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California Building Strong Motion Earthquake Instrumentation Program

by

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Introduction. In 1971 the State of California enacted a law[1] establishing a statewide Strong Motion Instrumentation Program to assure the development of a scientifically sound distribution of strong-motion instruments throughout the State. The law stipulates that the instruments are to be located in representative geologic environments and representative structures throughout the State, and that the California Division of Mines and Geology (CDMG), with the advice of an ad-hoc Advisory Board, should organize and monitor the program. Funding is provided by a .007 percent (7¢ per $1000) assessment of estimated construction costs collected statewide from building permits.[2]

During the first two years the program was in effect (1972-73), the instrumentation of ground or "freefield" sites was emphasized and all available funding was used to purchase and install strong-motion accelerographs for that purpose. In 1974, with the "freefield" instrumentation phase of the program well established, a large segment of the available funding was channeled for use in instrumenting buildings, the second priority of the program. Concurrently, at the request of the CDMG and its advisory panels, a set of detailed guidelines for selecting and instrumenting buildings was developed by a special ad-hoc committee, chaired by the author. Those guidelines, their background and subsequent implementation, are the subject of this paper. Similar guidelines, not discussed herein, have also been developed for a third phase of the program in which dams throughout the State are being instrumented.

Background Information. Prior to the implementation of the building instrumentation phase of the California Strong Motion Instrumentation Program (CSMIP), i.e. as of June 30, 1974, there were 225 buildings in the State housing strong-motion instruments for recording structural response to earthquakes (figure 1). One hundred seventy-two of these were located in the city of Los Angeles as a result of a building code ordinance, adopted in 1965, requiring that three triaxial accelerographs be installed in most buildings over six stories in height and in all buildings over ten stories in height--one in the basement, one

[1] Chapter 8 of Division 2 of the Public Resources Code (SB 1374).

[2] Cities that adopted ordinances requiring strong-motion instruments in buildings could request exemption from the State program.

at mid-height, and one near the top. Most of the other buildings were located in municipalities (statewide) that adopted similar ordinances. Buildings instrumented under such ordinances, however, were not instrumented specifically to provide data on which to base improvements in engineering design practice, one of the primary objectives of the CSMIP. Rather, they were instrumented so that the performance of each structure could be monitored to assess the safety of the facility in the event that damaging levels of motion occurred. Furthermore, such instrumented buildings did not represent a well-balanced distribution of the types and sizes of buildings already constructed throughout the State and were not adequately instrumented for defining complete translational and torsional response. In essence, the network of instrumented buildings in existence prior to the development of the State program was not oriented to the objectives of the CSMIP or the legislation creating it.

The basic objectives for the building instrumentation phase of the CSMIP, originally set forth in an unpublished paper by R. B. Matthiesen and C. Rojahn, were adopted by the Advisory Board's Site Selection Committee in mid-1973 as follows: to place a high priority on instrumenting buildings in Zone III of the Preliminary Map of the Maximum Expectable Earthquake Intensity in California (Alfors, Burnett, and Gay, 1973) and a lower priority on instrumenting buildings in Zone II; to place the highest priority on instrumenting buildings located within five miles of the major faults along which there is significant activity; to seek the assistance of the Structural Engineers Association of California in selecting buildings to be instrumented under the program; to select representative types and heights of buildings; and to instrument many buildings moderately rather than a few buildings highly using remote recording accelerograph systems with accelerometers located so as best to record both translational and torsional response of each building. With these objectives and at the request of the Site Selection Committee, the specially appointed ad-hoc committee (the Subcommittee on Instrumentation for Structures) developed a series of guidelines defining where, which types of, and how buildings should be instrumented under the CSMIP. Those guidelines, discussed in detail below, are now being implemented by the CDMG.

<u>Guidelines for the Geographic Distribution of Instrumented Buildings</u>. In adopting its objectives for the building instrumentation program, the Site Selection Committee stipulated that areas within Zone III (zone of maximum expected intensity) of the Preliminary Map of Maximum Expectable Earthquake Intensity in California, and especially areas within five miles of the major active fault zones, should be given highest priority for the instrumentation of buildings. In light of these stipulations and considering population densities, locations of buildings in which strong-motion instrumentation had already been installed, and a best-educated-guess on the probability for potentially damaging earthquakes in various areas throughout the State, the Subcommittee on Instrumentation for Structures (SIS) established a list of 21 areas recommended for instrumentation (table 1, figure 2) and suggested how many buildings should be instrumented in each area (expressed as a percentage of the total number of buildings to be instrumented). With the exception of the highly populated San Diego area, all selected areas were either in or immediately adjacent to Zone III. The area along the Hayward fault between Milpitas and Geyserville was selected for the largest number of buildings because of the high concentration of buildings adjacent to the fault, high probability for potentially damaging

earthquake activity, and lack of existing instrumented buildings. The area along the San Andreas fault between Los Gatos and Fort Bragg was chosen for similar reasons. In Los Angeles, where a large number of mid- and high-rise buildings have already been instrumented under the terms of the city ordinance, the concentration of buildings and probability for potentially damaging earthquake activity were also considered to be high and the need to instrument low-rise buildings was considered to be great. A slightly lower number of buildings were recommended along the Calaveras fault system as it extends from San Jose to Napa, along the San Jacinto fault from Cajon Pass to Hemet and from Hemet to El Centro, and along the San Andreas fault from Cajon Pass to Calipatria. These areas were considered to have a high probability for potentially damaging earthquake activity, moderately dense populations, and few instrumented buildings. In the remaining selected areas, a relatively small number of buildings were recommended because of lower population densities and postulated lower potential for seismic activity.

Because of the manner in which seismic waves propogate and attenuate in the California region (high frequencies tend to attenuate more quickly with distance than lower frequencies, which tend to be more pronounced away from the source of energy release) and the fact that the natural periods of vibration of buildings are approximately proportional to the number of stories (the higher the building, the longer the fundamental period), the SIS decided to make recommendations on the distribution of the height of instrumented buildings relative to the distance from potentially active faults. Those recommendations, shown in table 2, suggest that instrumented low-rise buildings (one to six stories) should be within 10 miles of the fault of interest, that most of the instrumented mid-rise buildings (seven to fifteen stories) should be within a 25-mile range, and that most of the instrumented high-rise buildings (greater than fifteen stories) should be in the 5- to 25-mile range.

Guidelines for the Selection of Types and Heights of Buildings to be Instrumented. In its interpretation of the legislation creating the CSMIP, the Advisory Board indicated that one of the primary objectives of the program should be to provide data on which to base improvements in engineering design practice (H. B. Seed and R. B. Matthiesen, unpublished report to the State of California Seismic Safety Commission). In light of this objective and the general stipulation that representative buildings throughout the State should be instrumented, the SIS recommended that: all major building types, construction techniques, and materials should be equitably represented in the program; each instrumented building should be relatively simple in framing and design so that the response can be readily interpreted; and the instrumentation of low-rise buildings should be emphasized.

