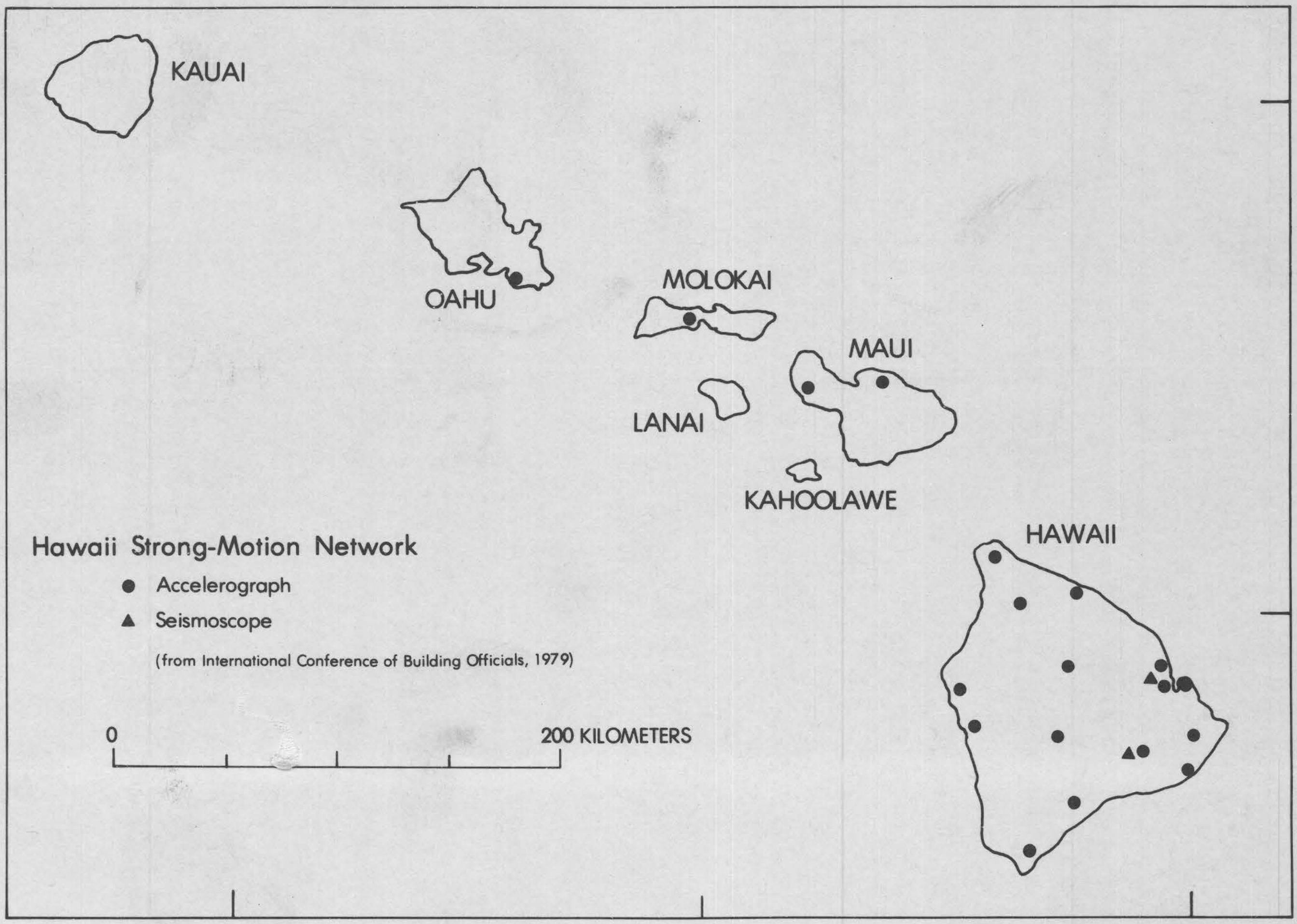
CIRC 854-C

Seismic Engineering Program Report, September - December 1980

Prepared on behalf of the National Science Foundation Grant CA-114



GEOLOGICAL SURVEY CIRCULAR 854-C

Seismic Engineering Program Report, September - December 1980

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National Science Foundation
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1983

United States Department of the Interior
JAMES G. WATT, *Secretary*

Geological Survey
Dallas L. Peck, *Director*

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PREFACE

This Seismic Engineering Program Report is an informal periodical primarily intended to keep the ever-growing international community of strong-motion data users apprised of the nature and availability of data recovered by the Seismic Engineering Branch of the U.S. Geological Survey (USGS). This Strong-Motion Program is administered by the USGS and supported by the National Science Foundation (Grant CA-114) in cooperation with numerous Federal, State, and local agencies and organizations. Major objectives of the program include recording both strong ground motion and the response of various types of engineered structures during potentially damaging earthquakes and disseminating this strong-motion information and data to the earthquake engineering research and design community.

This issue contains a summary of the accelerograms recovered from the USGS National Strong-Motion Network during the period September 1 through December 31, 1980. A report on the Hawaii Strong-Motion Network and a revision of USGS strong-motion data recorded during the magnitude 5.9, 1979 Gilroy (Coyote Lake) earthquake and the magnitude 5.0, 1979 Imperial Valley aftershock are included along with summaries of recent strong-motion reports, notes on the availability of digitized data, and additional general information pertinent to the USGS and to other strong-motion programs. The data summary included in table 1 contains information on those accelerograms recovered (although not necessarily recorded) during the period September - December 1980; this procedure has been adopted so that the dissemination of strong-motion information may be as expeditious and current as practicable.

Ronald L. Porcella, Editor
U.S. Geological Survey, Mail Stop 78
Menlo Park, California 94025

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SEISMIC ENGINEERING PROGRAM REPORT, SEPTEMBER - DECEMBER 1980

RECENT STRONG-MOTION RECORDS

By R. L. Porcella and J. C. Switzer

Fifty-four accelerograph records were recovered from the U.S. Geological Survey's National Strong-Motion Network during the period September 1 through December 31, 1980; these accelerograms are related to at least 24 earthquakes that occurred in California, Alaska, Hawaii, and South Carolina (see table 1, end of report). Event information listed in table 1 and given in the following paragraphs was taken from Preliminary Determination of Epicenters, published monthly by the U.S. Geological Survey.

The Bear Valley array southeast of Hollister, California, produced 15 accelerograms for 8 earthquakes that occurred between May 5 and November 22, 1980; four of these records contain peak accelerations greater than 0.05 g. The largest acceleration was a 0.31 g peak horizontal motion recorded at Bear Valley array station 11 during a magnitude 4.1 (M_L) event on October 13, 1980; epicentral distance was about 2 km.

A magnitude 4.4 earthquake on October 31 in the Imperial Valley, California, triggered accelerographs at El Centro array stations 11, 12, and 13, Calexico Fire Station, and the El Centro differential array station. The event caused slight damage in Calexico and produced a maximum recorded ground acceleration of 0.12 g at El Centro array station 12.

Three earthquakes triggered four of 13 strong-motion recorders on the Big Island of Hawaii during the period October 1979 through September 1980; a maximum horizontal acceleration of 0.07 g was recorded at the Honokaa Fire Station on the northeast part of the island.

A magnitude 7.0 (M_L) earthquake off the coast of northern California on November 8 injured six people, caused damage in many communities along the coast of Humboldt county, and was felt from southern Oregon to the San Francisco bay area. This event triggered just one USGS accelerograph at Butler Valley station 2 and produced a maximum horizontal ground acceleration of 0.10 g.

