 | 1.3 | 1 | 0 | 0 | 8 | 172 | 44 | 0 | 1 | 1 | 0 | 0 | 8 | 173 | 44 | 0 | 1.2 | 0.252 | 0.000 | SAN MARTIN |
| 95125 | 13.0 | 757 | 108 | 80 | 50 | 6.6 | 1,073 | 52 | 47 | 2 | 0.3 | 5 | 0 | 0 | 50 | 1,837 | 52 | 47 | 2 | 5 | 0 | 0 | 50 | 1,842 | 52 | 47 | 1.7 | 0.028 | 0.026 | SAN JOSE |
| 95136 | 13.1 | 687 | 95 | 71 | 20 | 2.9 | 452 | 9 | 29 | 0 | 0.0 | 0 | 0 | 0 | 20 | 759 | 9 | 29 | 0 | 0 | 0 | 0 | 20 | 759 | 9 | 29 | 0.8 | 0.012 | 0.038 | SAN JOSE |
| 95119 | 13.2 | 290 | 39 | 29 | 9 | 3.1 | 77 | 31 | 1 | 0 | 0.0 | 0 | 0 | 0 | 9 | 179 | 31 | 1 | 0 | 0 | 0 | 0 | 9 | 179 | 31 | 1 | 0.5 | 0.172 | 0.003 | SAN JOSE |
| 94087 | 13.5 | 1,297 | 189 | 143 | 9 | 0.7 | 76 | 74 | 0 | 0 | 0.0 | 0 | 0 | 0 | 9 | 181 | 74 | 0 | 0 | 0 | 0 | 0 | 9 | 181 | 74 | 0 | 0.1 | 0.406 | 0.000 | SUNNYVALE |
| 94024 | 13.7 | 96 | 20 | 15 | 6 | 6.3 | 336 | 17 | 0 | 1 | 1.0 | 2 | 0 | 0 | 6 | 644 | 17 | 0 | 1 | 2 | 0 | 0 | 6 | 646 | 17 | 0 | 3.2 | 0.026 | 0.000 | LOS ALTOS |
| 95051 | 13.8 | 966 | 119 | 89 | 34 | 3.5 | 335 | 51 | 7 | 0 | 0.0 | 0 | 0 | 0 | 34 | 710 | 51 | 7 | 0 | 0 | 0 | 0 | 34 | 710 | 51 | 7 | 0.6 | 0.072 | 0.010 | SANTA CLARA |
| 95126 | 13.8 | 135 | 20 | 14 | 4 | 3.0 | 31 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 89 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 89 | 2 | 0 | 0.5 | 0.024 | 0.000 | SAN JOSE |
| 95139 | 13.9 | 207 | 28 | 21 | 2 | 1.0 | 1 | 3 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 23 | 3 | 0 | 0.1 | 0.153 | 0.000 | SAN JOSE |
| 95050 | 14.3 | 364 | 43 | 32 | 6 | 1.6 | 69 | 18 | 3 | 0 | 0.0 | 0 | 0 | 0 | 6 | 146 | 18 | 3 | 0 | 0 | 0 | 0 | 6 | 146 | 18 | 3 | 0.3 | 0.122 | 0.017 | SANTA CLARA |
| 95052 | 14.3 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SANTA CLARA |
| 95114 | 14.4 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 95150 | 14.4 | 10 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 95157 | 14.4 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 95160 | 14.4 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 95045 | 14.5 | 29 | 4 | 3 | 1 | 3.4 | 48 | 21 | 31 | 1 | 3.4 | 4 | 0 | 0 | 1 | 100 | 21 | 31 | 1 | 4 | 0 | 0 | 1 | 104 | 21 | 31 | 2.4 | 0.202 | 0.299 | SAN JUAN BAUTISTA |
| 94088 | 14.7 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SUNNYVALE |
| 95111 | 14.8 | 347 | 41 | 30 | 4 | 1.2 | 25 | 8 | 1 | 0 | 0.0 | 0 | 0 | 0 | 4 | 70 | 8 | 1 | 0 | 0 | 0 | 0 | 4 | 70 | 8 | 1 | 0.2 | 0.116 | 0.016 | SAN JOSE |
| 94022 | 14.9 | 1,835 | 432 | 327 | 127 | 6.9 | 4,623 | 1,611 | 456 | 22 | 1.2 | 125 | 4 | 0 | 127 | 8,413 | 1,611 | 456 | 22 | 125 | 4 | 0 | 127 | 8,538 | 1,614 | 456 | 2.0 | 0.189 | 0.053 | LOS ALTOS |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT    DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP    DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | | <==EQ+HO COVER==> | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | <==DERIVED DATA=> | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | | | | |
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 93906 | 15.0 | 246 | 24 | 17 | 2 | 0.8 | 5 | 0 | 1 | 1 | 0.4 | 0 | 0 | 0 | 2 | 26 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 26 | 0 | 1 | 0.1 | 0.000 | 0.028 | SALINAS |
| 95110 | 15.0 | 27 | 3 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 94021 | 15.2 | 5 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | LOMA MAR |
| 95138 | 15.2 | 100 | 13 | 10 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 94086 | 15.3 | 523 | 68 | 51 | 4 | 0.8 | 18 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 58 | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 58 | 4 | 0 | 0.1 | 0.071 | 0.000 | SUNNYVALE |
| 94040 | 16.0 | 515 | 83 | 62 | 4 | 0.8 | 42 | 25 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 92 | 25 | 0 | 0 | 0 | 0 | 0 | 4 | 92 | 25 | 0 | 0.1 | 0.274 | 0.000 | MOUNTAIN VIEW |
| 95112 | 16.0 | 108 | 13 | 9 | 1 | 0.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN JOSE |
| 94041 | 16.1 | 91 | 14 | 11 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MOUNTAIN VIEW |
| 93912 | 16.3 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SALINAS |
| 93915 | 16.3 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SALINAS |
| 95121 | 16.5 | 397 | 49 | 36 | 2 | 0.5 | 17 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 46 | 0 | 0 | 0.1 | 0.007 | 0.000 | SAN JOSE |
| 93933 | 16.9 | 102 | 11 | 8 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MARINA |
| 94060 | 16.9 | 10 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PESCADERO |
| 95122 | 17.0 | 210 | 22 | 16 | 2 | 1.0 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 24 | 0 | 0 | 0.1 | 0.021 | 0.000 | SAN JOSE |
| 94089 | 17.2 | 82 | 9 | 6 | 1 | 1.2 | 4 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14 | 0 | 0 | 0.2 | 0.000 | 0.000 | SUNNYVALE |