In regard to building type, the SIS suggested that an attempt should be made to ascertain an equitable distribution of the types of buildings shown in table 3 (table 3 lists the most common types of buildings presently in existence statewide). No recommendations were made with regard to date of design or construction although the SIS did believe that the instrumentation of buildings designed since the Long Beach earthquake of 1933[3] should be emphasized.

With respect to the percentage distribution of instrumented building heights, the SIS suggested that 28% of the instrumented buildings should be in the one to two-story range, 32% in the three to six-story range, 26% in the seven to fifteen-story range, and 14% greater than fifteen stories (table 2). This distribution reflects the attitude that low-rise buildings (one to six stories) should make up 60% of the total number of buildings instrumented under the State program. The emphasis on low-rise buildings stems from the fact that they are vastly more numerous throughout the State than their high-rise counterparts, and that they have historically been more hazardous when subjected to strong ground shaking (all known deaths in the 1971 San Fernando earthquake, for example, occurred in low-rise buildings). Furthermore, relatively few low-rise buildings had been instrumented prior to the development of the State program.

Guidelines for the Selection and Placement of Instruments in Buildings. In general, the SIS recommended that all buildings instrumented under the CSMIP should be instrumented in accordance with the guidelines and specifications developed by the U.S. Geological Survey (USGS). More specifically, the SIS recommended that remote recording instrumentation, consisting of single or multi-axial accelerometers connected via data cable to a central recorder(s), be used, and that the accelerometers be installed at locations prescribed by the guidelines for instrumenting buildings developed by the author and R. B. Matthiesen (Rojahn and Matthiesen, 1975).

Remote recording systems were recommended rather than triaxial optical-mechanical self-contained accelerographs (triaxial accelerographs are presently required by the city of Los Angeles and other municipalities that adopted similar ordinances) because remote recording systems, though somewhat more expensive, give greater flexibility for accelerometer (figure 3a) placement, space requirements are minimized, and the recorder (figure 3b) can be centrally located for easy maintenance and record retrieval. Furthermore, triaxial systems like those presently required by the city of Los Angeles do not provide enough data to isolate translational and torsional response, a capability that forced-vibration tests (Goebler, 1969; Hart, DiJulio and Lew, 1974; Jennings, Matthiesen and Hoerner, 1972) as well as analyses of the 1971 San Fernando earthquake records (Blume and Associates, 1973; Gates, 1973) indicate is vital even in highly symmetrical buildings.

According to the instrument placement guidelines developed by Rojahn and Matthiesen, accelerometers should be placed, as a minimum, on the lowest level and at the main roof level. On the lowest level, it is recommended (as a minimum) that three orthogonal accelerometers (two horizontal and one vertical) be attached firmly to the foundation or floor near the center of plan with the horizontal accelerometers oriented parallel to the transverse and longitudinal axes of the building. If the foundation conditions are such that differential horizontal motion may occur (Yamahara, 1970), one or more additional horizontal

[3] The Long Beach earthquake provided the impetus for the enactment of the first stringent seismic codes in California (Moran and Bockemohle, 1973). Buildings, other than dwellings and farm buildings, designed subsequent to that earthquake (i.e., after the enactment of the Field and Riley Acts two months later), have been designed to resist seismic forces. No such design requirements, however, were in effect statewide prior to the Long Beach earthquake.

accelerometers are recommended. In a building that is large and relatively square in plan, two additional accelerometers should be positioned along and parallel to two adjacent outside walls (figure 4a), whereas in a building that is very long in comparison with its width, one additional accelerometer positioned along and parallel to one of the outside end walls may be sufficient. If the building has a rigid mat foundation and rocking motion is expected, two additional vertical accelerometers are recommended. These should be positioned so that rocking motion can be recorded along any azimuth, i.e., one vertical accelerometer should be positioned in each of three corners of the building (figure 4b). In a building that is quite large in plan with significantly varying foundation conditions, it is recommended that additional triaxial packages be installed on the different foundation materials.

Instrumentation at the main roof level, as well as at all instrumented intermediate floors, should consist of an array of remote horizontal accelerometers arranged so as separately to record both translational and torsional motion. If the roof or instrumented floor is very stiff and is expected to be rigid in the horizontal plane, only three horizontal accelerometers are required. A biaxial pair should be located at the predicted or known center of rigidity so as to record pure translational motion along the transverse and longitudinal axes of the building. The third accelerometer should be positioned along and parallel to the most distant outside end wall so as to record torsional motion (figure 5a). If the roof (floor) is not expected to be rigid in the horizontal plane, one or more additional horizontal accelerometers is recommended. The location of each of these will be dependent upon the expected response of the roof (floor). For example, in the case of a rectangular-plan exterior shear-wall building with the roof (floor) diaphragm flexible in the transverse direction and not in the longitudinal direction, one additional accelerometer is recommended. It should be positioned so as to facilitate the interpretation of relative motion in the transverse direction between the end walls and the center of the roof (floor) diaphragm (figure 5b). Because the most significant motions in building reponse to strong ground shaking are normally in the horizontal direction, vertical accelerometers are not felt to be as crucial above ground level as horizontal accelerometers. If vertical response is of interest, however, vertical accelerometers sufficient in number to determine all significant relative motions should be installed. In masonry-wall buildings, for example, where ultimate strength is a function of bearing stress (Mayes and Clough, 1975), the vertical accelerometers should be alined vertically on the wall(s) of interest at various heights throughout the building including the lowest level. Likewise, if the vertical response of a floor slab or beam is of interest (in any type of building), multiple vertical accelerometers should be installed at the slab edges, or beam ends, and the mid-span.

The number of intermediate levels at which instrumentation should be installed is a function of the structural framing system, number of stories, architectural configuration and known dynamic characteristics of the building. Unless mode shapes have been predetermined by forced-vibration or in-depth ambient vibration tests and intermediate level instrumentation is not considered to be necessary, instrumentation should be placed at as many intermediate floors as is economically feasible because the accuracy with which a building's response to earthquake motion can be determined is largely proportional to the number of levels instrumented. As a minimum, it is recommended that at least two intermediate levels be instrumented in buildings having more than six stories above ground and at least one be instrumented in buildings having three to six stories. The level(s) should not coincide, if at all possible, with a nodal point of any of the modes of predominant response (usually some or all of the first four modes). Close examination of the mode shapes in figure 6 indicates the two most optimal "anti-node" areas for buildings uniform in plan with height are located at about 40% and 70% of the above ground building height. If no other information is available, it is recommended that one or both of these 40% and 70% levels be instrumented. If, however, mode shapes based on a computerized model of the building are available, such mode shapes should be used to determine the optimal locations. Stiffness discontinuities must also be considered in the process and should be instrumented whenever their effect on mode shapes is unknown. Instrumentation at such locations could either serve as or complement the intermediate level instrumentation recommended as minimal. In some buildings, such as one having a slender tower on a wide base, the discontinuity is obvious, whereas in others, stiffness discontinuities may be revealed only through a thorough investigation of the structural framing system.

