

STRONG-MOTION RECORDS
RECOVERED FROM
THE MAMMOTH LAKES, CALIFORNIA, EARTHQUAKES
OF
6 JANUARY 1983

* * * * *

R.D. McJunkin
A.F. Shakal
N.A. Kaliakin
24 January 1983

* * * * *

California Strong Motion Instrumentation Program

PRELIMINARY DATA

(Subject to Revision)

California Department of Conservation
California Division of Mines and Geology

Office of Strong Motion Studies

2811 "O" Street

Sacramento, California 95816

Telephone: (916) 322-9320

CONTENTS

	Page
Introduction - - - - -	1
Epicentral area map (Figure 1) - - - - -	3
List of stations within 60 km (Table 1) - - - - -	4
Structural instrumentation schematics - - - - -	5
Mammoth Lakes - High School Gym (Figure 2) - - - - -	5
Long Valley Dam (Figure 3) - - - - -	6
Bishop - Office Building (Figure 4) - - - - -	7
Data from 17:38 (PST) 6 January earthquake - - - - -	8
Maximum acceleration data (Table 2) - - - - -	9
Accelerograms - - - - -	11
Mammoth Lakes - High School Gym - - - - -	11
Convict Creek - - - - -	12
Long Valley Dam - - - - -	13
June Lake - - - - -	17
Bishop - Office Building - - - - -	18
Data from 19:24 (PST) 6 January earthquake - - - - -	19
Maximum acceleration data (Table 3) - - - - -	20
Accelerograms - - - - -	22
Mammoth Lakes - High School Gym - - - - -	22
Convict Creek - - - - -	23
June Lake - - - - -	24
Long Valley Dam - - - - -	25
Bishop - Paradise Lodge - - - - -	29
Bishop - Office Building - - - - -	30
References cited - - - - -	31

STRONG-MOTION RECORDS
RECOVERED FROM
THE MAMMOTH LAKES, CALIFORNIA, EARTHQUAKES
OF
6 JANUARY 1983

* * * * *

R.D. McJunkin
A.F. Shaka1
N.A. Kaliakin
24 January 1983

* * * * *

California Strong Motion Instrumentation Program

PRELIMINARY DATA
(Subject to Revision)

California Department of Conservation
California Division of Mines and Geology
Office of Strong Motion Studies
2811 "0" Street
Sacramento, California 95816
Telephone: (916) 322-9320

INTRODUCTION

Two moderate earthquakes occurred in the vicinity of Mammoth Lakes, California on the evening of 6 January 1983 (approximately 17:38 and 19:24 PST). These events, both of magnitude 5 - 5½ (USGS) occurred in the same general area as the series of magnitude 6 events in May, 1980 and the magnitude 5½+ event in September 1981. The maximum accelerations from the most recent earthquakes are less than those of the 1980 earthquakes. The 1980 strong-motion data from most of the same stations discussed in this report are given in Turpen (1980), and the 1981 strong-motion data are given in McJunkin and Kaliakin (1981). Discussions of the Mammoth Lakes area geology, recent volcanism and crustal movement are included in the special report published after the 1980 earthquakes (Sherburne, 1980).

At the time of this writing, the USGS estimate of the epicenter of the first earthquake is 37.63N, 118.93W (3 km depth), and 37.63N, 118.94W (4.5 km depth) for the second earthquake (R. Cockerham, USGS, personal communication). Numerous smaller earthquakes occurred during the days following these earthquakes.

The two main earthquakes were felt as far away as Reno, Nevada (~160 km to north) and Stockton, California (~190 km to west). However, except for shelf stock in stores and power outages, the earthquakes did little local damage. The greatest reported damage (Sacramento Bee - January 9, 1983) was a hangar that collapsed on a private plane at Mammoth Lakes airport, approximately 2½ km northwest of the CDMG Convict Creek Station.

Fourteen CDMG strong-motion stations are located within 60 km of the epicenter area. These stations and their coordinates, site geology, housing structures, and instrument location(s) are listed in Table 1.

Four of the stations are instrumented with multi-channel central-recording accelerograph systems. Data from three of these stations (Mammoth Lakes-High School Gym, Long Valley Dam, Bishop-Office Building) are presented in this report. Schematics indicating the locations of the accelerometers in these three structures are shown in Figures 2, 3, and 4 respectively. The fourth structure, Vermilion Dam, is inaccessible (as are the ground stations Vermilion Dam-Downstream and Mono Lake) until after the spring snowmelt.