| 95054 | 17.3 | 111 | 13 | 10 | 1 | 0.9 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 13 | 0 | 0 | 0.1 | 0.000 | 0.000 | SANTA CLARA |
| 93905 | 17.4 | 83 | 7 | 5 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SALINAS |
| 95116 | 17.5 | 100 | 10 | 7 | 1 | 1.0 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN JOSE |
| 94043 | 17.6 | 176 | 22 | 16 | 3 | 1.7 | 23 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 54 | 0 | 0 | 0.2 | 0.002 | 0.000 | MOUNTAIN VIEW |
| 93901 | 17.8 | 218 | 28 | 20 | 2 | 0.9 | 8 | 0 | 1 | 0 | 0.0 | 0 | 0 | 0 | 2 | 30 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 30 | 0 | 1 | 0.1 | 0.013 | 0.016 | SALINAS |
| 94020 | 18.2 | 39 | 7 | 5 | 4 | 10.3 | 136 | 3 | 4 | 0 | 0.0 | 0 | 0 | 0 | 4 | 233 | 3 | 4 | 0 | 0 | 0 | 0 | 4 | 233 | 3 | 4 | 3.5 | 0.011 | 0.017 | LA HONDA |
| 95023 | 18.5 | 306 | 41 | 30 | 14 | 4.6 | 184 | 24 | 5 | 1 | 0.3 | 1 | 0 | 0 | 14 | 434 | 24 | 5 | 1 | 1 | 0 | 0 | 14 | 435 | 24 | 5 | 1.1 | 0.055 | 0.012 | HOLLISTER |
| 95133 | 18.5 | 324 | 45 | 34 | 2 | 0.6 | 44 | 3 | 2 | 0 | 0.0 | 0 | 0 | 0 | 2 | 64 | 3 | 2 | 0 | 0 | 0 | 0 | 2 | 64 | 3 | 2 | 0.1 | 0.052 | 0.027 | SAN JOSE |
| 94306 | 18.6 | 659 | 99 | 74 | 9 | 1.4 | 237 | 9 | 42 | 0 | 0.0 | 0 | 0 | 0 | 9 | 387 | 9 | 42 | 0 | 0 | 0 | 0 | 9 | 387 | 9 | 42 | 0.4 | 0.024 | 0.108 | PALO ALTO |
| 95131 | 18.7 | 293 | 38 | 28 | 2 | 0.7 | 8 | 0 | 1 | 0 | 0.0 | 0 | 0 | 0 | 2 | 31 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 31 | 0 | 1 | 0.1 | 0.000 | 0.016 | SAN JOSE |
| 95135 | 18.7 | 195 | 30 | 23 | 5 | 2.6 | 21 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 81 | 2 | 0 | 0 | 0 | 0 | 0 | 5 | 81 | 2 | 0 | 0.3 | 0.025 | 0.000 | SAN JOSE |
| 95148 | 18.9 | 681 | 95 | 70 | 14 | 2.1 | 73 | 6 | 2 | 2 | 0.3 | 3 | 0 | 0 | 14 | 254 | 6 | 2 | 2 | 3 | 0 | 0 | 14 | 257 | 6 | 2 | 0.3 | 0.025 | 0.008 | SAN JOSE |
| 95002 | 19.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | ALVISO |
| 95127 | 19.4 | 629 | 86 | 63 | 13 | 2.1 | 343 | 10 | 19 | 0 | 0.0 | 0 | 0 | 0 | 13 | 597 | 10 | 19 | 0 | 0 | 0 | 0 | 13 | 597 | 10 | 19 | 0.7 | 0.016 | 0.032 | SAN JOSE |
| 94304 | 19.6 | 21 | 8 | 6 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PALO ALTO |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | | <==EQ+HO COVER==> | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | <==DERIVED DATA==> | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | | | | |
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 94305 | 19.6 | 95 | 21 | 16 | 3 | 3.2 | 84 | 5 | 11 | 2 | 2.1 | 4 | 0 | 0 | 3 | 162 | 5 | 11 | 2 | 4 | 0 | 0 | 3 | 165 | 5 | 11 | 0.8 | 0.032 | 0.064 | PALO ALTO |
| 94309 | 20.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PALO ALTO |
| 95075 | 20.2 | 5 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | TRES PINOS |
| 95132 | 20.2 | 990 | 132 | 98 | 10 | 1.0 | 303 | 5 | 22 | 0 | 0.0 | 0 | 0 | 0 | 10 | 496 | 5 | 22 | 0 | 0 | 0 | 0 | 10 | 496 | 5 | 22 | 0.4 | 0.010 | 0.044 | SAN JOSE |
| 94301 | 20.7 | 280 | 62 | 47 | 2 | 0.7 | 37 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 57 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 57 | 0 | 0 | 0.1 | 0.000 | 0.000 | PALO ALTO |
| 94303 | 21.0 | 660 | 100 | 74 | 4 | 0.6 | 14 | 39 | 2 | 0 | 0.0 | 0 | 0 | 0 | 4 | 55 | 39 | 2 | 0 | 0 | 0 | 0 | 4 | 55 | 39 | 2 | 0.1 | 0.716 | 0.045 | PALO ALTO |
| 94025 | 21.3 | 1,341 | 305 | 230 | 21 | 1.6 | 579 | 35 | 0 | 0 | 0.0 | 0 | 0 | 0 | 21 | 1,326 | 35 | 0 | 0 | 0 | 0 | 0 | 21 | 1,326 | 35 | 0 | 0.4 | 0.026 | 0.000 | MENLO PARK |
| 95035 | 21.3 | 912 | 127 | 93 | 6 | 0.7 | 26 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 6 | 86 | 1 | 1 | 0 | 0 | 0 | 0 | 6 | 86 | 1 | 1 | 0.1 | 0.012 | 0.008 | MILPITAS |
| 93908 | 21.8 | 113 | 20 | 15 | 1 | 0.9 | 6 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 | 0 | 0 | 0.1 | 0.000 | 0.000 | SALINAS |
| 95140 | 22.5 | 7 | 2 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN JOSE |
| 93955 | 22.8 | 137 | 14 | 10 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SEASIDE |
| 94061 | 23.6 | 544 | 85 | 62 | 3 | 0.6 | 28 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 59 | 4 | 0 | 0 | 0 | 0 | 0 | 3 | 59 | 4 | 0 | 0.1 | 0.065 | 0.000 | REDWOOD CITY |
| 94062 | 23.9 | 730 | 163 | 120 | 19 | 2.6 | 230 | 125 | 21 | 1 | 0.1 | 0 | 0 | 0 | 19 | 676 | 125 | 21 | 1 | 0 | 0 | 0 | 19 | 676 | 125 | 21 | 0.4 | 0.185 | 0.030 | REDWOOD CITY |
| 94064 | 24.0 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | REDWOOD CITY |
| 94063 | 24.2 | 117 | 14 | 10 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | REDWOOD CITY |
| 93950 | 24.3 | 161 | 20 | 15 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PACIFIC GROVE |