Miscellaneous Guidelines. In order to facilitate and strengthen the implementation of the program, the SIS recommended that representatives of the various chapters of the Structural Engineers Association of California (SEAOC) select the buildings to be instrumented under the State program. More specifically, the SIS recommended that members of the Strong-Motion Instrumentation Committee from each of the Association's southern California and San Diego chapters jointly select the buildings to be instrumented in the south half of the State, and that members of the same committees from the central and northern California chapters jointly select the buildings to be instrumented in the north half of the State. All buildings were to be selected in accordance with the above guidelines and would be subject to the approval of the SIS, the Site Selection Committee, and the Advisory Board. Locations for instrumentation within each of the buildings would be chosen jointly by representatives of the ad-hoc SEAOC committees, the USGS and the design engineer.

The SIS also made two recommendations designed to enhance and facilitate the analysis of records obtained from the buildings. The first of these specified that, if at all possible, "free-field" accelerographs should be located near each instrumented building in order to obtain data on site-structure resonance effects and soil-structure interaction. The second called for the collection and archiving (by CDMG) of plans, specifications, calculations, and pertinent construction and inspection records for each instrumented building as well as site soil and geology descriptions.

Implementation of the Program. The above guildeines were submitted to the Advisory Board in mid-1974 and approved shortly thereafter with the stipulation that they be regularly updated (perhaps annually) as more geologic, seismological, engineering analysis and other pertinent information becomes available. After approval, the SIS solicited and received from the ad-hoc SEAOC building selection committees a list of 54 buildings to be instrumented under the first phase of the program (table 4). The size and location distribution of this first set of buildings (figure 7) are not in exact adherence to the criteria established by the above guidelines, though the basic intent of the guidelines certainly has been met. Significant deviations from the recommended distributions will be rectified in subsequent phases of the program.

As of the time of this writing (February, 1976) two of the 54 buildings have been instrumented--the Eastman Kodak Building in San Ramon and Capwell's Department Store in El Cerrito. Instrument locations have also been selected for seven others that are expected to be instrumented in the near future. The manner in which two of these, the Title Insurance and Trust Building in Oakland and the San Diego Gas and Electric Company Building in San Diego, will be instrumented is illustrated in figures 8 and 9. The remaining 45 buildings are expected to be instrumented within the next one to three years.

On the basis of current projected revenues,[4] and instrument procurement, installation and maintenance expenses, it is now estimated that as many as 400 buildings may be instrumented under the State program (California Division of Mines & Geology, unpublished report to the California Legislature). The installation phase of the program is expected to be completed in the year 2035, the time at which program revenues are expected to be sufficient only for covering instrument maintenance (a major cost), personnel (minimal staff), and data analysis expenses.

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[4] Average annual revenues for the first 3 1/2 years of the CSMIP were $414,162. Projected annual revenues are expected to be at the same level as current revenues (California Division of Mines & Geology, unpublished report to the California Legislature).

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Table 1.- Proposed Geographic Distribution of Instrumented Buildings

Percent of total number of instrumented buildings	Geographic area
14	- along the Hayward fault system as it extends from Milpitas to Geyserville.
12	- along the San Andreas fault as it extends from west of Los Gatos to west of Fort Bragg.
12	- greater Los Angeles area.
8	- along the Calaveras fault system as it extends from east of San Jose through Concord to east of Napa.
6	- along the San Jacinto fault as it extends from Cajon Pass to Hemet.
6	- along the San Jacinto fault as it extends from Hemet to El Centro.
6	- along the San Andreas fault as it extends from Cajon Pass to Calipatria.
4	- South Lake Tahoe.
4	- Eureka and Ferndale.
4	- along the coast from Goleta to Oxnard.
4	- San Diego.
2	- along the Midland fault system as it extends from Winters to Birds Landing.
2	- Bishop.
2	- Susanville.
2	- Cedarville or Fort Bidwell.
2	- along the Calaveras fault system as it extends from east of San Jose through Hollister to the San Andreas fault.
2	- Monterey.
2	- along the San Andreas fault as it extends from a few miles east of Los Gatos to Parkfield.
2	- along the San Andreas fault as it extends from Parkfield to Cajon Pass.
2	- along the Sierra Nevada fault as it extends from China Lake to Independence.
2	- Barstow.

Table 2.- Proposed Distribution of Instrumented Buildings as a Function of Distance from Fault of Interest, in percent

Distance from fault in miles \ Number of stories	1-2	3-6	7-5	≥16
0-5	16	16	4	0+
5-10	12	16	12	4
10-25	0+	0+	8	8
≥26	0+	0+	2	2

Table 3.- Recommended Types of Buildings to be Instrumented

I. One and two-story buildings.
   A. Open frame type - gymnasiums, auditoriums.
   B. Continuous frame - school classrooms, offices.
   C. Box structures - commercial masonry or concrete wall structures with flexible diaphragms.

II. Three to six-story buildings.
   A. Frame.
   B. Shearwall.
   C. Combination.
   D. Precast structural elements.

III. Buildings over six stories.
   A. Frame.
   B. Shearwall.
   C. Combination.

Table 4.- First Set of Buildings Recommended for Instrumentation

Location	Building	Number of stories
Belmont	Envirotec Systems, Inc. 15 Davis Drive	2
Big Pine	Big Pine High School Gymnasium	1
China Lake	Cerro Coso College (Main building)	3
Concord	Standard Oil Company Building 2001 Diamond Boulevard	2
Daly City	Mary's Help Hospital	10
El Centro	Imperial County Services Building	6
El Cerrito	Capwell's Department Store	3
Hayward	Administration Building California State College	12
Hayward	Levine Hospital Addition	5
Healdsburg	Cambiaso Winery 1141 Grant Avenue	1
Hemet	Hemet City Library	1
Hemet	Hemet Valley Hospital	4
Huntington Beach	Huntington Beach Library	2
Independence	Garage and office building Kearsarge and Webster Streets	1
Indio	Riverside County Building	4
Irvine	Engineering Building University of California	10
Long Beach	Harbor Dept. Administration Bldg. Long Beach Harbor	6
Long Beach	Engineering Building Long Beach State College	5
Los Angeles	Century City Shopping Center	1+
Los Angeles	Hollywood Storage Building 1025 North Highland	15
Los Angeles	UCLA Math-Science Building	6
Los Angeles	Union Bank Building 15233 Ventura Boulevard	15
Mammoth Lakes	Mammoth Lakes High School Gymnasium	1
Oakland	10850 MacArthur	3
Oakland	Oak Center Towers 1515 Market Street	11
Oakland	Title Insurance & Trust Building	2
Palmdale	Holiday Inn	4