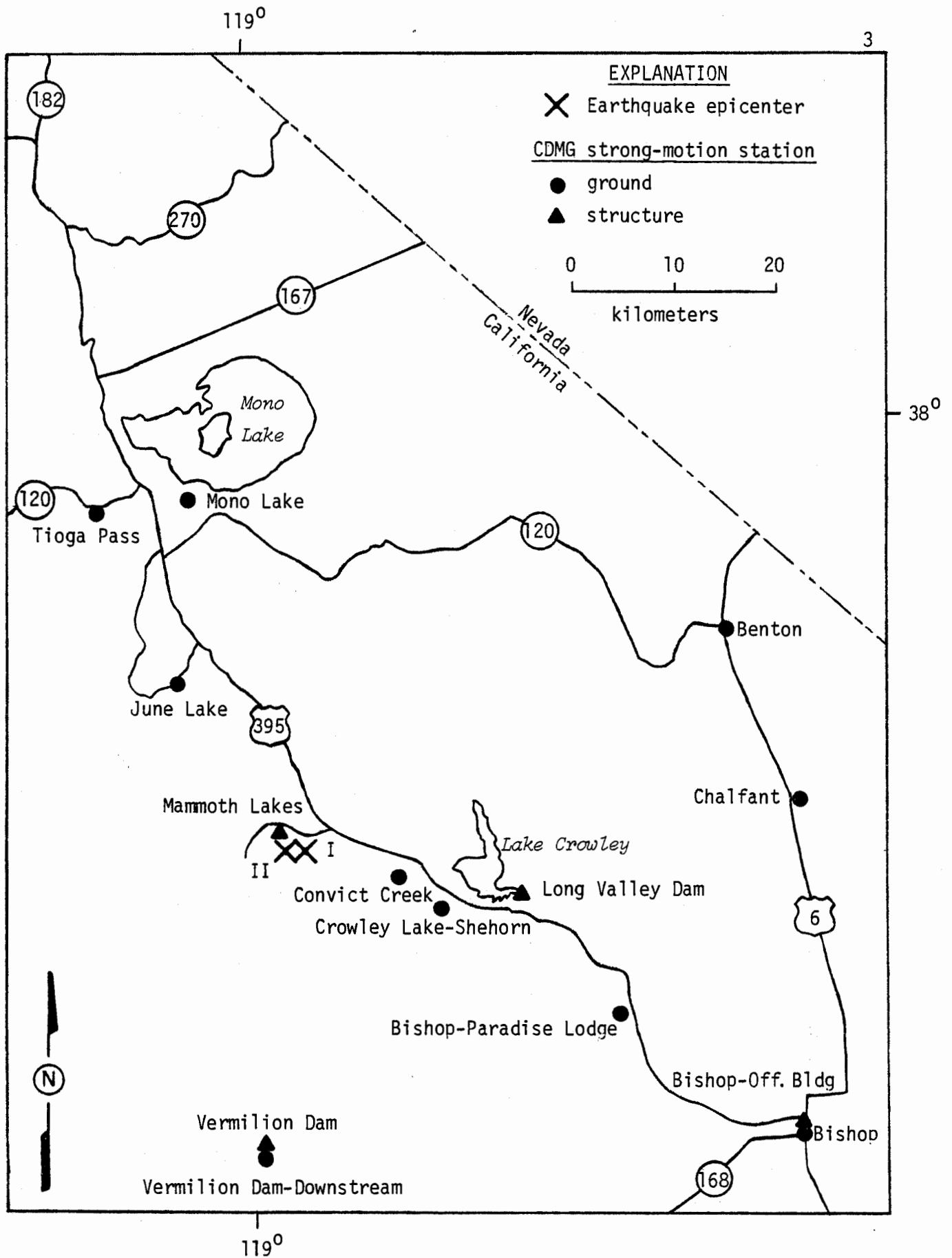


Figure 1. CDMG strong-motion stations within 60 km of the epicentral area for the 6 January 1983 Mammoth Lakes earthquakes. Epicenters (USGS) for the two earthquakes are plotted; numerals I and II indicate the 17:38 and 19:24 (PST) events respectively.

TABLE 1

Alphabetical list of CDMG strong-motion stations located within 60 km of the 6 January 1983 Mammoth Lakes earthquakes.