| 93940 | 24.8 | 263 | 45 | 33 | 2 | 0.8 | 18 | 12 | 5 | 0 | 0.0 | 0 | 0 | 0 | 2 | 54 | 12 | 5 | 0 | 0 | 0 | 0 | 2 | 54 | 12 | 5 | 0.1 | 0.216 | 0.095 | MONTEREY |
| 94538 | 26.2 | 762 | 88 | 65 | 3 | 0.4 | 12 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 43 | 0 | 0 | 0.0 | 0.000 | 0.000 | FREMONT |
| 94539 | 26.3 | 1,636 | 280 | 210 | 10 | 0.6 | 44 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 10 | 185 | 4 | 0 | 0 | 0 | 0 | 0 | 10 | 185 | 4 | 0 | 0.1 | 0.022 | 0.000 | FREMONT |
| 93953 | 26.4 | 116 | 29 | 22 | 1 | 0.9 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 12 | 0 | 0 | 0.0 | 0.000 | 0.000 | PEBBLE BEACH |
| 94070 | 26.4 | 826 | 146 | 110 | 3 | 0.4 | 12 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 52 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN CARLOS |
| 94560 | 26.5 | 683 | 83 | 61 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | NEWARK |
| 94065 | 27.7 | 191 | 32 | 24 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | REDWOOD CITY |
| 93921 | 27.8 | 70 | 12 | 9 | 2 | 2.9 | 7 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 31 | 0 | 0 | 0.3 | 0.000 | 0.000 | CARMEL |
| 93922 | 27.9 | 6 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CARMEL |
| 94536 | 28.1 | 1,192 | 159 | 118 | 1 | 0.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0.0 | 0.000 | 0.000 | FREMONT |
| 93923 | 28.3 | 221 | 52 | 38 | 1 | 0.5 | 6 | 0 | 1 | 0 | 0.0 | 0 | 0 | 0 | 1 | 26 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 26 | 0 | 1 | 0.1 | 0.000 | 0.019 | CARMEL |
| 94002 | 28.4 | 708 | 122 | 91 | 7 | 1.0 | 50 | 0 | 0 | 1 | 0.1 | 0 | 0 | 0 | 7 | 129 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | 129 | 0 | 0 | 0.1 | 0.000 | 0.000 | BELMONT |
| 94555 | 29.0 | 628 | 85 | 64 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | FREMONT |
| 93925 | 29.3 | 5 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CHUALAR |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | | <==EQ+HO COVER==> | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | <==DERIVED DATA==> | | | |
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 94403 | 29.9 | 747 | 116 | 85 | 11 | 1.5 | 118 | 27 | 0 | 0 | 0.0 | 0 | 0 | 0 | 11 | 268 | 27 | 0 | 0 | 0 | 0 | 0 | 11 | 268 | 27 | 0 | 0.2 | 0.100 | 0.000 | SAN MATEO |
| 94404 | 29.9 | 1,022 | 184 | 137 | 15 | 1.5 | 213 | 209 | 14 | 1 | 0.1 | 0 | 0 | 0 | 15 | 453 | 209 | 14 | 1 | 0 | 0 | 0 | 15 | 453 | 209 | 14 | 0.2 | 0.461 | 0.031 | SAN MATEO |
| 94587 | 30.1 | 834 | 105 | 77 | 1 | 0.1 | 10 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 20 | 0 | 0 | 0.0 | 0.000 | 0.000 | UNION CITY |
| 93924 | 30.4 | 105 | 19 | 14 | 3 | 2.9 | 35 | 13 | 6 | 0 | 0.0 | 0 | 0 | 0 | 3 | 70 | 13 | 6 | 0 | 0 | 0 | 0 | 3 | 70 | 13 | 6 | 0.4 | 0.185 | 0.086 | CARMEL VALLEY |
| 94019 | 30.7 | 242 | 41 | 30 | 3 | 1.2 | 12 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 3 | 43 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 43 | 2 | 1 | 0.1 | 0.048 | 0.026 | HALF MOON BAY |
| 94402 | 31.1 | 588 | 109 | 81 | 5 | 0.9 | 35 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 91 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN MATEO |
| 93926 | 32.4 | 10 | 1 | 1 | 1 | 10.0 | 10 | 0 | 2 | 0 | 0.0 | 0 | 0 | 0 | 1 | 20 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 20 | 0 | 2 | 2.1 | 0.000 | 0.101 | GONZALES |
| 94401 | 32.4 | 210 | 27 | 19 | 14 | 6.7 | 324 | 153 | 10 | 0 | 0.0 | 0 | 0 | 0 | 14 | 604 | 153 | 10 | 0 | 0 | 0 | 0 | 14 | 604 | 153 | 10 | 2.3 | 0.253 | 0.017 | SAN MATEO |
| 94545 | 33.0 | 390 | 45 | 32 | 2 | 0.5 | 2 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 22 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 22 | 1 | 0 | 0.0 | 0.060 | 0.000 | HAYWARD |
| 94544 | 33.3 | 593 | 65 | 47 | 2 | 0.3 | 6 | 0 | 0 | 1 | 0.2 | 1 | 0 | 0 | 2 | 26 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 28 | 0 | 0 | 0.0 | 0.000 | 0.000 | HAYWARD |
| 94018 | 33.6 | 83 | 14 | 10 | 1 | 1.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0.1 | 0.000 | 0.000 | EL GRANADA |
| 94010 | 33.8 | 805 | 222 | 167 | 13 | 1.6 | 550 | 9 | 5 | 0 | 0.0 | 0 | 0 | 0 | 13 | 899 | 9 | 5 | 0 | 0 | 0 | 0 | 13 | 899 | 9 | 5 | 0.4 | 0.010 | 0.005 | BURLINGAME |
| 94542 | 34.7 | 274 | 47 | 35 | 2 | 0.7 | 13 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 38 | 0 | 0 | 0.1 | 0.000 | 0.000 | HAYWARD |
| 94586 | 34.8 | 18 | 4 | 3 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SUNOL |
| 94540 | 35.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | HAYWARD |
| 94038 | 35.7 | 81 | 15 | 11 | 1 | 1.2 | 4 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 23 | 0 | 0 | 0.2 | 0.000 | 0.000 | MOSS BEACH |
| 94541 | 35.8 | 483 | 59 | 43 | 3 | 0.6 | 8 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 38 | 0 | 0 | 0.1 | 0.000 | 0.000 | HAYWARD |