Table 4 (continued).- First Set of Buildings Recommended for Instrumentation

Location	Building	Number of stories
Palm Desert	Eisenhower Memorial Hospital	5
Palm Springs	Desert Hospital	4
Palo Alto	1900 Embarcadero Road	2
Piedmont	Piedmont Junior High School	3
Pleasant Hill	Citizens Savings and Loan Association 2255 Contra Cost Boulevard	3
Redwood City	Building K City College of San Mateo (Canada Campus)	3
Riverside	Riverside County Hall of Records	13
Sacramento	Greenfair Tower No. 2 Fairground Drive at Broadway	9
San Bernardino	Hilton Hotel	6
San Bernardino	Library/Classroom Building San Bernardino State College	6
San Diego	San Giego Gas & Electric Company Bldg.	22
San Fernando	Indian Hills Medical Center	6
San Francisco	Alcoa Building 1 Maritime Plaza	27
San Francisco	East Building and Mechanical Service Tower University of California Medical Center	15
San Jose	Town Park Towers 60 Third Street	10
San Jose	Murdock Building 111 West St. John Street	10
San Rafael	Computer Center Fireman's Fund Insurance Company	2
San Ramon	Eastman Kodak Building	1
Santa Barbara	200 East Carrillo Street	4
Santa Barbara	North Hall University of California	3
Santa Rosa	Crocker-Citizens Bank	5
Saratoga	Gymansium West Valley Community College	1
South San Francisco	Kaiser Hospital	4
Truckee	Tahoe-Truckee High School (Main building)	2
Ventura	Holiday Inn	12
Walnut Creek	Fidelity Savings & Loan Association 1990 North California Boulevard	10
Winters	Winters Intermediate School	1

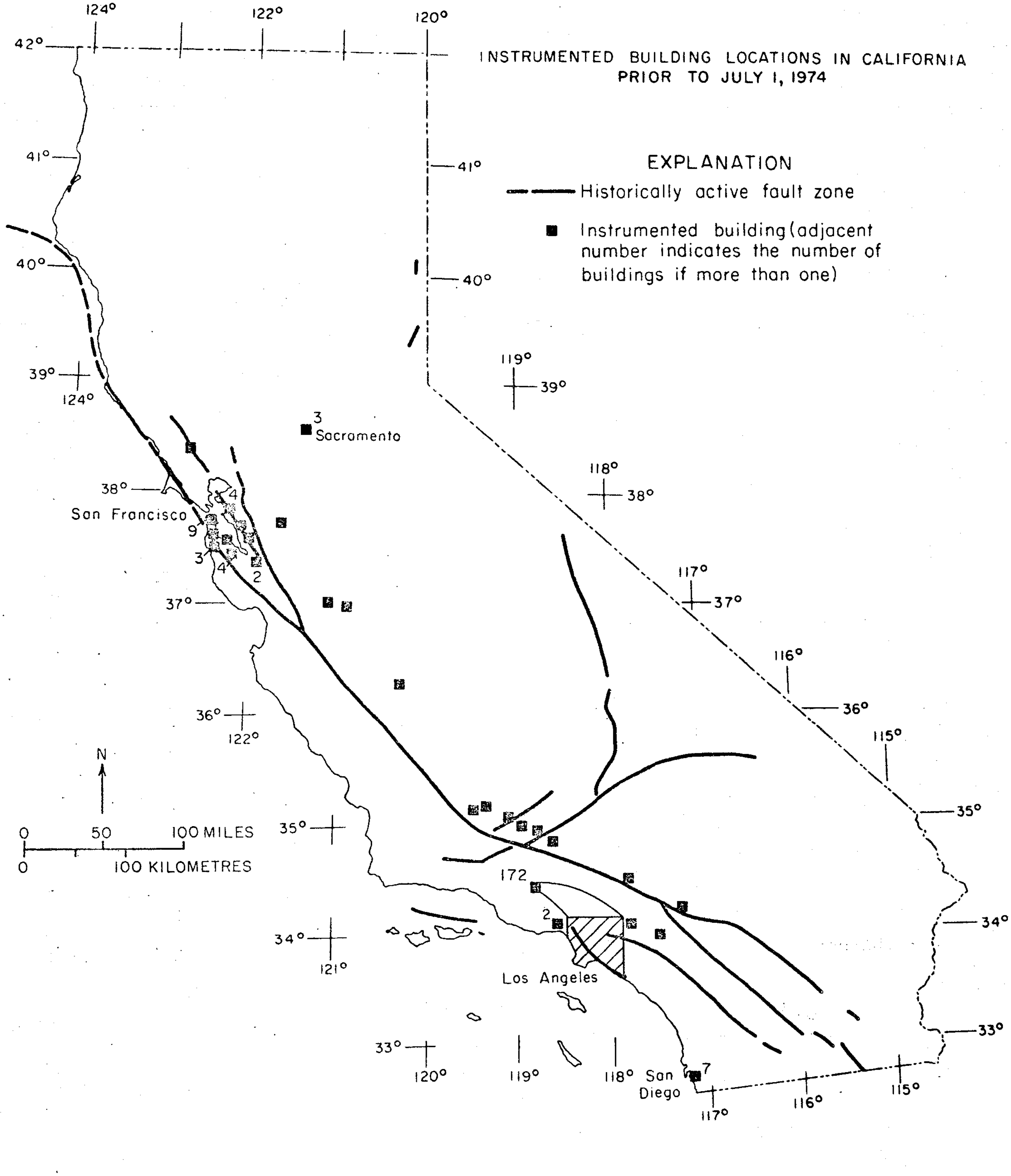


Figure 1.- Instrumented building locations in California prior to July 1, 1974.