No.	Station	Coordinates	Site Geology	Structure Type/Size	Instrument Location(s)
54100	Benton	37.818°N 118.475°W	alluvium >500 m	1-story bldg	ground level
54171	Bishop	37.360°N 118.396°W	alluvium >1000 m	1-story bldg	ground level
54338	Bishop Office Bldg	37.370°N 118.396°W	alluvium >1000 m	2-story bldg	ground level 2nd, roof
54424	Bishop Paradise Lodge	37.481°N 118.602°W	~5 m alluvium over tuff	1-story bldg	ground level
54428	Chalfant	37.662°N 118.398°W	alluvium >500 m	1-story bldg	ground level
54099	Convict Creek UC Res Station	37.614°N 118.831°W	alluvium >200 m	1-story bldg	ground level
Temp	Crowley Lake Shehorn Res	37.561°N 118.743°W	alluvium ~50 m	1-story bldg	ground level
55429	June Lake Fire Station	37.783°N 119.075°W	rock (granitic)	2-story bldg	ground level
54214	Long Valley Dam	37.588°N 118.705°W	rock (Bishop tuff)	earth dam	abutment crest, face, toe
54301	Mammoth Lakes High School Gym	37.641°N 118.963°W	glacial debris ~75 m	1-story bldg	ground level roof
55098	Mono Lake	37.940°N 119.065°W	alluvium >500 m	Inst Shelter	ground level
55031	Tioga Pass	37.940°N 119.190°W	rock (granitic)	Inst Shelter	ground level
54362	Vermilion Dam	37.370°N 118.987°W	glacial debris >75 m	earth dam	abutment crest, face, toe
54384	Vermilion Dam Downstream	37.356°N 118.988°W	rock (granitic)	Inst Shelter	ground level