On November 28 a magnitude 5.2 (M_L) earthquake caused slight damage in Georgetown in northeast California and was felt widely in the area from Sacramento to Reno-Lake Tahoe. Seven accelerographs at Boca and Martis Creek Dams were triggered but recorded maximum accelerations less than 0.05 g.

Additional earthquakes that produced maximum accelerations less than 0.05 g were recorded at USGS stations near Jenkinsville, South Carolina; southwest of Bakersfield, Calif.; in the Sierra Nevada foothills east of Tulare, Calif.; near the central California town of Hollister; and in the Talkeetna-Cantwell region in south-central Alaska (see table 1).

REVISED STRONG-MOTION DATA, PART II

By R. L. Porcella

The National Strong-Motion Network operated by the U.S. Geological Survey since 1973 is supported by the National Science Foundation (Grant CA 114). The objectives of the program are to record strong ground motions and the response of representative types of engineered structures during potentially damaging earthquakes and to disseminate processed data and information about the records, sites, and structures to external users in earthquake engineering research and design practice. The dissemination of this information and data is achieved in various ways, including the triannual publication of this Seismic Engineering Program Report (SEPR).

The SEPR has been published on a regular basis since 1974 and includes peak accelerations greater than 0.05 g recorded at ground level and greater than 0.10 g recorded at upper levels of structures. This minimum acceleration level is based primarily on the apparent significance of this data for use in engineering studies and on the current capability of the USGS to process strong-motion records and may vary with both the significance and degree of seismic activity and number of personnel available at any given time.

Because of the recent increase in "real time" strong-motion data at both far- and near-source distances, it has become apparent that more detailed lists of the recorded ground accelerations and source site distances for recent selected earthquakes would be useful to the seismological community in ground-motion attenuation studies (Porcella, 1982). Although peak acceleration is not directly related to frequency content or duration of strong motion, the value can be readily obtained from an accelerogram and has been used widely in recent years in studies of the attenuation characteristics of horizontal ground acceleration for varying earthquake magnitudes, source-site distances, source mechanisms, and recording-site conditions.

USGS data from the magnitude 5.9 Coyote Lake (Gilroy, California) earthquake of August 6, 1979, and the magnitude 5.0 Imperial Valley aftershock of October 15, 1979 (23:19:29 UTC), have been rescaled to 0.001 g and together with epicentral distances are listed in tables 2 and 3.

References:

Lee, W. H. K., Herd, D. G., Cagnetti, V., Bakun, W. H., and Rapport, A., 1979, A preliminary study of the Coyote Lake earthquake of August 6, 1979 and its major aftershocks: U.S. Geological Survey Open-File Report 79-1621, 43 p.

Porcella, R. L., 1982, Revised strong-motion data, in Seismic Engineering Program Report, May-August 1980: U.S. Geological Survey Circular 854-B, 25 p.

HAWAII STRONG-MOTION NETWORK

By R. L. Porcella

In an attempt to assess seismic risk and recommend appropriate zoning for the Hawaiian Islands, Furumoto and others (1972) undertook a study of the seismicity of Hawaii. This study was initiated by a group of engineers and geophysicists that had formed a committee to study recommendations for changes in the building code for Hawaii and included the compilation of earthquake data from many sources into a form that would be useful to engineers and others involved in earthquake-resistant design and construction. In anticipation of future seismic building code requirements based on recorded ground accelerations and in order to better define the characteristics of ground motion in Hawaii, the study proposed that a network of about 12 accelerographs be installed in the islands. Because the dynamic analyses used in structure design at that time could not utilize ground-motion data recorded in Hawaii, and with additional incentive added by the occurrence of the 1971 San Fernando, California, earthquake, the committee contacted the Seismological Field Survey of the National Oceanic and Atmospheric Administration (NOAA) and requested that "at least a few" accelerographs be installed in the Hawaiian Islands (Furumoto and others, 1972).

The Hawaii strong-motion network was begun in February 1973 when accelerographs were installed by NOAA at Honolulu, Oahu, and at Hawaii National Park, Hawaii (table 4); 2 months later these instruments and three seismoscopes provided the first records of strong-ground motion in the Hawaiian Islands when they recorded the magnitude 6.2 Honomu earthquake of April 26, 1973. Two additional accelerographs were installed immediately after this event, five more stations were established in October 1973, and one in October 1974.

During the early morning hours of November 29, 1975, a series of earthquakes occurred beneath the southeast coast of the Island of Hawaii causing two deaths and an estimated $4,000,000 in property damage (U.S. Geological Survey, 1975). The two largest events, a magnitude 5.7 at 0335 and magnitude 7.2 at 0447, triggered three of four accelerographs installed on the Island of Hawaii; a maximum acceleration of 0.22 *g* was recorded in the south-central part of Hilo approximately 43 km north of the epicenter (Rojahn and Morrill, 1977).

In 1973 NOAA transferred its strong-motion program to the U.S. Geological Survey (USGS), which then expanded the Hawaii network during the period 1976-80 to include 19 accelerograph stations--15 on Hawaii, 2 on Maui, 1 on Molokai, and 1 on Oahu (see fig. 1). More than 75 accelerograph records have been recovered from this network; approximately one third contain peak accelerations greater than 0.05 *g*. A dominant frequency apparent in many of the records at selected sites suggests that the subsurface conditions are markedly dissimilar not only from those at most sites in the western United States, but also among the various sites within the Hawaii network (Porcella, 1979a, b). These notable dissimilarities have complicated efforts related to the routine analyses and prediction of site response throughout the network and suggest that detailed investigations including geophysical and geological studies need to be made at all of the Hawaii accelerograph sites before this strong-motion data can provide significant information for use in studies of soil-structure interaction, ground-motion attenuation, and wave propagation in the Hawaiian Islands.

References:

Furumoto, A. S., Nielsen, N. N., and Phillips, W. R., 1972, A study of past earthquakes, isoseismic zones of intensity, and recommended zones for structural design for Hawaii: Engineering Bulletin PACE 72033, Center for Engineering Research, University of Hawaii, 53 p.

International Conference of Building Officials, 1979, Uniform building code: Whittier, California, 734 p.

Nielsen, N. N., Furumoto, A. S., Lum, Walter, and Morrill, B. J., 1977 The Honomu, Hawaii, earthquake: Washington, D.C., National Academy of Sciences, 79 p.

Porcella, R. L., 1979a, Recent strong-motion records, in Seismic Engineering Program Report, May-August 1979: Geological Survey Circular 818-B, p. 1-3.

____ 1979b, Recent strong-motion records, in Seismic Engineering Program Report, September-December 1979: Geological Survey Circular 818-C, p. 1-2.

Rojahn, Christopher, and Morrill, B. J., 1977, The Island of Hawaii earthquakes of November 19, 1975: strong-motion data and damage reconnaissance report: Seismological Society of America Bulletin, v. 67, no. 2, p. 493-515.

Switzer, J., Johnson, D., Maley, R., and Matthiesen, R., 1981, Western hemisphere strong-motion accelerograph station list - 1980: U.S. Geological Survey Open-File Report 81-664, 162 p.

U.S. Geological Survey, 1975, Preliminary determination of epicenters: November 1975, 11 p.