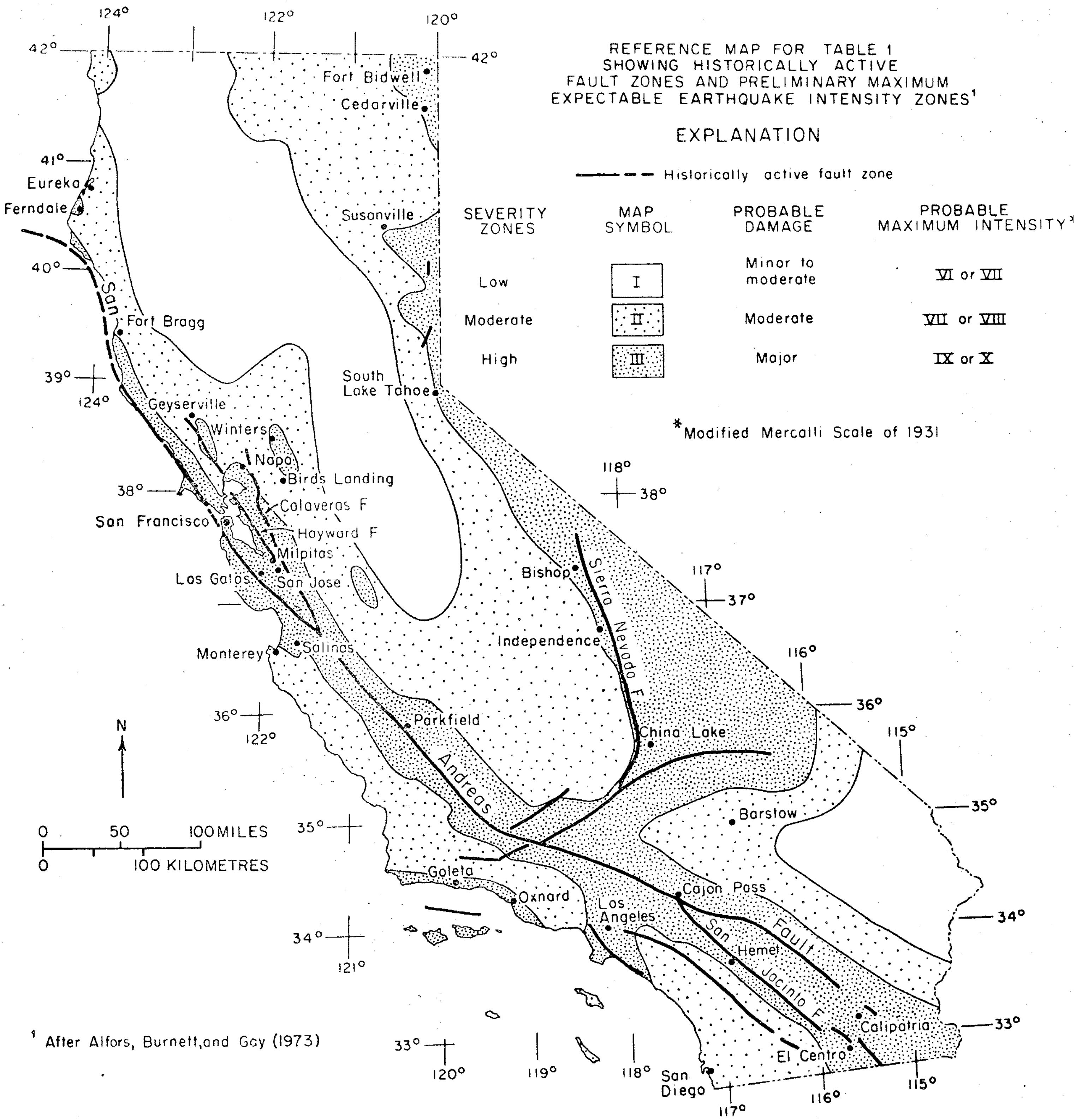
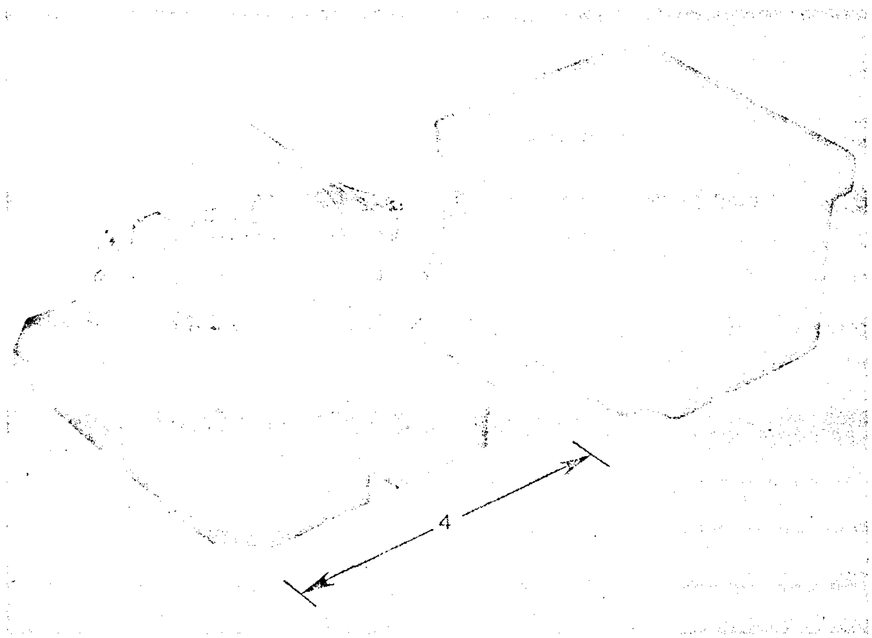
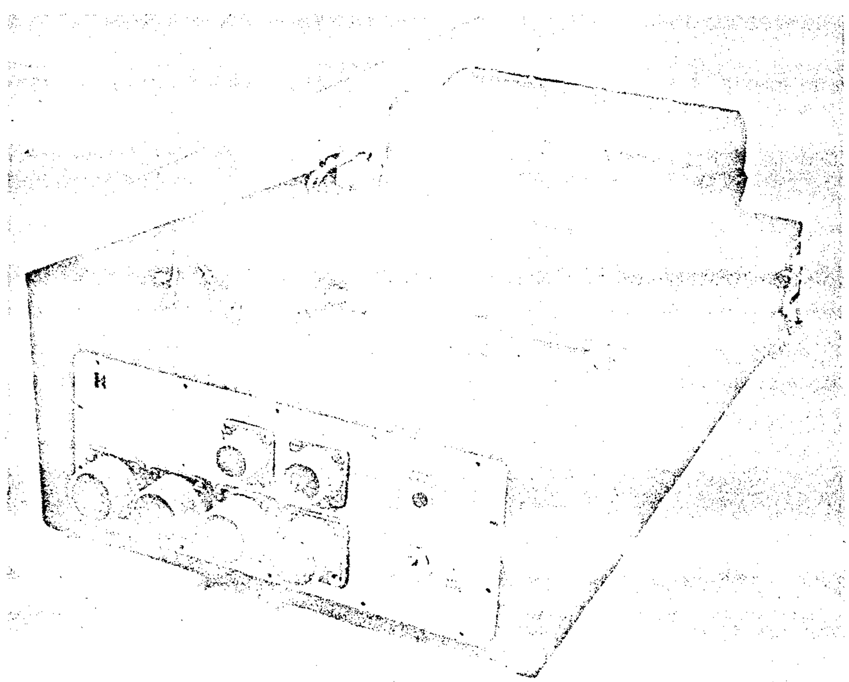


Figure 2.- Reference map for table 1 showing historically active fault zones and preliminary maximum expectable earthquake intensity zones (Alfors, Burnett, and Gay, 1973).



3a- Accelerometer.



3b- Central recorder.

Figure 3.- Typical remote recording accelerograph system (Kinemetrics CR-1).