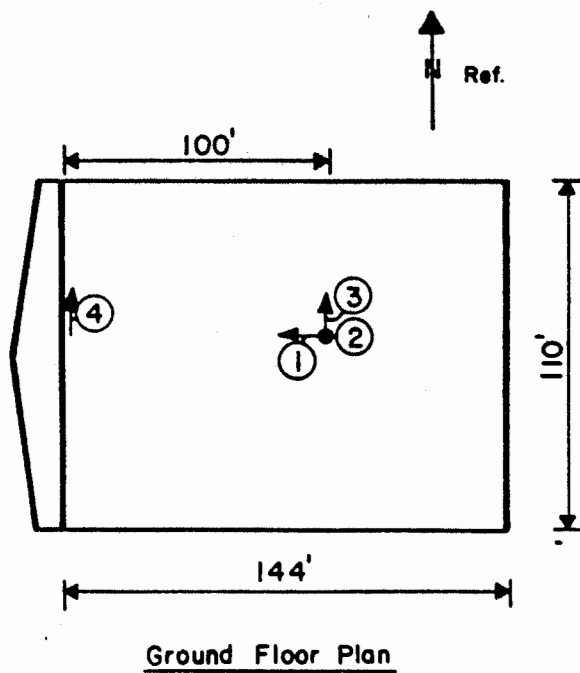
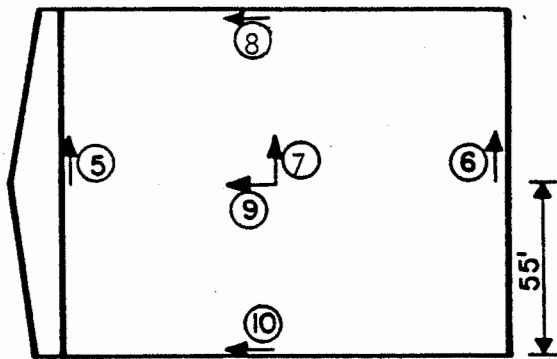
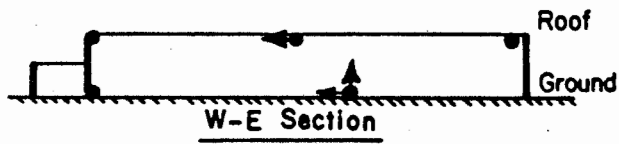
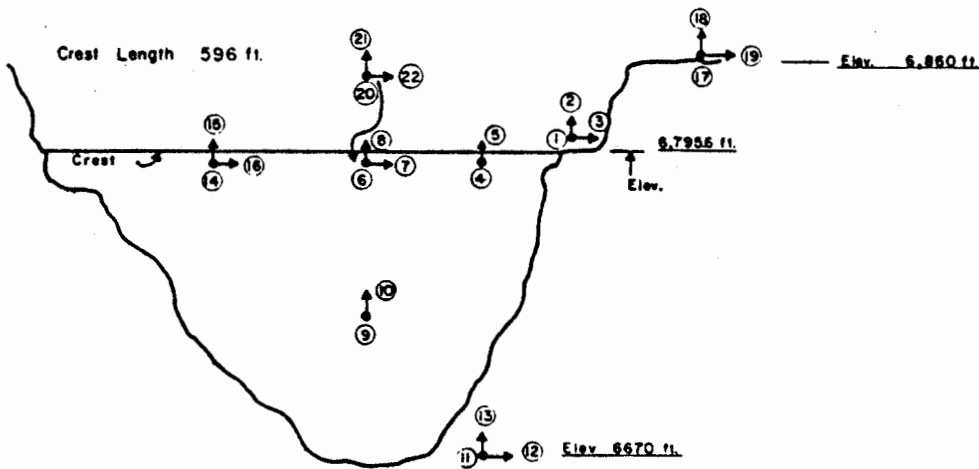
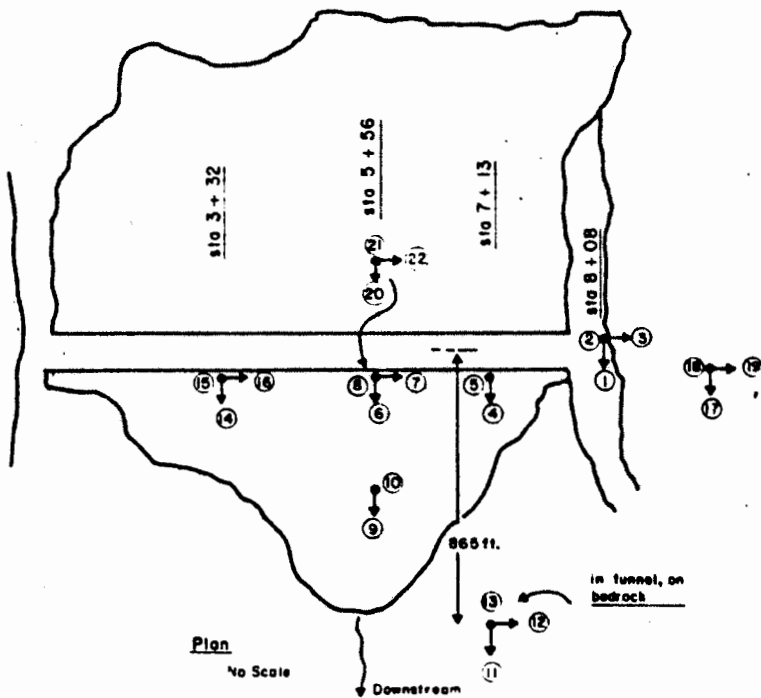
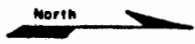


Figure 2 - Mammoth High School Gymnasium, strong-motion instrumentation scheme. Reference orientations for structure are $N=344^\circ$, $W=254^\circ$.



Elevation
(Downstream Face)



Note: All instruments tied together with common start and WWVB Radio Time.

Figure 3 - Long Valley Dam, strong-motion instrumentation scheme. (Note that for dams, left and right are defined relative to an observer on the crest facing downstream.) Reference orientations for structure are N=360°, E=90°.