SUMMARIES OF RECENT STRONG-MOTION REPORTS *

PROCESSED ACCELEROGRAMS FROM MONTICELLO DAM, JENKINSVILLE, SOUTH CAROLINA, 27 AUGUST 1978, AND TWO LATER SHOCKS

By A. G. Brady, P. N. Mork, and J. P. Fletcher

This report serves two purposes: The documentation of a digital magnetic tape containing the results of processing the strong-motion data from Monticello Dam, South Carolina, during a series of three events in 1978, and the reproduction of the more

* Inclusion of strong-motion information sources is intended as a service to our readers and does not imply endorsement of these reports by the U.S. Geological Survey.

Table 2.- USGS strong-motion data from the magnitude 5.9, August 6, 1979, Coyote Lake (Gilroy) earthquake

Strong-motion station			Ground acceleration		
Name and number	Coordinates	Epicentral distance[1] (km)	Azimuth[2]	Peak (g)	Duration[3] (s)
Gilroy array sta. 6	37.026 N	1.2	310	0.344	1.8
1413	121.484 W		Up	.172	1.5
			230	.419	3.0
Gilroy array sta. 4	37.000 N	3.7	360	.257	3.4
1411	121.521 W		Up	.440	3.2
			270	.236	6.1
Gilroy array sta. 3	36.991 N	5.3	140	.267	1.8
1410	121.536 W		Up	.150	2.2
			050	.260	2.5
Gilroy array sta. 2	36.982 N	7.4	140	.263	1.3
1409	121.556 W		Up	.176	3.0
			050	.196	1.6
Gilroy array sta. 1	36.973 N	9.1	320	.127	1.0
1408	121.572 W		Up	.076	-
			230	.100	1-peak

[1] Distance from epicenter at 37.11°N. lat, 121.53°W. long (± 1 km; Lee and others, 1979). When coordinates of station and (or) source are listed to 0.01 or 0.001 degree, implicaton is an accuracy in epicentral distance of approximately 1.0 or 0.1 km, respectively; a program of upgrading all station coordinates to 0.001 degree is underway.

[2] Azimuthal direction (degrees clockwise from north) of case acceleration for upward trace deflection on accelerogram; vertical component listed as "up" or "down."

[3] Time between first and last peaks of acceleration greater than 0.10 g.

Table 3.- USGS strong-motion data from the magnitude 5.0, October 15, 1979, Imperial Valley aftershock of 23:19:29 UTC

Strong-motion station			Ground acceleration		
Name and number	Coordinates	Epicentral distance[1] (km)	Azimuth[2]	Peak (g)	Duration[3] (s)
Bond's Corner 5054	32.693 N 115.338 W	12.8	230	0.129	1-peak
			Up	.052	-
			140	.074	-
Brawley Airport 5060	32.988 N 115.509 W	25.0	315	.057	-
			Up	.043	-
			225	.045	-
Calexico Fire Station 5053	32.669 N 115.492 W	12.2	315	.011	-
			Up	.034	-
			225	.097	-
El Centro array sta. 1 5056	32.960 N 115.319 W	23.9	230	.060	-
			Up	.033	-
			140	.033	-
El Centro array sta. 2 5115	32.916 N 115.366 W	17.6	230	.089	-
			Up	.054	-
			140	.154	1-peak
El Centro array sta. 3 5057	32.894 N 115.380 W	14.9	230	.103	1-peak
			Up	.039	-
			140	.147	0.4
El Centro array sta. 4 955	32.864 N 115.432 W	10.5	230	.168	.7
			Up	.079	-
			140	.237	.5
El Centro array sta. 5 952	32.855 N 115.466 W	9.7	230	.286	.2
			Up	.117	1-peak
			140	.235	.3
El Centro array sta. 6 942	32.839 N 115.487 W	8.8	230	.263	1.3
			Up	.080	-
			140	.175	.3
El Centro array sta. 7 5028	32.829 N 115.504 W	8.9	230	.230	.4
			Up	.086	-
			140	.147	.3

See footnotes at end of table

Table 3.- USGS strong-motion data from the magnitude 5.0, October 15, 1979, Imperial Valley aftershock of 23:19:29 UTC - continued

Strong-motion station			Ground acceleration		
Name and number	Coordinates	Epicentral distance[1] (km)	Azimuth[2]	Peak (g)	Duration[3] (s)
El Centro array sta. 8 958	32.811 N 115.532 W	9.7	230 Up 140	0.157 .056 .128	0.2 - .8
El Centro array sta. 9 117	32.794 N 115.549 W	10.5	Down 360 090	.078 .086 .133	- - .6
El Centro array sta. 10 412	32.780 N 115.567 W	12.0	050 Up 320	.055 .026 .051	- - -
El Centro array sta. 11 5058	32.752 N 115.594 W	14.6	230 Up 140	.192 .063 .098	.5 - -
El Centro diff. array 5165	32.796 N 115.535 W	9.4	360 Up 270	.146 .103 .147	.9 1-peak .5
Holtville Post Office 5055	32.812 N 115.377 W	7.5	315 Up 225	.264 .042 .116	.3 - .4

[1] Distance from epicenter at 32.767°N. lat, 115.441°W. long (± 0.6 km; D. Boore, written commun., March 1980). When coordinates of station and (or) source are listed to 0.01 or 0.001 degree, the implication is an accuracy in epicentral distance of approximately 1.0 or 0.1 km, respectively; a program of upgrading all station coordinates to 0.001 degree is underway.

[2] Azimuthal direction (degrees clockwise from north) of case acceleration for upward trace deflection on accelerogram; vertical component listed as "up" or "down."

[3] Time between first and last peaks of acceleration greater than 0.10 g.

Table 4.- USGS accelerograph stations in the Hawaiian Islands

Accelerograph station[1]			Local geology[2]	Number events recorded[3]	Recordings ≥0.05 g; peak accel.[4]
Location; number; Coordinates	Structure size; type	Installed; (Removed)			
Hawaii National Park, HI, Nami Kani Paio Campground; 2801; 19.43N, 155.30W	1-story bldg.; 5m by 7m concrete slab, wood frame	2-21-73 (9-5-76)	shallow ash over lava flows (rock)	8	4; 0.17, 0.06, 0.06, and 0.05 g
Hawaii National Park, HI, USGS Volcano Observatory; 2813; 19.423N, 155.291W	1-story bldg.; concrete block, slab floor	9-5-76; (in place)	shallow ash over lava flows (rock)	1	1; 0.11 g
Hawaii National Park, HI, Wahaula Utility Center; 2811; 19.329N, 155.031W	1-story bldg.; wood frame, slab floor	9-8-76; (in place)	lava flows (rock)	18	2; 0.07 and 0.11 g
Hilo, Hawaii, Cloud Physics Lab., UHH; 2808; 19.70N, 155.08W	1-story bldg.; concrete block, slab floor	10-15-73 (6-6-77)	lava flows (rock)	2	2; 0.15 and 0.22 g
Hilo, Hawaii, St. Joseph High School; 2828; 19.72N, 155.09W	3m by 3m; concrete slab, metal enclosure	4-28-73; (10-17-73)?	lava flows (rock)	none	-
Hilo, Hawaii, Sewage Treatment Plant; 2823; 19.734N, 155.050W	1-story bldg.; concrete slab, concrete block	9-1-78; (in place)	lava flows (rock)	2	1; 0.06 g
Hilo, Hawaii, Univ. of Hawaii, Hilo; 2817; 19.707N, 155.083W	1-story bldg.; concrete slab, concrete block	6-6-77; (in place)	lava flows (rock)	2	1; 0.11 g
Hilo, Hawaii, U.S. Fish and Wildlife; 2818; 19.731N, 155.100W	1-story bldg.; slab, steel frame, metal sides & roof	6-9-77; (in place)	volcanic ash deposits	3	2; 0.11 and 0.44 g
Honokaa, Hawaii, Central Service Building; 2809; 20.07N, 155.46W	1-story bldg.; steel frame, metal, 10x25 m	10-15-73; (3-23-76)	volcanic ash deposits	1	1; 0.11 g
Honokaa, Hawaii, Fire Station; 2819; 20.080N, 155.465W	1-story bldg.; concrete slab, wood frame	3-23-78; (in place)	volcanic ash deposits	8	4; 0.12, 0.05, 0.07, and 0.07 g
Honokaa, Hawaii, Honokaa School; 2814; 20.08N, 155.47W	1-story bldg.; concrete block, slab floor	3-23-76; (3-23-78)	volcanic ash deposits	2	2; 0.06 and 0.07 g
Honolulu, Oahu, Alawai Golf Club; 2802; 21.280N, 157.822W	1-story bldg., 2.5 by 2.5 m; concrete slab, wood	2-18-73; (10-10-73)	deep (200m) sediments over basalt	1	none