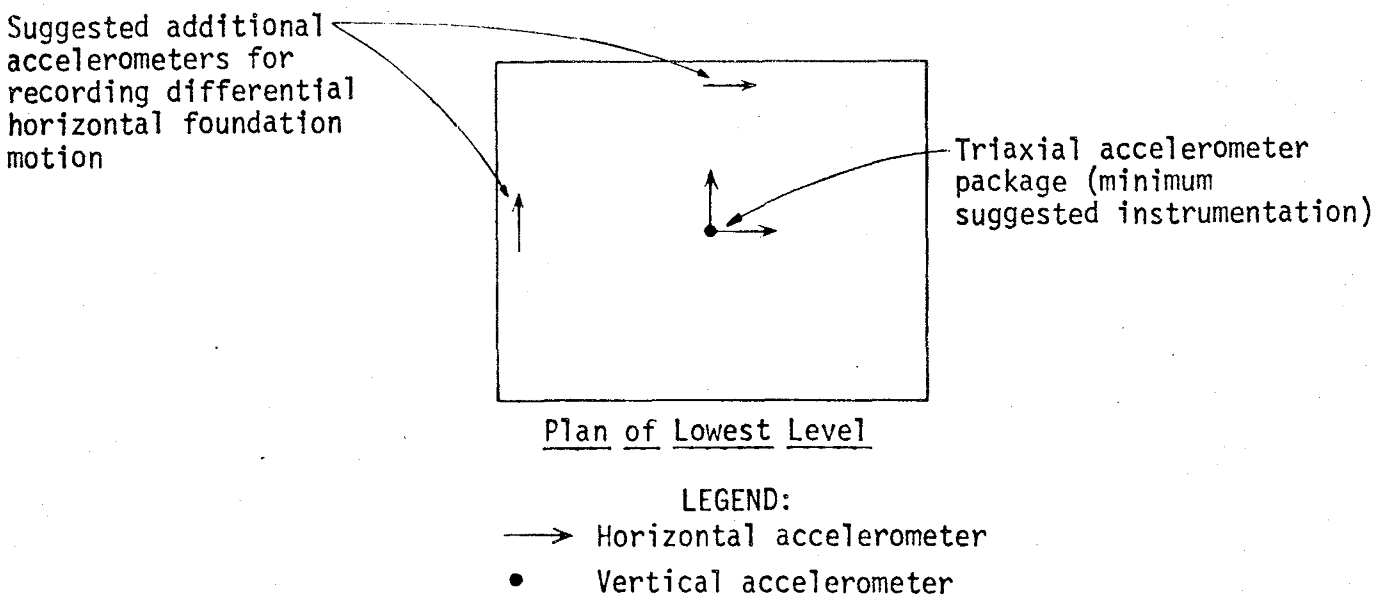


Figure 4a.- Suggested strong-motion instrumentation scheme for recording differential horizontal foundation motion in a building that is large and relatively square in plan.

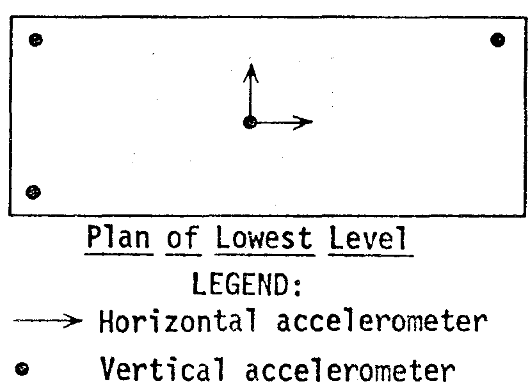
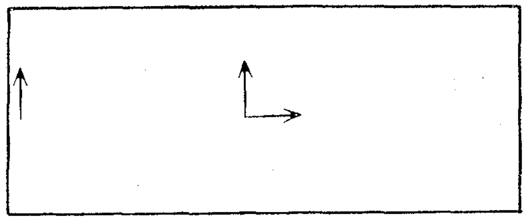


Figure 4b.- Suggested strong-motion instrumentation scheme for recording rocking motion at lowest level.

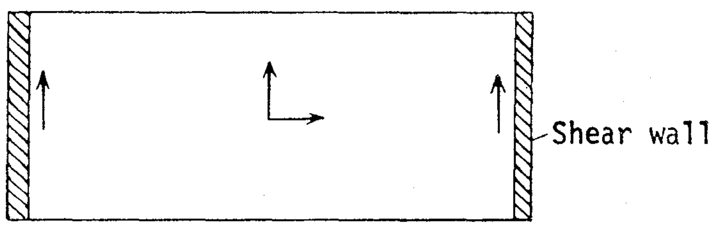


Plan of Upper Floor or Roof

LEGEND:

→ Horizontal accelerometer

Figure 5a.- Suggested strong-motion instrumentation scheme for roof (or floor) expected to be rigid in the horizontal plane.

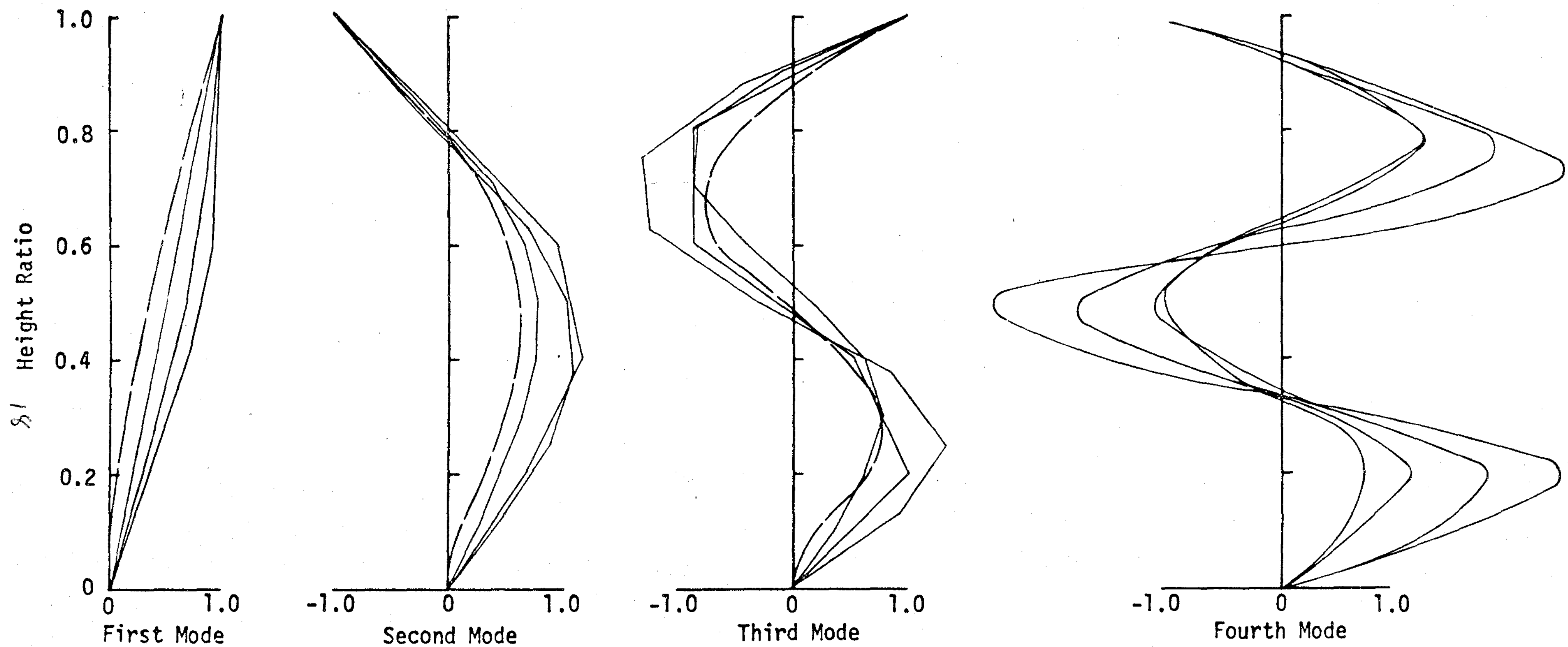


Plan of Upper Floor or Roof

LEGEND:

→ Horizontal accelerometer

Figure 5b.- Suggested strong-motion instrumentation scheme for roof (or floor) where relative diaphragm motion is expected in the transverse direction.



(After Jennings, 1969)

Figure 6.- Experimental and analytical mode shapes for buildings.

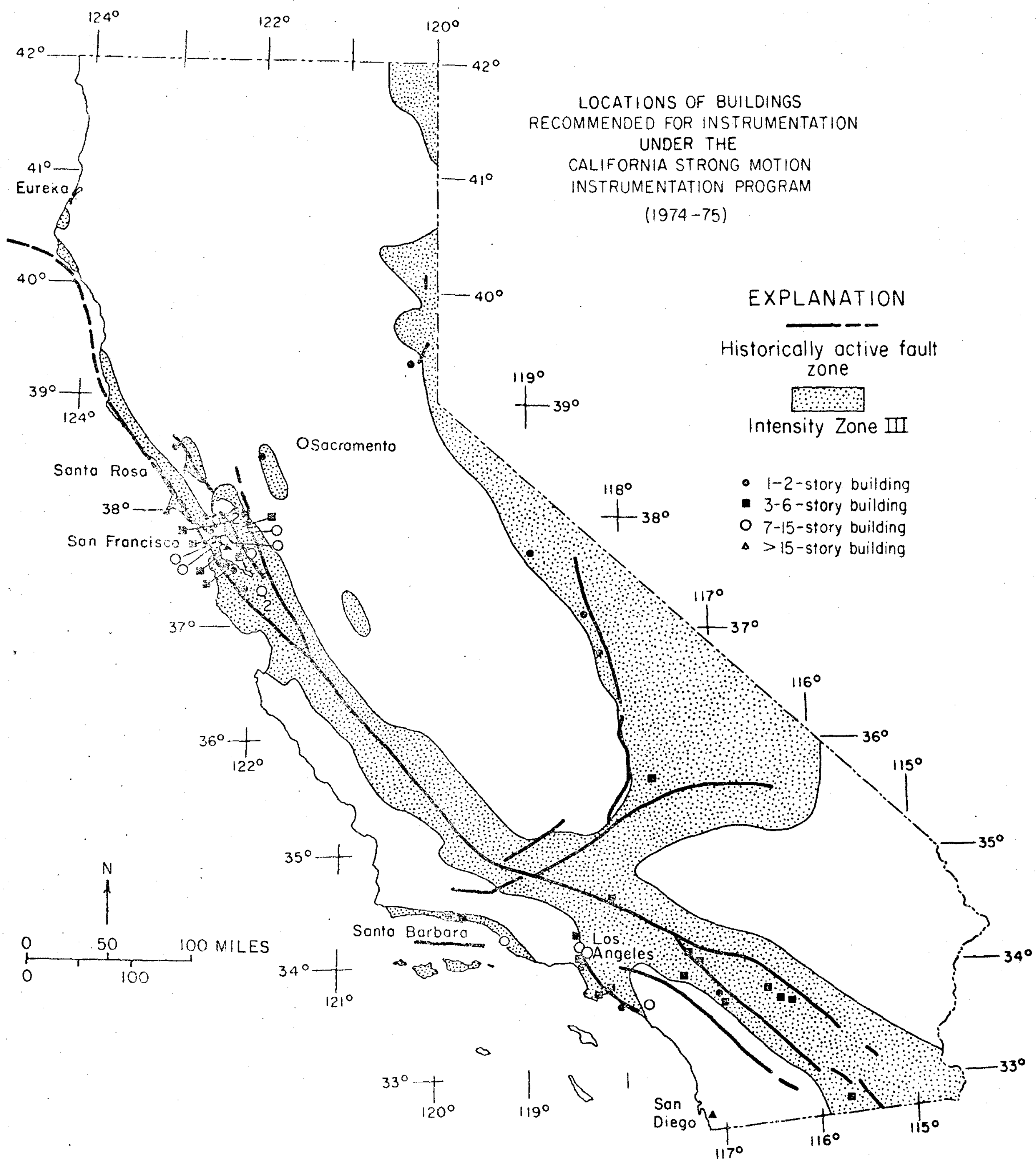
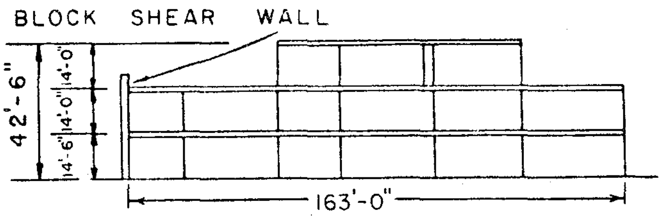
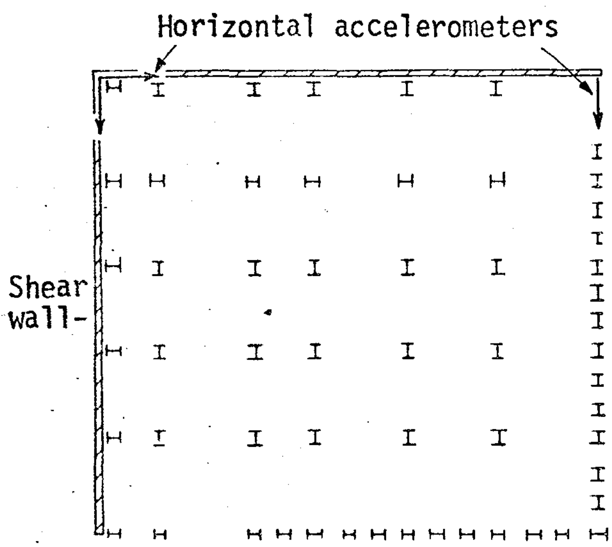


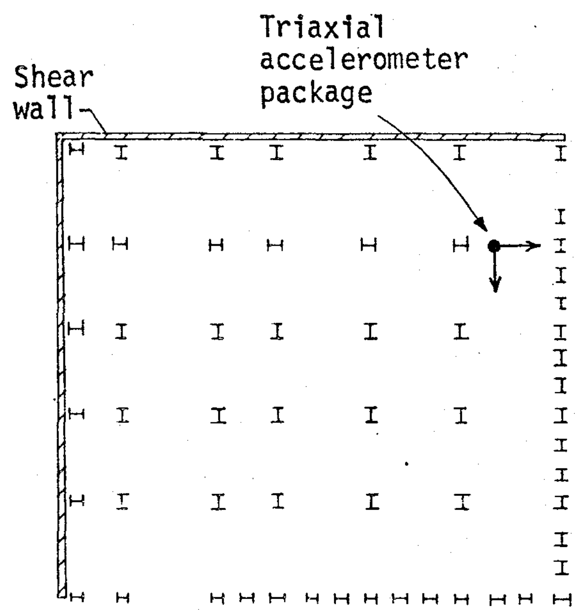
Figure 7.- Locations of buildings recommended for instrumentation under the California Strong Motion Instrumentation Program (1974-75).