| 94580 | 36.2 | 513 | 55 | 40 | 2 | 0.4 | 13 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 33 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN LORENZO |
| 94030 | 36.3 | 493 | 82 | 60 | 1 | 0.2 | 1 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 2 | 0 | 0.0 | 0.132 | 0.000 | MILLBRAE |
| 94037 | 36.6 | 90 | 15 | 11 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MONTARA |
| 94566 | 36.8 | 1,681 | 280 | 210 | 5 | 0.3 | 36 | 3 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 90 | 3 | 0 | 0 | 0 | 0 | 0 | 5 | 90 | 3 | 0 | 0.0 | 0.034 | 0.000 | PLEASANTON |
| 94579 | 37.3 | 415 | 45 | 33 | 1 | 0.2 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 13 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN LEANDRO |
| 95043 | 37.5 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PAICINES |
| 94546 | 37.8 | 855 | 114 | 84 | 6 | 0.7 | 51 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 6 | 120 | 1 | 0 | 0 | 0 | 0 | 0 | 6 | 120 | 1 | 0 | 0.1 | 0.006 | 0.000 | HAYWARD |
| 94578 | 38.0 | 437 | 51 | 37 | 3 | 0.7 | 24 | 5 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 61 | 5 | 0 | 0 | 0 | 0 | 0 | 3 | 61 | 5 | 0 | 0.1 | 0.085 | 0.000 | SAN LEANDRO |
| 94066 | 38.5 | 568 | 77 | 55 | 3 | 0.5 | 17 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 52 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN BRUNO |
| 94568 | 39.2 | 530 | 75 | 56 | 1 | 0.2 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 15 | 0 | 0 | 0.0 | 0.000 | 0.000 | PLEASANTON |
| 93960 | 39.3 | 6 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SOLEDAD |
| 94550 | 39.6 | 1,362 | 183 | 138 | 1 | 0.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 | 0 | 0 | 0.0 | 0.000 | 0.000 | LIVERMORE |
| 94044 | 39.8 | 671 | 88 | 62 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PACIFICA |

**Table 44.** Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | | <==EQ+HO COVER==> | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | <==DERIVED DATA=> | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ZIP | | DWEL. | CONTS. | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | | | | |
| | FAULT | NO. | VALUE | VALUE | NO. | PCT. | DWEL. | CONTS. | ALE | NO. | PCT. | DWEL. | CONTS. | ALE | NO. | | | | NO. | | | | NO. | | | | BLDG. | CONTS. | ALE | |
| ZIP | DIST. | DWEL. | x$Mil. | x$Mil. | DWEL. | DWEL. | x$1000 | x$1000 | x$1000 | DWEL. | DWEL. | x$1000 | x$1000 | x$1000 | DWEL. | BLDG. | CONTS. | ALE | DWEL. | BLDG. | CONTS. | ALE | DWEL. | BLDG. | CONTS. | ALE | %LOSS | RATIO | RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 94552 | 39.8 | 239 | 42 | 31 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | HAYWARD |
| 94080 | 40.4 | 662 | 86 | 60 | 1 | 0.2 | 6 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 19 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 19 | 4 | 0 | 0.0 | 0.193 | 0.000 | SOUTH SAN FRANCISCO |
| 94603 | 40.9 | 120 | 11 | 7 | 3 | 2.5 | 4 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 34 | 0 | 0 | 0.3 | 0.000 | 0.000 | OAKLAND |
| 94005 | 41.1 | 33 | 5 | 3 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BRISBANE |
| 94583 | 41.5 | 1,120 | 192 | 145 | 6 | 0.5 | 36 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 6 | 121 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 121 | 0 | 0 | 0.1 | 0.001 | 0.000 | SAN RAMON |
| 94621 | 42.3 | 82 | 7 | 5 | 4 | 4.9 | 168 | 0 | 12 | 1 | 1.2 | 1 | 0 | 0 | 4 | 195 | 0 | 12 | 1 | 1 | 0 | 0 | 4 | 196 | 0 | 12 | 2.7 | 0.000 | 0.061 | OAKLAND |
| 94605 | 42.5 | 481 | 64 | 45 | 20 | 4.2 | 354 | 4 | 0 | 1 | 0.2 | 1 | 0 | 0 | 20 | 568 | 4 | 0 | 1 | 1 | 0 | 0 | 20 | 569 | 4 | 0 | 0.9 | 0.007 | 0.000 | OAKLAND |
| 94015 | 43.2 | 771 | 99 | 70 | 2 | 0.3 | 5 | 6 | 0 | 1 | 0.1 | 0 | 0 | 0 | 2 | 26 | 6 | 0 | 1 | 0 | 0 | 0 | 2 | 26 | 6 | 0 | 0.0 | 0.236 | 0.000 | DALY CITY |
| 94014 | 43.5 | 197 | 26 | 17 | 2 | 1.0 | 2 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 22 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 22 | 2 | 0 | 0.1 | 0.079 | 0.000 | DALY CITY |
| 94134 | 43.6 | 155 | 20 | 13 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94501 | 43.7 | 728 | 118 | 86 | 5 | 0.7 | 29 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 97 | 0 | 0 | 0.1 | 0.000 | 0.000 | ALAMEDA |
| 94124 | 44.0 | 62 | 8 | 5 | 2 | 3.2 | 72 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 92 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 92 | 2 | 0 | 1.2 | 0.024 | 0.000 | SAN FRANCISCO |
| 94601 | 44.1 | 109 | 11 | 7 | 3 | 2.8 | 43 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 73 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 73 | 0 | 0 | 0.7 | 0.000 | 0.000 | OAKLAND |
| 94619 | 44.3 | 318 | 47 | 33 | 6 | 1.9 | 76 | 2 | 0 | 0 | 0.0 | 0 | 0 | 0 | 6 | 142 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 142 | 2 | 0 | 0.3 | 0.011 | 0.000 | OAKLAND |