See footnotes at end of table

Table 4.- USGS accelerograph stations in the Hawaiian Islands - continued

Accelerograph station[1] Location; number; Coordinates	Structure size; type	installed; (removed)	Local geology[2]	Number events recorded[3]	Recordings ≥0.05 g; peak accel.[4]
Honolulu, Oahu, Ft. DeRussy; 2827; 21.288N, 157.834W	1-story bldg.; concrete slab, steel frame, wood	4-3-78; (in place)	deep sediments over basalt	none	-
Honolulu, Oahu, Maluhia Service Club; 2805; 21.288N, 157.834W	1-story bldg.; slab floor, wood walls	10-10-73; (4-3-78)	deep sediments over basalt	none	-
Honomu, Hawaii, Tanimore Residence; 2804; 19.87N, 155.12W	1-story house; concrete slab, wood frame	4-29-73; (10-17-73)	volcanic ash deposits	1	none
Kahalui, Maui, Community College; 2821; 20.893N, 156.479W	1-story bldg.; concrete slab, concrete block	3-31-78 (in place)	-	none	-
Kailua-Kona, Hawaii, Fire Station; 2810; 19.649N, 155.996W	1-story bldg.; concrete slab, concrete block	10-17-73; (in place)	lava flows (rock)	none	-
Kapaau, Hawaii, Kohala Police Station; 2826; 20.230N, 155.801W	1-story bldg.; concrete block, steel frame	8-2-79; (in place)	-	1	none
Kaunakakai, Molokai, Airport Fire Station; 2806; 21.158N, 157.096W	1-story bldg.; concrete slab, steel frame/wood	10-11-73; (9-6-76 to 10-17-79, in place)	-	none	-
Kealakekua, Hawaii, Kona Hospital; 2815; 19.523N, 155.879W	3-story bldg.; steel frame, concrete block	6-10-77; (in place)	-	none	-
Lahaina, Maui, Fire Station; 2807; 20.912N, 156.690W	1-story bldg.; concrete slab, concrete block	10-12-73; (8-31-76 to 6-16-77, in place)	-	none	-
Mauna Kea, Hawaii State Park Visitor Center; 2829; 19.752N, 155.530W	1-story bldg.; slab floor, wood frame	10-6-80; (in place)	-	none	-
Mauna Loa, Hawaii, NOAA Weather Observatory; 2824; 19.539N, 155.580W	1-story bldg.; concrete slab, wood/metal walls	8-2-79; (in place)	-	none	-

See footnotes at end of table

Table 4.- USGS accelerograph stations in the Hawaiian Islands - continued

Accelerograph station[1] Location; number; Coordinates	Structure size; type	installed; (removed)	Local geology[2]	Number events recorded[3]	Recordings ≥0.05 g; peak accel.[4]
Pahala, Hawaii, Kau Hospital; 2812; 19.20N, 155.47W	1-story bldg.; slab floor, concrete block	9-8-76; (in place)	-	8	2; 0.05 and 0.08 g
Pahoa, Hawaii, Fire Station; 2816; 19.498N, 154.951W	1-story bldg.; slab floor, concrete block	6-7-77; (in place)	-	none	-
Punaluu, Hawaii, Village Services Bldg.; 2803; 19.16N, 155.52W	1-story bldg.; slab floor, concrete block	10-1-74; (11-30-75)	beach sand over lava rock	18	1; 0.14 g
Waimea, Hawaii, Fire Station; 2825; 20.03N, 155.66W	1-story bldg.; concrete block, steel frame	8-1-79; (in place)	-	1	none
Waimea, Hawaii, Waimea School; 2820; 20.02N, 155.67W	1-story bldg.; slab floor, wood frame	3-29-78; (8-1-79)	-	1	1; 0.17 g
Waiohinu, Hawaii, Kau Baseyard; 2822; 19.070N, 155.615W	1-story bldg.; slab floor, concrete block	9-1-78; (in place)	-	1	none

[1] Station information from USGS unpublished file data and Switzer and others, 1981.

[2] Geology from Nielsen and others (1977) and USGS unpublished file data.

[3] Strong-motion stations, events, and recordings listed are complete through December 1980.

[4] Positive correlation of most records with a specific earthquake cannot be made because the Hawaii network accelerographs do not have real-time capability; peak acceleration listed is maximum for each event and was recorded on one of two horizontal or one vertical instrument components.