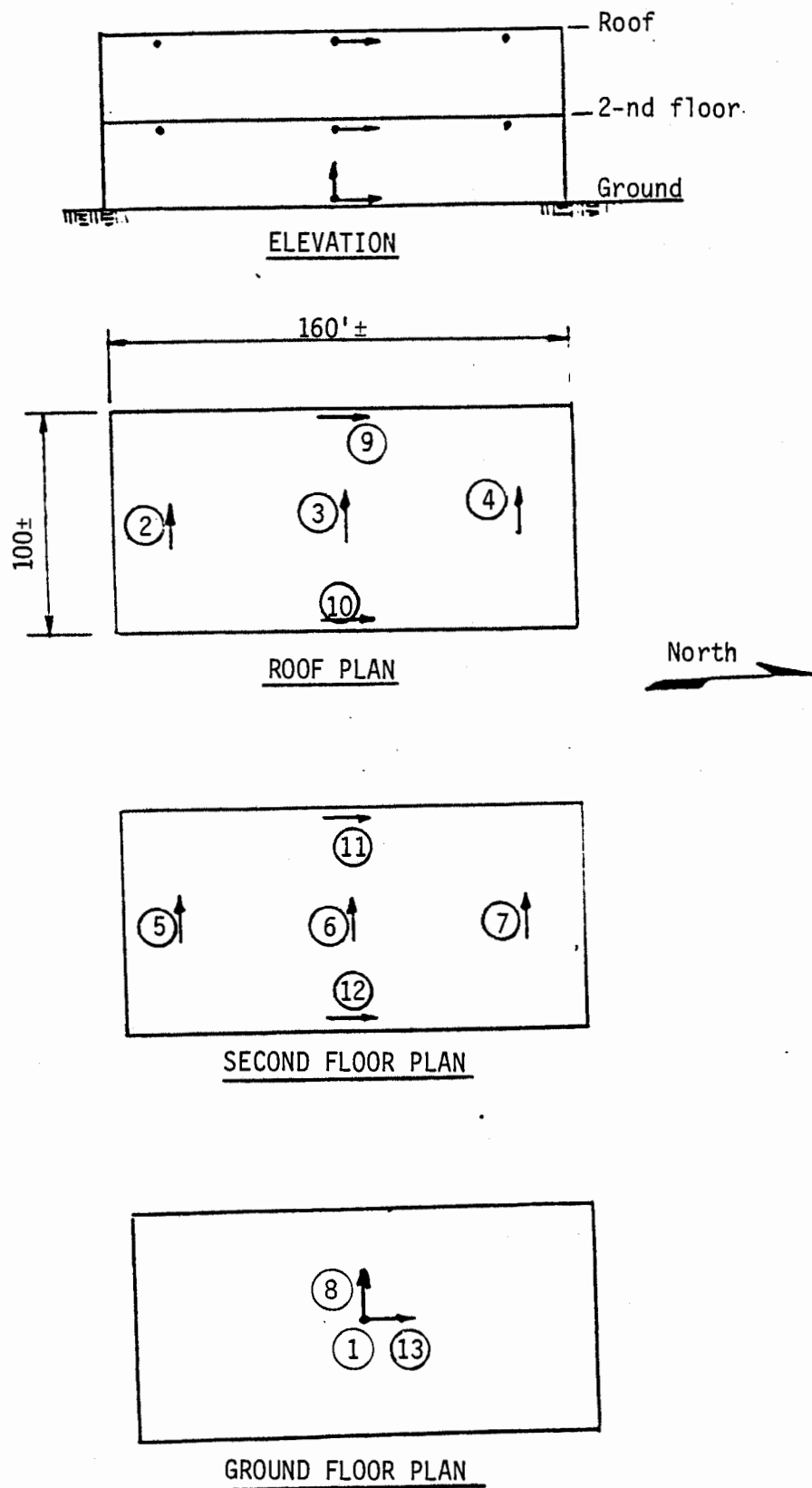


Figure 4. Office bldg, 873 No. Main St., Bishop - Strong-motion instrumentation scheme. Reference orientations for structure are $N=360^\circ$, $W=270^\circ$.

DATA FROM THE 17:38 (PST) 6 JANUARY EARTHQUAKE

The preliminary epicentral coordinates of the first $M > 5$ earthquake on 6 January 1983 are (USGS):

Coordinates: 37.63 N, 118.93 W
Focal Depth: shallow (~3 km)
Origin Time: 17:38:10.2 PST
(01:38:10.2, 7 January UTC)

Preliminary estimates of the magnitude are 5-5 1/2 (USGS) and 5.2 M_L (BRK)

Accelerograms were recovered from five CDMG strong-motion stations as indicated in Table 2. More complete descriptions of the stations are given in Table 1. Epicentral distances of the triggered stations range from 3.5 to 55 km. (All triggered stations are within 22 km, except for the Bishop-Office Building station at 55 km, which has a horizontal trigger at the roof of the structure). Three of the four records recovered within 22 km include a good WWVB time trace.