| 94112 | 44.5 | 429 | 54 | 35 | 12 | 2.8 | 204 | 33 | 10 | 1 | 0.2 | 1 | 0 | 0 | 12 | 337 | 33 | 10 | 1 | 1 | 0 | 0 | 12 | 338 | 33 | 10 | 0.6 | 0.099 | 0.029 | SAN FRANCISCO |
| 94620 | 45.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | OAKLAND |
| 94602 | 45.4 | 382 | 56 | 39 | 3 | 0.8 | 61 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 91 | 0 | 0 | 0.2 | 0.000 | 0.000 | OAKLAND |
| 94606 | 45.4 | 50 | 6 | 4 | 1 | 2.0 | 3 | 3 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 13 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 13 | 3 | 0 | 0.2 | 0.224 | 0.000 | OAKLAND |
| 94132 | 45.6 | 142 | 22 | 15 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94110 | 45.7 | 205 | 32 | 22 | 2 | 1.0 | 129 | 0 | 5 | 0 | 0.0 | 0 | 0 | 0 | 2 | 166 | 0 | 5 | 0 | 0 | 0 | 0 | 2 | 166 | 0 | 5 | 0.5 | 0.000 | 0.031 | SAN FRANCISCO |
| 94526 | 45.8 | 1,363 | 314 | 238 | 9 | 0.7 | 176 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 9 | 279 | 4 | 0 | 0 | 0 | 0 | 0 | 9 | 279 | 4 | 0 | 0.1 | 0.015 | 0.000 | DANVILLE |
| 94127 | 45.9 | 332 | 61 | 42 | 9 | 2.7 | 183 | 34 | 6 | 0 | 0.0 | 0 | 0 | 0 | 9 | 293 | 34 | 6 | 0 | 0 | 0 | 0 | 9 | 293 | 34 | 6 | 0.5 | 0.117 | 0.019 | SAN FRANCISCO |
| 94131 | 45.9 | 359 | 60 | 43 | 4 | 1.1 | 73 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 121 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 121 | 1 | 0 | 0.2 | 0.005 | 0.000 | SAN FRANCISCO |
| 94107 | 46.0 | 53 | 9 | 7 | 1 | 1.9 | 25 | 0 | 2 | 0 | 0.0 | 0 | 0 | 0 | 1 | 43 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 43 | 0 | 2 | 0.5 | 0.000 | 0.048 | SAN FRANCISCO |
| 94516 | 46.2 | 5 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CANYON |
| 94114 | 46.6 | 262 | 59 | 41 | 5 | 1.9 | 33 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 93 | 0 | 0 | 0.2 | 0.000 | 0.000 | SAN FRANCISCO |
| 94610 | 46.6 | 239 | 47 | 33 | 7 | 2.9 | 173 | 2 | 3 | 0 | 0.0 | 0 | 0 | 0 | 7 | 233 | 2 | 3 | 0 | 0 | 0 | 0 | 7 | 233 | 2 | 3 | 0.5 | 0.010 | 0.012 | OAKLAND |
| 94612 | 46.6 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | OAKLAND |
| 94607 | 46.8 | 22 | 2 | 2 | 4 | 18.2 | 43 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 4 | 84 | 2 | 1 | 0 | 0 | 0 | 0 | 4 | 84 | 2 | 1 | 3.8 | 0.021 | 0.009 | OAKLAND |
| 94101 | 46.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | EQ+HO COVER | | | AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 | | | | | | | | | | AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 | | | | | | | | | | | | DERIVED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PAID LOSS UNDER EQ COVER | | | | | PAID LOSS UNDER HO COVER | | | | | EQ COVER | | | | HO COVER | | | | EQ+HO COVER | | | | | | | |
| ZIP (1) | FAULT DIST. (2) | NO. DWEL. (3) | DWEL. VALUE x$Mil. (4) | CONTS. VALUE x$Mil. (5) | NO. DWEL. (6) | PCT. DWEL. (7) | DWEL. x$1000 (8) | CONTS. x$1000 (9) | ALE x$1000 (10) | NO. DWEL. (11) | PCT. DWEL. (12) | DWEL. x$1000 (13) | CONTS. x$1000 (14) | ALE x$1000 (15) | NO. DWEL. (16) | BLDG. (17) | CONTS. (18) | ALE (19) | NO. DWEL. (20) | BLDG. (21) | CONTS. (22) | ALE (23) | NO. DWEL. (24) | BLDG. (25) | CONTS. (26) | ALE (27) | BLDG. %LOSS (28) | CONTS. RATIO (29) | ALE RATIO (30) | PO (31) |
| 94119 | 46.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94128 | 46.9 | 2 | 1 | 0 | 1 | 50.0 | 7 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 | 3.2 | 0.000 | 0.000 | SAN FRANCISCO |
| 94139 | 46.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94146 | 46.9 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94103 | 47.0 | 8 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94116 | 47.2 | 388 | 58 | 39 | 8 | 2.1 | 249 | 5 | 6 | 0 | 0.0 | 0 | 0 | 0 | 8 | 362 | 5 | 6 | 0 | 0 | 0 | 0 | 8 | 362 | 5 | 6 | 0.6 | 0.015 | 0.017 | SAN FRANCISCO |
| 94611 | 47.4 | 700 | 142 | 100 | 4 | 0.6 | 197 | 21 | 16 | 0 | 0.0 | 0 | 0 | 0 | 4 | 307 | 21 | 16 | 0 | 0 | 0 | 0 | 4 | 307 | 21 | 16 | 0.2 | 0.067 | 0.052 | OAKLAND |
| 94102 | 47.6 | 3 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94117 | 47.6 | 106 | 27 | 19 | 8 | 7.5 | 66 | 10 | 1 | 0 | 0.0 | 0 | 0 | 0 | 8 | 187 | 10 | 1 | 0 | 0 | 0 | 0 | 8 | 187 | 10 | 1 | 0.7 | 0.053 | 0.008 | SAN FRANCISCO |
| 94556 | 47.6 | 574 | 123 | 94 | 1 | 0.2 | 8 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 25 | 0 | 0 | 0.0 | 0.000 | 0.000 | MORAGA |
| 94105 | 47.7 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94122 | 48.0 | 351 | 54 | 36 | 27 | 7.7 | 469 | 116 | 1 | 2 | 0.6 | 13 | 0 | 0 | 27 | 886 | 116 | 1 | 2 | 13 | 0 | 0 | 27 | 899 | 116 | 1 | 1.7 | 0.129 | 0.001 | SAN FRANCISCO |
| 93920 | 48.1 | 18 | 5 | 3 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BIG SUR |