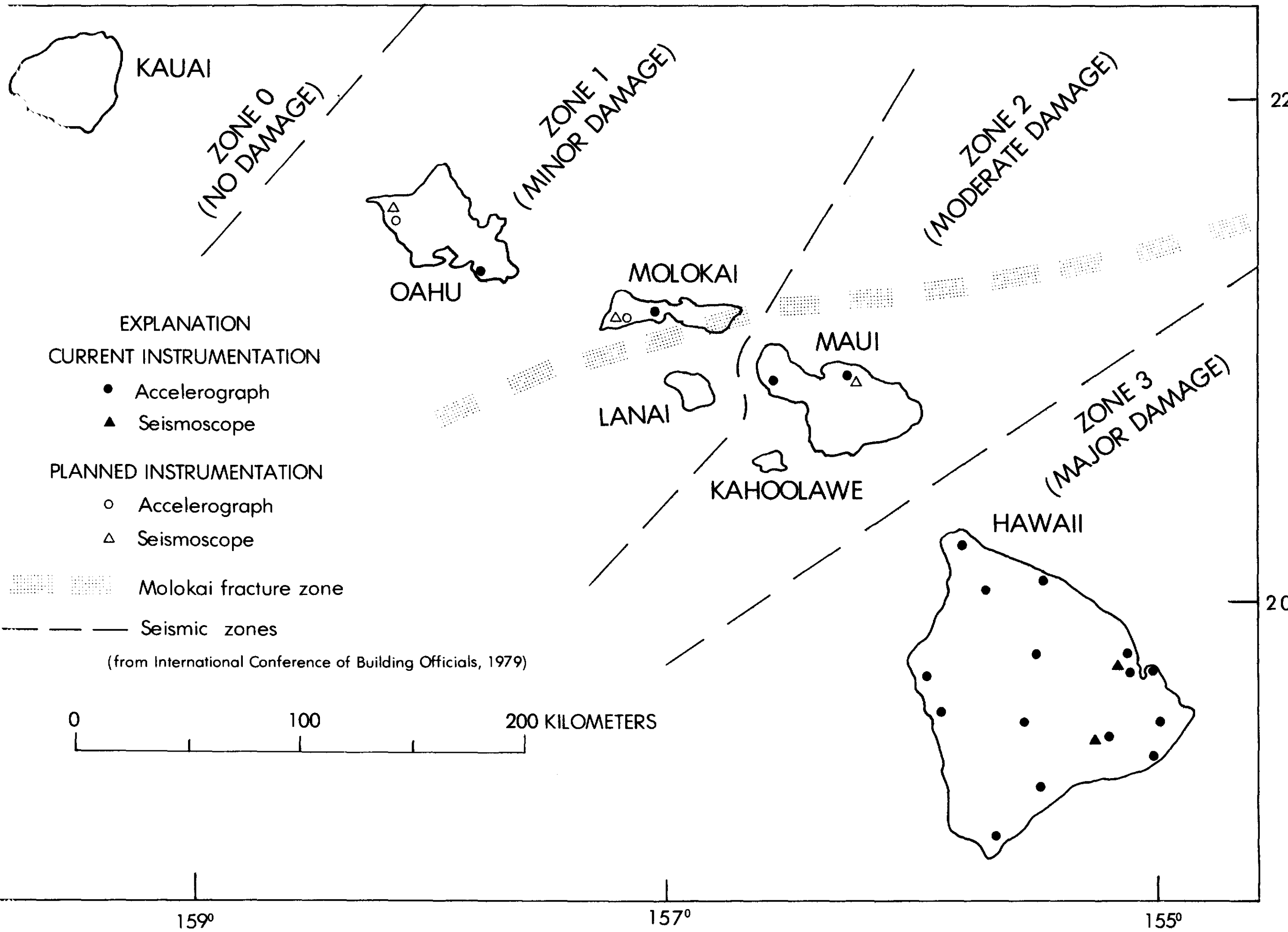

Figure 1.- Hawaii strong-motion network

important graphical results.

Only one event is identified: 27 August 1978; 1023 UTC; coordinates 34.31 N, 81.33 W; depth 1.5 km; magnitude 2.7. The second and third events occurred during the period from 31 August 1978 to 6 November 1978. On this section of the original film record a total of eight events were recorded. The two selected for this processing package had peak horizontal accelerations, scaled from the records, of 0.22 and 0.24 g. The identified event had a peak of 0.25 g, the largest known recorded acceleration from an earthquake in central or eastern North America.

Digitization of the three recordings was carried out by IOM-TOWILL of Santa Clara, California; USGS processing of the data has resulted in plots of the corrected acceleration, velocity, and displacement and response spectra. The results of corrected data only are available on magnetic tape.

Reference: U.S. Geological Survey Open-File Report 81-0448, 35 p.

PROCESSED ACCELEROGRAMS FROM MONTICELLO DAM,JENKINSVILLE,SOUTH CAROLINA, 16 OCTOBER 1979, 0706 UTC

By P. N. Mork and A. G. Brady

This report serves first to document a magnetic tape containing the results of processing of the strong-motion data from this accelerogram, and second to reproduce the more important graphical results. This processing follows, by a little more than one year, processing of three records that were described in our March 1981 Open-File Report 81-0448 to which reference may be made for a description of the site, records, and processing.

Digitization was carried out by IOM-TOWILL of Santa Clara, California, and USGS processing has produced plots of acceleration at three stages of correction: corrected velocity and displacement, and response and Fourier spectra. Numerical data is available on magnetic tape from the Environmental Data and Information Service (see "Data Sources," this report).

The special processing required for the evidently visible 25 and 35 Hz content has resulted in the following plots. "Raw data" signifies the input to the correction scheme and corresponds to uncorrected data of Caltech and USGS processing. These data are interpolated at 500 points/second, and the plot is labelled "interpolated/decimated." Butterworth filters whose corner frequencies are 3 db down are used to band pass the interpolated data between the low frequency limit of 1 Hz (with n =1, first order) and the high frequency limit of 50 Hz (n = 2, second order). These plots are labelled "filtered/windowed." The second page of plots for each component contains the acceleration, velocity, and displacement with the instrument correction applied. All plots are scaled so that the peak value, listed in the title, fills the vertical axis.

The response spectra plots, both linear and tripartite, contain plots from 1 to 25 Hz, or 0.04 to 1 second. The high frequencies, up to 50 Hz, are portrayed in the Fourier spectra plots.

Reference: U.S. Geological Survey Open-File Report 81-1214, 20 p.

THE EFFECT OF QUARTERNARY ALLUVIUM ON STRONG GROUND MOTION IN THE COYOTE LAKE, CALIFORNIA,EARTHQUAKE OF 1979

By W. B. Joyner, R. E. Warrick, and T. E. Fumal

The effect of alluvium on strong ground motion can be seen by comparing two strong-motion records of the Coyote Lake, California, earthquake of 6 August 1979 (M_L = 5.9). One record at a site on Franciscan bedrock had a peak horizontal acceleration of 0.13 g and a peak horizontal velocity of 10 cm/sec. The other, at a site 2 km distant on 180 meters of Quaternary alluvium overlying Franciscan, had values of 0.26 g and 32 cm/sec, amplifications by factors of 2 and 3. Horizontal motions computed at the alluvial site for a linear plane-layered model based on measured P- and S-wave velocities show reasonably good agreement in shape with the observed motions, but the observed peak amplitudes are greater by a factor of about 1.25 in acceleration and 1.8 in velocity. About 15 percent of the discrepancy in acceleration and 20 percent in velocity can be attributed to the difference in source distance; the remainder may represent focusing by refraction at a bedrock surface concave upward. There is no clear evidence of nonlinear soil response. Fourier spectral ratios between motions observed on bedrock and alluvium show good agreement with ratios predicted from the linear model. In particular, the observed frequency of the fundamental peak in the amplification spectrum agrees with the computed value, indicating that no significant nonlinearity occurs in the secant shear modulus. Computations show that nonlinear models are compatible with the data if values of the coefficient of dynamic shear strength in terms of vertical effective stress are in the range of 0.5 to 1.0 or greater. The data illustrate that site amplification may be less a matter of resonance involving reinforcing multiple reflections, and more the simple effect of the low near-surface velocity. Application of traditional seismological theory leads to the conclusion that the site amplification for peak horizontal velocity is approximately proportional to the reciprocal of the square root of the product of density and shear-wave velocity.

Reference: Bulletin of the Seismological Society of America, v. 71, no. 4, p. 1333-1349.

WESTERN HEMISPHERE STRONG-MOTION ACCELEROGRAPH STATION LIST, 1980

By J. Switzer, D. Johnson, R. Maley, and R. Matthiesen

This list contains information on western hemisphere strong-motion stations that have been installed and are maintained by many different organizations. It contains information on all of those stations for which there is some data in the files of the USGS, but the list is incomplete even for stations in the United States. Since the stations being maintained are continuously changing, it is impossible to have complete information about all of the stations at any one time. The objective is to provide the community of persons who have an interest in strong-motion programs with an indication of the current status of the networks in this part of the world. The USGS also maintains a computerized Strong Motion Information Retrieval System (SMIRS), which permits searching for various types of information about the strong-motion stations, records, and events. In general, the information in SMIRS is more current than the information in this list.