The maximum ground-level acceleration recorded (0.26 g) occurred at the Mammoth High Gym station, the closest station. The acceleration at the roof level reached 0.49 g. (Note that accelerometers 7 and 8 have been interchanged relative to the records from the 1980 earthquakes shown in Turpen (1980).)

The data from the Long Valley Dam, at 22 km distance, include a total of twenty-two channels recording the motion at various locations on the structure. Three channels of the central recorder (CRA #C0190) are co-located with an SMA (center crest instrument, SMA #S3504). The upper left abutment instrument (SMA #S3484) is different from the instrument which recorded the anomalous spikes during the 1980 earthquakes (#S3505). Evaluation of the 1983 left abutment records is continuing.

TABLE 2

Strong-motion data from CDMG accelerograph stations located within 60 km of the 17:38 (PST) 6 January 1983 Mammoth Lakes earthquake. Stations are arranged in order of increasing epicentral distance.

Number	Station Name	Coordinates (degrees)	Epicentral Distance (km)	S-t ¹ Interval (sec)	WVB ² Trigger Time	Maximum Acceleration		
						Azimuth ³	Ground (g) Structure (g)	
54301	Mammoth Lakes High School Gym	37.641 N 118.963 W	3.5	0.5	radio inoperative	344 UP 254	0.26 0.17 0.20	0.49 - 0.46
54099	Convict Creek U.C. Research Station	37.614 N 118.831 W	8.6	1.5	38:12.7	180 UP 90	0.16 0.10 0.17	- - -
Temp	Crowley Lake Shehorn Res	37.561 N 118.743 W	18	-	-	-	Inoperative	-
54241	Long Valley Dam	37.588 N 118.705 W	20	2.3	38:14.8	90 UP 360	0.06 0.06 0.08	0.09 0.07 0.13
55429	June Lake Fire Station	37.783 N 119.075 W	22	2.4	38:16.0	360 UP 270	< 0.05 " "	- - -
54362	Vermillion Dam	37.370 N 118.987 W	29	-	-	-	Station not accessible	-
54384	Vermillion Dam Downstream	37.356 N 118.988 W	31	-	-	-	Station not accessible	-
54424	Bishop Paradise Lodge	37.481 N 118.602 W	33	-	-	-	Not Triggered	-

TABLE 2 (cont.)

Station Number	Station Name	Coordinates (degrees)		Epicentral Distance (km)	S-t ¹ Interval (sec)	WVVB ² Trigger Time	Maximum Acceleration	
		North	West				Azimuth ³	Ground Structure (g)
55098	Mono Lake	37.940 N	119.065 W	37	-	-	Station not accessible	
55031	Tioga Pass	37.940 N	119.190 W	42	-	-	Not Triggered	
54100	Benton	37.818 N	118.475 W	45	*	radio inoperative	#	-
54428	Chalfant	37.662 N	118.398 W	47	-	-	Not Triggered	
54388	Bishop Office Bldg	37.370 N	118.396 W	55	*	no radio	360 UP	< 0.05 "
54171	Bishop	37.360 N	118.396 W	56	-	-	270 "	0.05

¹S-wave arrival minus trigger time.

* S-t is not recognizable.

²Trigger time in minutes and seconds after 19:00 hours (PST) on 6 January 1983 as determined from WVVB time code.

³Azimuthal direction of ground or structure acceleration for upward trace deflection on accelerogram (degrees clockwise from north).

#Benton record cannot with certainty be associated with first or second earthquake (maximum acceleration < 0.05g).

Mammoth Lakes-High School Gym
CDMG Station #54301
Record #54301-C0135-83007.04

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

1) W  Ground Floor-Center 0.20 g

2) UP  " " " 0.17 g

3) N  " " " 0.17 g

4) N  " " -West Wall 0.26 g

5) N  Roof-West Wall 0.34 g

6) N  " " -East Wall 0.26 g

7) N  " " -Center 0.49 g

8) W  " " -North Wall 0.24 g

9) W  " " -Center 0.46 g

10) W  " " -South Wall 0.19 g

Structure Reference Orientation: N=344°

Timing: 1 cm/sec (approx)