| 94108 | 48.2 | 3 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94507 | 48.2 | 290 | 77 | 59 | 1 | 0.3 | 23 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 33 | 0 | 0 | 0.0 | 0.000 | 0.000 | ALAMO |
| 93927 | 48.3 | 16 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | GREENFIELD |
| 94109 | 48.3 | 22 | 9 | 7 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94115 | 48.4 | 68 | 23 | 16 | 5 | 7.4 | 145 | 4 | 0 | 0 | 0.0 | 0 | 0 | 0 | 5 | 235 | 4 | 0 | 0 | 0 | 0 | 0 | 5 | 235 | 4 | 0 | 1.0 | 0.015 | 0.000 | SAN FRANCISCO |
| 94609 | 48.4 | 72 | 8 | 6 | 1 | 1.4 | 27 | 0 | 9 | 0 | 0.0 | 0 | 0 | 0 | 1 | 39 | 0 | 9 | 0 | 0 | 0 | 0 | 1 | 39 | 0 | 9 | 0.5 | 0.000 | 0.231 | OAKLAND |
| 94133 | 48.6 | 22 | 7 | 5 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN FRANCISCO |
| 94528 | 48.6 | 26 | 7 | 5 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | DIABLO |
| 94608 | 48.6 | 45 | 5 | 3 | 4 | 8.9 | 8 | 9 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 48 | 9 | 0 | 0 | 0 | 0 | 0 | 4 | 48 | 9 | 0 | 1.0 | 0.196 | 0.000 | OAKLAND |
| 94118 | 48.7 | 142 | 41 | 28 | 16 | 11.3 | 301 | 20 | 0 | 0 | 0.0 | 0 | 0 | 0 | 16 | 516 | 20 | 0 | 0 | 0 | 0 | 0 | 16 | 516 | 20 | 0 | 1.2 | 0.039 | 0.001 | SAN FRANCISCO |
| 94618 | 48.7 | 286 | 51 | 36 | 2 | 0.7 | 9 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 30 | 0 | 0 | 0.1 | 0.000 | 0.000 | OAKLAND |
| 94123 | 49.2 | 66 | 23 | 16 | 15 | 22.7 | 454 | 29 | 5 | 1 | 1.5 | 0 | 0 | 0 | 15 | 811 | 29 | 5 | 1 | 0 | 0 | 0 | 15 | 811 | 29 | 5 | 3.6 | 0.035 | 0.006 | SAN FRANCISCO |
| 94121 | 49.3 | 184 | 36 | 25 | 15 | 8.2 | 282 | 16 | 3 | 2 | 1.1 | 10 | 0 | 0 | 15 | 834 | 16 | 3 | 2 | 10 | 0 | 0 | 15 | 844 | 16 | 3 | 2.3 | 0.019 | 0.004 | SAN FRANCISCO |
| 94129 | 49.6 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | |
| 94595 | 49.7 | 177 | 33 | 25 | 2 | 1.1 | 75 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 105 | 0 | 0 | 0.3 | 0.000 | 0.000 | WALNUT CREEK |
| 94705 | 49.7 | 286 | 65 | 45 | 4 | 1.4 | 101 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 142 | 0 | 0 | 0.2 | 0.000 | 0.000 | BERKELEY |
| 94563 | 50.3 | 580 | 140 | 105 | 4 | 0.7 | 99 | 0 | 3 | 0 | 0.0 | 0 | 0 | 0 | 4 | 144 | 0 | 3 | 0 | 0 | 0 | 0 | 4 | 144 | 0 | 3 | 0.1 | 0.000 | 0.021 | ORINOA |

# Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT OISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | EQ+HO COVER | | | AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 | | | | | | | | | | AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 | | | | | | | | | | | | DERIVED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PAID LOSS UNDER EQ COVER | | | | | PAID LOSS UNOER HO COVER | | | | | EQ COVER | | | | HO COVER | | | | EQ+HO COVER | | | | | | | |
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 94704 | 50.3 | 48 | 9 | 6 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BERKELEY |
| 94703 | 50.4 | 116 | 15 | 10 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BERKELEY |
| 94702 | 50.7 | 115 | 14 | 9 | 2 | 1.7 | 33 | 3 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 53 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 53 | 3 | 0 | 0.4 | 0.059 | 0.000 | BERKELEY |
| 94549 | 51.2 | 671 | 147 | 111 | 8 | 1.2 | 129 | 1 | 4 | 0 | 0.0 | 0 | 0 | 0 | 8 | 268 | 1 | 4 | 0 | 0 | 0 | 0 | 8 | 268 | 1 | 4 | 0.2 | 0.004 | 0.016 | LAFAYETTE |
| 94709 | 51.2 | 93 | 16 | 11 | 1 | 1.1 | 4 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14 | 0 | 0 | 0.1 | 0.000 | 0.000 | BERKELEY |
| 94710 | 51.3 | 20 | 3 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BERKELEY |
| 94594 | 51.6 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | WALNUT CREEK |
| 94596 | 51.7 | 492 | 83 | 62 | 2 | 0.4 | 11 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 31 | 0 | 0 | 0.0 | 0.000 | 0.000 | WALNUT CREEK |
| 94708 | 52.3 | 526 | 102 | 74 | 7 | 1.3 | 173 | 0 | 2 | 0 | 0.0 | 0 | 0 | 0 | 7 | 298 | 0 | 2 | 0 | 0 | 0 | 0 | 7 | 298 | 0 | 2 | 0.3 | 0.000 | 0.006 | BERKELEY |
| 94598 | 52.7 | 584 | 105 | 79 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | WALNUT CREEK |
| 94707 | 52.7 | 514 | 98 | 69 | 8 | 1.6 | 146 | 0 | 3 | 0 | 0.0 | 0 | 0 | 0 | 8 | 270 | 0 | 3 | 0 | 0 | 0 | 0 | 8 | 270 | 0 | 3 | 0.3 | 0.000 | 0.011 | BERKELEY |
| 94517 | 53.8 | 201 | 34 | 26 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CLAYTON |
| 94514 | 54.2 | 93 | 17 | 13 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BYRON |
| 94530 | 54.4 | 554 | 81 | 58 | 4 | 0.7 | 82 | 1 | 5 | 0 | 0.0 | 0 | 0 | 0 | 4 | 142 | 1 | 5 | 0 | 0 | 0 | 0 | 4 | 142 | 1 | 5 | 0.2 | 0.006 | 0.032 | EL CERRITO |
| 94965 | 54.7 | 105 | 25 | 18 | 2 | 1.9 | 8 | 52 | 0 | 1 | 1.0 | 0 | 35 | 0 | 2 | 63 | 52 | 0 | 0 | 0 | 35 | 0 | 2 | 63 | 86 | 0 | 0.2 | 1.362 | 0.000 | SAUSALITO |