For convenience, the list has been arranged by country, north to south, alphabetically by states in the section for the United States, and then alphabetically by station name. Subsequent sections include a list by stations numbers, a cross-reference of obsolete station names, and a cross-reference of three character designations for those who find that form of station designation useful. A list of the stations that were installed as required by a local building code or that are maintained by the owner of the facility appears in an appendix. That list has not been updated since 1976, at which time the USGS stopped receiving information about new installations required by building codes.

Reference: U.S. Geological Survey Open-File Report 81-664, 162 p.

ANOMALOUS FREE-FIELD RECORDINGS AT CERTAIN ACCELEROGRAPH LOCATIONS

By G. N. Bycroft

Accelerographs are used to measure both the "free-field" motion of the ground during an earthquake and the motion of points on a structure. In general free-field accelerograms exhibit a somewhat random signal and to the eye show no particular character or dominant frequency. This is better shown by a spectral analysis. However, occasionally a record is obtained that does not fit this general pattern. It is then generally difficult to decide if the record is true or spurious. The record may indeed be true and may be the result of a highly unusual local terrain, that is, there may be a large underground rock lying in a low-velocity medium nearby or an underground cavity, trench, or tunnel of such dimensions so as to impose an atypical character on the record. A low-velocity layer overlying rock may produce a dominant surface wave. On the other hand, the record may be anomalous because of instrument malfunction, improper or loose mounting, or local noise. The recording may appear to be normal but actually has been compromised by soil-structure interaction.

For convenience, instruments are often located in the basement of buildings. In this case the motion of the structure modifies the free-field motion. Many studies have been made that show soil-structure interaction in certain cases has a substantial effect on the motion of the foundation and hence on any recordings made there.

In this report some examples are given of selected records that are suspect or show evidence of soil-structure interaction.

Reference: U.S. Geological Survey Open-File Report 82-318, 40 p.

ANOMALOUS RECORD OF OCTOBER 15,1979, IMPERIAL VALLEY,CALIFORNIA,EARTHQUAKE FROM COACHELLA CANAL ENGINE HOUSE NO. 4

By G. N. Bycroft

A recording obtained at the Coachella Canal Engine House No. 4 of the October 15, 1979, Imperial Valley earthquake shows a dominant 2 Hz frequency. This feature is very unusual and an attempt has been made to determine if the recording is real or spurious. Because the pumping station is a small heavily constructed bunker-type structure located on material of low shear-wave velocity, it was considered likely that soil-structure interaction might be responsible for the 2-Hz component. However, both an experimental and theoretical investigation failed to confirm this. This report describes the theoretical investigation. The experimental investigation is described in a separate open-file report (see previous summary).

Reference: U.S. Geological Survey Open-File Report 82-317, 13 p.

AVAILABILITY OF STRONG-MOTION INFORMATION AND DATA

U.S. GEOLOGICAL SURVEY STRONG-MOTION NETWORK DATA

By April Converse

Descriptions of strong-motion accelerograph records and the circumstances in which they were recorded are available to anyone involved in earthquake engineering through the computer based Strong-Motion Information Retrieval System (SMIRS). The system provides ready access to information about strong-motion records and the level of processing and analysis that has been performed on them. Information about earthquakes that generated recorded motion and about the sites at which the motion was recorded is also provided. The information has been arranged into several data sets. The three major data sets are the record descriptions, the earthquake descriptions, and the recording site descriptions. Supplementary data sets include instructions and information about the data base, information about the recording instruments, and identification of organizations that own strong-motion instruments, that have additional information about the recording sites, or that archive the original or processed records.

With an ordinary phone line and a keyboard terminal, users of the system may review the information free of charge. Instructions are available from the system so that a user needs to know only how to dial the computer and what to type to enter the retrieval system and begin using it. Once accessed, the system will offer a general introduction and will tell the user how to request more detailed instructions. The user also will be given an opportunity to request a copy of the printed user's manual.

The best SMIRS telephone number to use will depend on where the user's office is located and on the transmission speed of the terminal that will be used. In most locations, users should dial a number in the TYMNET telecommunications network in order to access the computer without incurring a long-distance telephone charge. TYMNET Corporation maintains local telephone numbers in many cities in the United States and in several foreign countries. TYMNET phone numbers are available from TYMNET corporation's Western Customer Service at (800) 323-7389 or TYMNET Customer Support Group at (800) 366-0149.

SMIRS resides in one of the USGS computers in Denver Colorado. Users located near Denver may dial the computer directly using one of the following telephone numbers:

(303) 232-0058 for 300 baud modems such as those included in the TI Silent 700 terminals,
(303) 232-5309 for 1200 baud modems such as the VADIC modems,
(303) 232-2248 for 1200 baud BELL 212a modems,
(303) 234-4247 for a tape-recorded message giving the status of the computer.

Whenever the computer is not operational, the tape-recorded status message will let you know when the computer is expected to be operational again.

Users located near Menlo Park, California, may also dial a local number and directly access the Denver computer. The Menlo Park numbers are:

(415) 329-8600 for 300 baud modems,
(415) 329-8597, 98 for 1200 baud BELL 212a modems,
(415) 329-8550 through 65 for other 1200 baud modems.

Take the following steps to access SMIRS.

1) Set the switches, keys, or buttons on the terminal that allow a choice of operating modes:

transmission speed, 300 baud (30 characters per second) or 1200 baud;
on line;
lower case ASCII characters; and full duplex (if you are going to dial a TYMNET number) or
half duplex (if you are going to dial Denver directly).

2) Plug in and turn on the terminal; turn on the modem if it is a separate device. Notice whether the modem uses an acoustic coupler or whether the modem is directly connected to a telephone. An acoustic coupler will have a cradle into which a telephone handset can be inserted. Look for a label or diagram on an acoustic coupler that will show you in which direction the telephone cord should go. A direct-connect modem will have a switch that can be set for voice or data transmission.

3) Dial the USGS computer number in Denver or dial the TYMNET number nearest you; wait for a high-pitched tone.

4) Place the telephone handset in the cradle on the acoustic coupler or set the direct-connect switch to "data." Wait for the "carrier detect" light to turn on; this indicates that the terminal is receiving a signal from the computer or from the TYMNET equipment.

5) If you are using TYMNET, the TYMNET prompts (shown underlined here); your response (shown in italics here) should proceed as follows:

<u>please type your terminal identifier</u>
<u>please log in:</u> *<CR>*
<u>user name:</u> *denverdn <CR>*
<u>password:</u> *<your_password> <CR>*
The <CR> symbol represents the carriage-return key.

Do not be alarmed when the first prompt comes at an odd speed.

TYMNET will now connect your terminal to the computer in Denver. If the computer is operating, "USGS is online" will be printed at your terminal.

6) Type the line-feed key. The computer will respond with several lines that will tell you which computer you have accessed, how many other users are connected, and so forth.

7a) If your terminal will transmit both upper and lowercase characters type:

enter <your_name> SMIRS <CR>

where <CR> is the carriage-return key and

<your_name> is your own name typed without any embedded blanks.

Note that the word "enter" is in lower case and "SMIRS" is in upper case.