Elevation

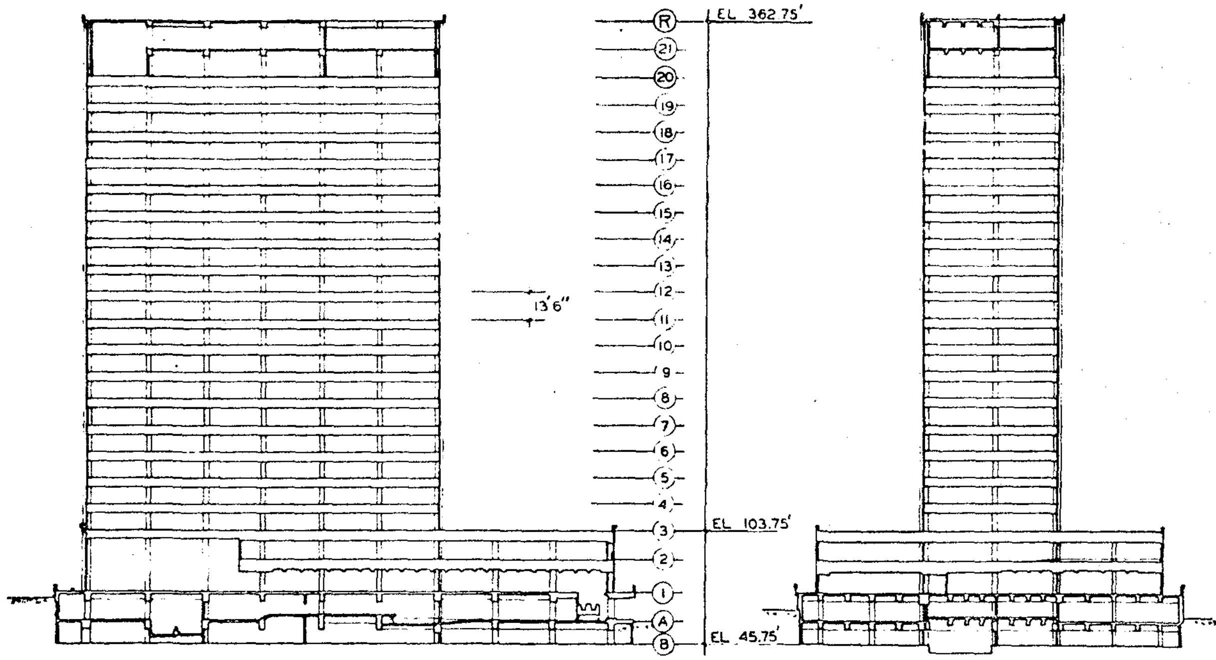


Main Roof Plan



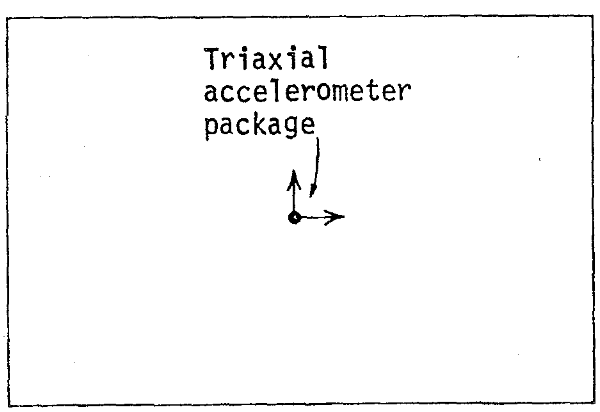
Ground Floor Plan

Figure 8.- Strong-motion instrumentation scheme for Title Insurance and Trust Building, Oakland, California. The locations of the horizontal accelerometers at the roof level are based on forced-vibration tests that indicate the center of rotation of the building is located near the intersection of the two shear walls (Bouwkamp and Blohm, 1966). The location of the triaxial package at ground level was chosen on the basis of convenience to the owner.

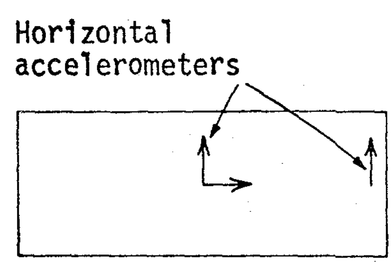


N-S Elevation

E-W Elevation



Basement B Plan



3rd Floor, 12th Floor,
20th Floor, and Roof Plan

Figure 9.- Strong-motion instrumentation scheme for San Diego Gas and Electric Company Building. The floors at which instrumentation is to be located were selected on the basis of experimentally determined mode shapes (Jennings, Matthiesen and Hoerner, 1972).

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16\. Abstract (Limit: 200 words)

In 1971 the State of California enacted a law establishing a statewide Strong Motion Instrumentation Program to assure the development of a scientifically sound distribution of strong-motion instruments throughout the state. The law stipulates that the instruments are to be located in representative geologic environments and representative structures throughout the state. During the first two years the program was in effect (1972-73), the instrumentation of ground or freefield sites was emphasized and all available funding was used to purchase and install strong-motion accelerographs for that purpose. In 1974, a large segment of available funding was channeled for use in instrumenting buildings, the second priority of the program. A set of detailed guidelines for selecting and instrumenting buildings was developed. Those guidelines, their background, and subsequent implementation are the subject of this paper. The network of instrumented buildings in existence prior to the development of the state program was not oriented to its objectives. The basic objectives for the building instrumentation phase of this program are reviewed. The established guidelines for the geographic distribution of instrumented buildings, for the selection of types and heights of buildings to be instrumented, and for the selection and placement of instruments in buildings, are discussed. It is estimated that as many as 400 buildings may be instrumented under the state program by the year 2035.

17\. Document Analysis a. Descriptors

Seismic detection	Earthquakes	Accelerometers
Seismometers	State government	Buildings

b. Identifiers/Open-Ended Terms

Strong-motion

c. COSATI Field/Group

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