| 94518 | 54.9 | 397 | 58 | 43 | 1 | 0.3 | 7 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 | 0.0 | 0.000 | 0.000 | CONCORD |
| 94523 | 54.9 | 491 | 70 | 52 | 2 | 0.4 | 57 | 1 | 7 | 0 | 0.0 | 0 | 0 | 0 | 2 | 86 | 1 | 7 | 0 | 0 | 0 | 0 | 2 | 86 | 1 | 7 | 0.1 | 0.011 | 0.081 | CONCORD |
| 94521 | 55.5 | 651 | 92 | 68 | 2 | 0.3 | 11 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 37 | 0 | 0 | 0.0 | 0.000 | 0.000 | CONCORD |
| 94804 | 55.5 | 243 | 25 | 17 | 4 | 1.6 | 10 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 4 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 52 | 0 | 0 | 0.2 | 0.000 | 0.000 | RICHMOND |
| 94920 | 55.8 | 176 | 48 | 36 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BELVEDERE-TIBURON |
| 94805 | 56.3 | 254 | 29 | 20 | 1 | 0.4 | 3 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 13 | 1 | 0 | 0.0 | 0.053 | 0.000 | RICHMOND |
| 94801 | 56.8 | 78 | 10 | 7 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | RICHMOND |
| 94520 | 57.0 | 145 | 16 | 11 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CONCORD |
| 94808 | 57.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | RICHMOND |
| 94513 | 57.2 | 103 | 12 | 9 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BRENTWOOD |
| 94519 | 57.2 | 209 | 25 | 18 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | CONCORD |
| 94803 | 57.7 | 657 | 92 | 67 | 3 | 0.5 | 42 | 13 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 79 | 13 | 0 | 0 | 0 | 0 | 0 | 3 | 79 | 13 | 0 | 0.1 | 0.161 | 0.000 | RICHMOND |
| 94941 | 57.7 | 526 | 109 | 80 | 2 | 0.4 | 7 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 27 | 0 | 0 | 0.0 | 0.000 | 0.000 | MILL VALLEY |
| 94942 | 57.7 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MILL VALLEY |
| 94553 | 58.0 | 660 | 90 | 66 | 2 | 0.3 | 7 | 1 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 37 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 37 | 1 | 0 | 0.0 | 0.033 | 0.000 | MARTINEZ |

## Table 44. Building, contents, and Ale losses, before and after deductible—Continued

DATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | <==EQ+HO COVER==> | | | <== AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000 ==> | | | | | | | | | | <== AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000 ==> | | | | | | | | | | | | <==DERIVED DATA==> | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <== PAID LOSS UNDER EQ COVER ==> | | | | | <== PAID LOSS UNDER HO COVER ==> | | | | | <== EQ COVER ==> | | | | <== HO COVER ==> | | | | <== EQ+HO COVER ==> | | | | | | | |
| ZIP (1) | ZIP FAULT DIST. (2) | NO. DWEL. (3) | DWEL. VALUE x$Mil. (4) | CONTS. VALUE x$Mil. (5) | NO. DWEL. (6) | PCT. DWEL. (7) | DWEL. x$1000 (8) | CONTS. x$1000 (9) | ALE x$1000 (10) | NO. DWEL. (11) | PCT. DWEL. (12) | DWEL. x$1000 (13) | CONTS. x$1000 (14) | ALE x$1000 (15) | NO. DWEL. (16) | BLDG. (17) | CONTS. (18) | ALE (19) | NO. DWEL. (20) | BLDG. (21) | CONTS. (22) | ALE (23) | NO. DWEL. (24) | BLDG. (25) | CONTS. (26) | ALE (27) | BLDG. %LOSS (28) | CONTS. RATIO (29) | ALE RATIO (30) | PO (31) |
| 94806 | 58.5 | 476 | 52 | 36 | 2 | 0.4 | 14 | 8 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 34 | 8 | 0 | 0 | 0 | 0 | 0 | 2 | 34 | 8 | 0 | 0.1 | 0.235 | 0.000 | RICHMOND |
| 94925 | 58.7 | 136 | 20 | 15 | 2 | 1.5 | 29 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 56 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 56 | 0 | 0 | 0.3 | 0.007 | 0.000 | CORTE MADERA |
| 94564 | 59.2 | 383 | 49 | 36 | 6 | 1.6 | 46 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 6 | 109 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 109 | 0 | 0 | 0.2 | 0.004 | 0.000 | PINOLE |
| 94964 | 59.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN QUENTIN |
| 94547 | 59.4 | 252 | 36 | 26 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | RODEO |
| 94509 | 59.6 | 727 | 90 | 67 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | ANTIOCH |
| 93930 | 59.7 | 29 | 3 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | KING CITY |
| 94565 | 60.0 | 698 | 77 | 56 | 2 | 0.3 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 22 | 0 | 0 | 0.0 | 0.000 | 0.000 | PITTSBURG |
| 94548 | 60.1 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | KNIGHTSEN |
| 94939 | 60.2 | 82 | 16 | 12 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | LARKSPUR |
| 94561 | 60.8 | 163 | 19 | 14 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | OAKLEY |
| 94904 | 61.0 | 160 | 38 | 29 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN RAFAEL |
| 94970 | 61.2 | 24 | 4 | 3 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | STINSON BEACH |
| 94572 | 61.4 | 92 | 11 | 8 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | RODEO |
| 94569 | 62.0 | 4 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PORT COSTA |