Convict Creek-UC Res Station
CDMG Station #54099
Record #54099-S2593-83008.02

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

17K 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

180

0.16 g

UP

0.10 g

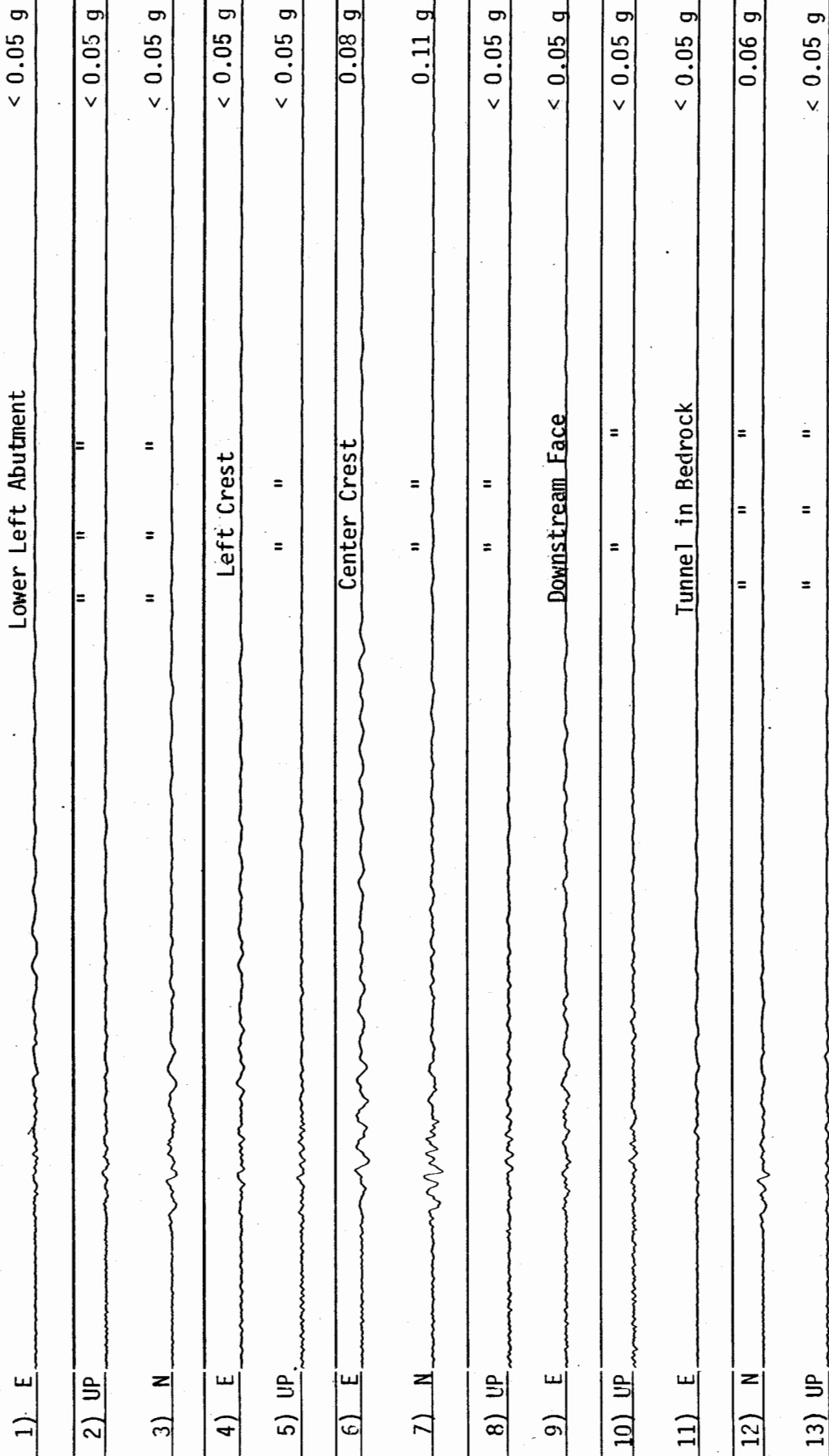
90

0.17 g

Timing: 2 marks/sec

Long Valley Dam
CDMG Station #54214
Record #54214-C0190-83008.01

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)



Structure Reference Orientation: N=360°

Timing: 1 cm/sec (approx)

Long Valley Dam-Right Crest
CDMG Station #54214
Record #54214-S3506-83008.01

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)



14) E

0.08 g

15) UP

> 0.05 g

16) N

0.09 g

Timing: 2 marks/sec

Long Valley Dam-Upper Left Abutment
CDMG Station #54214
Record #54214-S3484-83008.01