7b) If your terminal has only uppercase characters type:

MAP <CR>
ENTER <your_name> \S\M\I\R\S *<CR>*

The "MAP" statement instructs the computer to interpret all the alphabetic characters you will subsequently type as though they were in lowercase, except those characters that follow a left slant (\).

8) From now on, SMIRS will prompt you whenever it expects you to type something. All the prompt lines begin and end with two dashes; answer by typing a question mark if you do not know what is expected of you.

Don't be concerned if the computer does not respond immediately after you enter SMIRS. The response time may improve in the future, but it will always be fastest during nonworking hours (Denver time).

CALIFORNIA DIVISION OF MINES AND GEOLOGY STRONG-MOTION DATA

Processed strong-motion data from selected earthquakes are available from the California Division of Mines and Geology (CDMG). The data have been prepared by the interim CDMG strong-motion data processing system. This system is composed of a series of programs that have been developed by the California Institute of Technology, the USGS , and the CDMG, with special emphasis on the handling of long-duration film records from multiple-channel central recording instruments.

The data are grouped by phase:

Phase I	Uncorrected accelerations,
Phase II	Corrected accelerations, velocities, and displacements,
Phase III	Response spectra.

Each phase contains three-channel subgroups arranged by station. At the present time, data from the following earthquakes have been processed:

Santa Barbara earthquake of August 13, 1978

Station	Channels
UCSB Goleta	3
UCSB North Hall	9
Freitas Building	9

Imperial Valley earthquake of October 15, 1979

El Centro free-field	3
Imperial County Services Bldg.	13

The data are available on standard nine-track tapes, along with a microfiche copy of the tape contents. Interested parties should contact the CDMG Office of Strong-Motion Studies (see "Data Sources").

It is the policy of the CDMG to make all strong-motion record data promptly available to the public in a manner consistent with good data management. Requests for copies of records, personal access to record or data files, and copies of data files should be made to the Chief, Office of Strong-Motion Studies (OSMS), and should specify identity and medium of materials to be provided or reviewed. Desired access or delivery dates should be specific. When a request for copies of materials or personal access to files is received, OSMS staff will provide the requested material or will set an appointment time for personal review of files; the requestor will be notified immediately of any significant delay or other problems that prevent meeting the request. Charges for copying or other processing of materials will be based on the actual cost of producing and delivering the items, and OSMS will retain control of originals and master copies of all items.

FOREIGN STRONG-MOTION DATA

Because of the long history of close cooperation between the United States and the Central and South American strong-motion programs, much of the data from those programs are available from the same sources as the United States data (see below). Information about strong-motion data from the Western Hemisphere will be included in the Strong-Motion Information Retrieval System operated by the USGS.

The USGS does not attempt to obtain first- class copies of records from those foreign organizations that prepare data reports comparable to those prepared by the USGS. Abstracts of the data reports from such organizations are presented in this Seismic Engineering Program Report series, and through informal arrangements, copies of the data and records are made available.

EDIS/NOAA WORLDWIDE STRONG-MOTION DATA

A worldwide collection of strong-motion seismograms for dissemination to the scientific and engineering community is available from World Data Center A for Solid Earth Geophysics and the National Geophysical and Solar- Terrestrial Data Center (NGSDC). Countries contributing to the strong-motion data base include Australia, Italy, Japan, New Zealand, Rumania, U.S.S.R., and Yugoslavia. The U.S. Geological Survey has furnished records from its network of cooperative strong-motion sta- tions, including those in Central and South America.

Copies of strong-motion records are avail- able on 35-mm film, on 70-mm film chips, as paper copies, and as digitized data on punched cards or magnetic tape. A list of most records can be obtained from the World Data Center A publication "Catalog of Seismograms and Strong- Motion Records," Report SE-6. This catalog can be ordered from NGSDC (EDIS/NOAA) for $3.00 (see "Data Sources").

The most significant strong-motion records recorded in the United States and Latin America between 1931 and 1971 have been copied on seven reels of 35-mm film (x12 reduction) and 70-mm film chips (approximately x8 reduction). The film chips are available for $1.50 per chip; longer records are continued on additional chips. The 35-mm film copies can be purchased for $30 per reel, the complete set of reels for $180. There is a minimum charge of $10 per order.

Japan and Australia have supplied magnetic tapes of digitized data from stations located in the western Pacific Ocean (the Japanese Islands, New Guinea, and New Britain). A series of 400 United States strong-motion records (1933-71) were digitized by the California Institute of Technology and are now available on six magnetic tapes. The USGS is digitizing post-1971 records from its network; they have generated 15 tapes of strong-motion records recorded from 1967 to 1975 in the United States, Chile, Nicaragua, San Salvador, and Mexico.

Other digitized data include punched cards containing strong-motion records from the March 4, 1977, earthquake in Rumania (recorded in Bucharest); the Gazli earthquake of May 17, 1976, in Uzbek, U.S.S.R.; and three earthquakes in the New Madrid seismic zone (located in midcontinental United States) in 1975 and 1976.

Recent acquisitions include a magnetic tape of strong-motion records triggered by a swarm of earthquakes that occurred in northern Italy near the town of Friuli in 1976; these were compiled by the National Commission for Nuclear Energy and have been given to the center for distribution. Other data include records obtained from California earthquakes near Santa Barbara in August 1978, Gilroy in August 1979, El Centro in October 1979, and Livermore in January 1980.

A table listing all digitized strong-motion records available on magnetic tape may be obtained free of charge from EDIS/NOAA. Digi- tized strong-motion records may be purchased either in punched card format at $60 per record (including all three instrument components) or in tape format at $80 per tape.

Checks or money orders should be made payable to "Commerce/NOAA/NGSDC"; inquiries should be addressed to EDIS/NOAA (see "Data Sources").

DATA SOURCES

For reports or information regarding strong-motion records and data, address inquiries to the appropriate agency listed below:

1.	Branch of Distribution U.S. Geological Survey 604 So. Pickett Street Alexandria, VA 22304	(804) 756-6141 (FTS) 756-6141
2.	Earthquake Engineering Research Institute 2620 Telegraph Avenue Berkeley, CA 94704	(415) 848-0972
3.	EDIS/NOAA National Geophysical Data Center (D622) Boulder, CO 80303	(303) 497-6764 (FTS) 320-6764
4.	National Technical Information Service 5285 Port Royal Road U.S. Dept. of Commerce Springfield, VA 22161	(703) 487-4650 (FTS) 737-4650
5.	NISEE/Computer Applications 519 Davis Hall, UC Berkeley Berkeley, CA 94720.	(415) 642-5113
6.	Office of Strong-Motion Studies California Division of Mines and Geology 2811 "O" Street Sacramento, CA 95816	(916) 322-3105 (FTS) 552-3105
7.	Open-File Services Section Branch of Distribution U.S. Geological Survey Box 25425, Federal Center Denver, CO 80225	(303) 234-5888 (FTS) 234-5888
8.	Seismic Engineering Branch U.S. Geological Survey 345 Middlefield Road, MS 78 Menlo Park, CA 94025.	(415) 323-8111 ext 2881 (FTS) 467-2881