| 94901 | 62.0 | 376 | 78 | 59 | 3 | 0.8 | 14 | 10 | 0 | 0 | 0.0 | 0 | 0 | 0 | 3 | 54 | 10 | 0 | 0 | 0 | 0 | 0 | 3 | 54 | 10 | 0 | 0.1 | 0.178 | 0.000 | SAN RAFAEL |
| 94525 | 62.5 | 30 | 4 | 3 | 1 | 3.3 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 0 | 0 | 0.3 | 0.000 | 0.000 | CROCKETT |
| 94957 | 62.5 | 34 | 11 | 8 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | ROSS |
| 94924 | 62.8 | 30 | 5 | 4 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BOLINAS |
| 94915 | 63.1 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN RAFAEL |
| 94510 | 63.2 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BENICIA |
| 94960 | 64.2 | 240 | 42 | 31 | 1 | 0.4 | 13 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 24 | 0 | 0 | 0.1 | 0.000 | 0.000 | SAN ANSELMO |
| 94930 | 64.8 | 123 | 18 | 13 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | FAIRFAX |
| 94511 | 65.4 | 14 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | BETHEL ISLAND |
| 94903 | 65.4 | 360 | 56 | 42 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN RAFAEL |
| 94591 | 65.7 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | VALLEJO |
| 94590 | 66.4 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | VALLEJO |
| 94963 | 67.8 | 12 | 2 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | SAN GERONIMO |
| 94973 | 67.8 | 40 | 6 | 5 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | WOODACRE |
| 94949 | 67.9 | 148 | 29 | 22 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | NOVATO |

# Table 44. Building, contents, and Ale losses, before and after deductible—Continued

OATA FILE STATE-6A.DAT DISTRIBUTION OF BUILDING AND CONTENTS LOSSES BY ZIP DATA IN ZIP-FAULT ORDER (Column 2)

ALAMEDA, CONTRA COSTA, MARIN, MONTEREY, SAN BENITO, SAN FRANCISCO, SAN MATEO, SANTA CLARA, and SANTA CRUZ Counties

| | | EQ+HO COVER | | | AGGREGATE LOSSES AFTER DEDUCTIBLE x$1000: PAID LOSS UNDER EQ COVER | | | | | PAID LOSS UNDER HO COVER | | | | | AGGREGATE LOSSES BEFORE DEDUCTIBLE x $1000: EQ COVER | | | | HO COVER | | | | EQ+HO COVER | | | | DERIVED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ZIP | ZIP FAULT DIST. | NO. DWEL. | DWEL. VALUE x$Mil. | CONTS. VALUE x$Mil. | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | PCT. DWEL. | DWEL. x$1000 | CONTS. x$1000 | ALE x$1000 | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | NO. DWEL. | BLDG. | CONTS. | ALE | BLDG. %LOSS | CONTS. RATIO | ALE RATIO | PO |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) |
| 94589 | 69.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | VALLEJO |
| 94933 | 69.2 | 9 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | FOREST KNOLLS |
| 94938 | 69.4 | 11 | 2 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | LAGUNITAS |
| 94947 | 71.3 | 371 | 60 | 45 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | NOVATO |
| 94950 | 71.7 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | OLEMA |
| 94945 | 72.1 | 255 | 44 | 34 | 2 | 0.8 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 2 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 39 | 0 | 0 | 0.1 | 0.000 | 0.000 | NOVATO |
| 94946 | 73.0 | 8 | 3 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | NICASIO |
| 94533 | 76.6 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | FAIRFIELO |
| 94956 | 76.6 | 15 | 2 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | POINT REYES STATION |
| 94535 | 76.7 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | FAIRFIELD |
| 93932 | 78.1 | 2 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | LOCKWOOD |
| 94937 | 78.3 | 33 | 5 | 3 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | INVERNESS |
| 94952 | 81.9 | 3 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | PETALUMA |
| 94940 | 82.1 | 7 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | MARSHALL |
| 94928 | 89.2 | 1 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | COTATI |
| 94929 | 90.1 | 8 | 1 | 1 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.000 | 0.000 | DILLON BEACH |
| | | 84,423 | 13,520 | 9,987 | 2,784 | | 63,985 | 14,885 | 5,159 | 245 | | 2,391 | 467 | 115 | 2,784 | 114,864 | 14,885 | 5,159 | 230 | 1,941 | 467 | 115 | 3,014 | 116,805 | 15,352 | 5,275 | | | | |

NOTES:

Column 7: PCT. DWEL. = Column 6 divided by column 3, in %.

Column 12: PCT. DWEL. = Column 11 divided by column 3 in %.

Column 28: BLDG. %LOSS = Average building loss as a % of insured value, before deductible. Column 17 divided by column 4, in %.

Column 29: CONTS. RATIO = (Aggregate contents loss [column 26]) divided by (Aggregate building loss before deductible [column 25]).

Column 30: ALE RATIO = (Aggregate ALE loss [has no deductible -- column 27]) divided by (Aggregate building loss before deductible [column 25]).