Table 1. - *Summary of accelerograms recovered during September - December 1980*

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
17 October 1979 1607 UTC Jenkinsville, S.C. Epicenter and magnitude unknown	Monticello Dam (USGS)	34.304° N 81.333° W	*			
	Shared abutment (Center crest)				**	
18 October 1979 0807 UTC Jenkinsville, S.C. Epicenter and magnitude unknown	Monticello Dam (USGS)	34.304° N 81.333° W	*			
	Shared abutment (Center crest)				**	
1 January 1980- 19 May 1980 Jenkinsville, S.C. Epicenter and magnitude unknown	Monticello Dam (USGS)	34.304° N 81.333° W	*			
	Shared abutment (Center crest)				**	
5 May 1980- 10 June 1980 Central California Epicenter and magnitude unknown	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.3		**	
11 June 1980 0734 UTC Central California Epicenter and magnitude unknown	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.1	310° Up 220°	0.11 .04 .22	1-peak - 0.15
	Bear Valley: Sta. 11 Wilkinson Ranch (USGS)	36.608° N 121.109° W	1.7		**	
14 April 1980- 23 June 1980 Central California Epicenter and magnitude unknown	Hollister City Hall (USGS)	36.85° N 121.40° W	*		**	
20 July 1980 1633 UTC Central California Epicenter and magnitude unknown	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.4		**	
29 July 1980 1545 UTC Central California Epicenter and magnitude unknown	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.5		**	

See footnotes at end of table

Table 1. - *Summary of accelerograms recovered during September - December 1980* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
9 September 1980 1642 UTC Central California 36.52N, 121.14W Magnitude 3.0	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.0		**	
	Bear Valley: Sta. 6 James Ranch (USGS)	36.504° N 121.101° W	1.4		**	
13 September 1980 1050 UTC Central California 36.65N, 121.36W Magnitude 3.3	Bear Valley: Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	1.8		**	
26 September 1980 1319 UTC Central California 35.27N, 119.40W Magnitude 4.4	Buena Vista Pumping plant (CDWR)	36.16° N 119.35° W	2.8		**	
9 October 1979- 28 September 1980 So. Hawaii Epicenters and magnitudes unknown	Honokaa, Hawaii Fire Station (USGS)	20.081° N 155.465° W	*	021° Up 291°	0.07 .04 .04	- - -
	Note: Two additional records** recovered at Honokaa, Hawaii.					
	Kau Hospital Pahala, Hawaii (USGS)	19.20° N 155.47° W	*		**	
	Waimea, Hawaii Fire Station (USGS)	20.03° N 155.66° W	*		**	
	Kapa'au, Hawaii Kohala Police Sta. (USGS)	20.23° N 155.80° W	*		**	
13 October 1980 0246 UTC Central California 36.60N, 121.09W Magnitude 4.1	Bear Valley: Sta. 5 Callens Ranch (USGS)	36.673° N 121.195° W	3.1	310° Up 220°	.06 .03 .05	- - -
	Bear Valley: Sta. 6 James Ranch (USGS)	36.504° N 121.101° W	2.2		**	
	Bear Valley: Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	4.7		**	

See footnotes at end of table

Table 1. - *Summary of accelerograms recovered during September - December 1980* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
13 October 1980 0246 UTC -continued-	Bear Valley: Sta. 11 Wilkinson Ranch (USGS)	36.608° N 121.109° W	1.4	130° Up 040°	0.31 .12 .18	0.5 1-peak .5
	Bear Valley: Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	2.1		**	
	Bear Valley: Sta. 14 Upper Butts Ranch (USGS)	36.569° N 121.043° W	1.4	310° Up 220	.07 .07 .07	- - -
31 October 1980 1256 UTC So. California 32.58N, 115.57W Magnitude 4.4	Calexico Fire Station Fifth and Mary (USGS)†	32.669° N 115.492° W	2.7	315° Up 225°	.06 .04 .05	- - -
	El Centro Array 11 McCabe School (USGS)†	32.752° N 115.594° W	3.2	230° Up 140°	.05 .02 .06	- - -
	El Centro Array 12 907 Brockman Road (USGS)†	32.718° N 115.637° W	2.8	230° Up 140°	.11 .02 .12	1-peak - 1-peak
	El Centro Array 13 Strobel Residence (USGS)	32.709° N 115.683° W	*		**	
	El Centro Differential Array (USGS)†	32.796° N 115.535° W	3.7	360° Up 270°	.04 .02 .06	- - -
8 November 1980 1027 UTC No. California 41.12N, 124.25W Magnitude 7.0	Butler Valley: Sta. 2 (USGS)†	40.79° N 123.88° W	2.5	060° Up 330°	.10 .04 .08	1-peak - -
12 September 1979- 13 November 1980 Central Alaska Epicenter and magnitude unknown	Talkeetna, Alaska FAA/VOR (USGS)	62.30° N 150.10° W	*		**	
	Cantwell, Alaska Highway Station (USGS)	63.388° N 148.878° W	*		**	

See footnotes at end of table

Table 1. - *Summary of accelerograms recovered during September - December 1980* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
22 November 1980 1148 UTC Central California Epicenter and magnitude unknown	Bear Valley: Sta. 14 Upper Butts Ranch (USGS)	36.569° N 121.043° W	*		**	
28 November 1980 1821 UTC No. California 39.31N, 120.43W Magnitude 5.3	Boca Dam (WPRS)†	39.382° N 120.095° W	0.3			
	Crest				**	
	Valve house				**	
	Martis Creek Dam (ACOE)†	39.326° N 120.115° W	*			
	Left crest				**	
	Right crest				**	
	Downstream				**	
	Toe				**	
	Right abutment				**	
5 August 1980- 3 December 1980 Jenkinsville, S.C. Epicenter and magnitude unknown	Monticello Dam (USGS)	34.304° N 81.333° W	*			
	Shared abutment (Center crest)				**	
4 June 1980- 5 December 1980 Central California Epicenters and magnitudes unknown	Lake Success Dam (ACOE)	36.061° N 118.920° W	*			
	Left crest				**	
	Left abutment				**	
	Middam				**	
	Right crest				**	
	Right abutment				**	
	Note: One each additional record** recovered at left crest, middam, and right crest.					

See footnotes at end of table

Table 1. - *Summary of accelerograms recovered during September - December 1980* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] ($\underline{g}$)	Duration[5] (s)
6 June 1980- 12 December 1980 Central California Epicenter and magnitude unknown	Pleasant Valley Pumping Plant (USGS)	36.31° N 120.25° W	*			
	Main floor				**	
	Switchyard				**	
	Roof				**	
5 August 1980- 10 December 1980 Central California Epicenter and magnitude unknown	Maricopa Array Station 4 (CDWR)	35.13° N 119.37° W	*		**	

[1] Station owner code:
ACOE - U.S. Army Corps of Engineers.
CDWR - California Department of Water Resources.
USGS - U.S. Geological Survey.
WPRS - U.S. Water and Power Research Service.
† - WWVB time code not legible or instrument not equipped with a radio receiver, correlation of accelerogram with event may be questionable.

[2] S-wave arrival minus trigger time (S - t) interval.
* S-t time is questionable or cannot be determined.

[3] Direction of case acceleration for upward trace deflection on accelerogram. Horizontal components are listed as azimuth in degrees clockwise from north. Vertical components are listed as "up" or "down."

[4] Peak acceleration recorded at ground level on one vertical and two orthogonal horizontal components unless otherwise noted.
** Denotes maximum acceleration is less than 0.05 $\underline{g}$ at ground level or less than 0.10 $\underline{g}$ at non ground-level stations.

[5] Duration between first and last peaks of acceleration greater than 0.10 $\underline{g}$.

GPO 687-040/22