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

0.06 g

0.06 g

0.08 g

17) E

0.06 g

18) UP

0.06 g

19) N

0.08 g

Timing: 2 marks/sec

Long Valley Dam-Center Crest
CDMG Station #54214
Record #54214-S3504-83008.01

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

20) E

0.09 g

21) UP

0.09 g

22) N

0.13 g

Timing: 2 marks/sec

June Lake-Fire Station
CDMG Station #55429
Record #55429-S2778-83009.01

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

KODAK 13 100 25LELA E1FM

360

< 0.05 g

UP

< 0.05 g

270

< 0.05 g

Timing: 2 marks/sec

Bishop-Office Building
CDMG Station #54388
Record #54388-C0183-83010.02

Mammoth Lakes Earthquake of
6 Jan 83-17:38 (PST)

1) UP	Ground Floor-Center	$\leq 0.05 g$
2) W	Roof-South End	$< 0.05 g$
3) W	" -Center	$< 0.05 g$
4) W	" -North End	$< 0.05 g$
5) W	2nd Floor-South End	$< 0.05 g$
6) W	" -Center	$< 0.05 g$
7) W	" -North End	$< 0.05 g$
8) W	Ground Floor-Center	$< 0.05 g$
9) N	Roof-West Wall	$< 0.05 g$
10) N	" -East Wall	$< 0.05 g$
11) N	2nd Floor-West Wall	$\leq 0.05 g$
12) N	" -East Wall	$< 0.05 g$
13) N	Ground Floor-Center	$< 0.05 g$

Structure Reference Orientation: N=360°

Timing: 2 marks/sec

DATA FROM THE 19:24 (PST) 6 JANUARY EARTHQUAKE

The preliminary epicentral coordinates of the second $M > 5$ earthquake on 6 January 1983 are (USGS):

Coordinates: 37.63 N, 118.94 W
Focal Depth: shallow (~4 1/2 km)
Origin Time: 19:24:19.0 PST
(03:24:19.0, 7 January, UTC)

Preliminary estimates of the magnitude are 5-5 1/2 (USGS) and 5.4 M_L (BRK). As indicated on Figure 1, the second epicenter is approximately 1.5 km west of the first (closer to the Mammoth Lakes station).

Accelerograms were recovered at the five stations which recorded the 17:38 earthquake as well as the Bishop-Paradise Lodge station. Epicentral distances of the triggered stations range from 2.3 km (Mammoth Lakes High) to 56 km (Table 3).

In general, the records for the second earthquake are similar in amplitude and duration to those for the first. An exception is the lower amplitude record at Convict Creek. The maximum recorded ground-level acceleration (0.19 g) occurred again at the Mammoth High Gym. This value is slightly less than that for the first earthquake (0.26 g), although the earthquake epicenter was closer, and the magnitude may have been greater.

TABLE 3

Strong-motion data from CDMG accelerograph stations located within 60 km of the 19:24 (PST) 6 January 1983 Mammoth Lakes earthquake. Stations are arranged in order of increasing epicentral distance.

Station Number	Station Name	Coordinates (degrees)		Epicentral Distance (km)	S-t ¹ Interval (sec)	MWV ² Trigger Time	Maximum Acceleration	
		344	254				Azimuth ³	Structure (g)
54301	Mammoth Lakes High School Gym	37.641 N 118.963 W		2.3	0.9(?)	radio inoperative	0.19 0.16 0.15	0.39 - 0.49
54099	Convict Creek U.C. Research Station	37.614 N 118.831 W		10.1	0.9	24:22.4	0.09 0.07 0.16	-
Temp	Crowley Lake Shehorn Res	37.561 N 118.743 W		19	-	-	Inoperative	
55429	June Lake Fire Station	37.783 N 119.075 W		21	2.6	24:24.4	< 0.05 " "	-
54214	Long Valley Dam	37.588 N 118.705 W		22	2.0	radio inoperative	0.08 0.06 0.11	0.09 < 0.05 0.13
54362	Vermilion Dam	37.370 N 118.987 W		29	-	-	Station not accessible	
54384	Vermilion Dam Downstream	37.356 N 118.988 W		30	-	-	Station not accessible	
54424	Bishop Paradise Lodge	37.481 N 113.602 W		34	*	24:31.2	< 0.05 " "	-

TABLE 3 (cont.)

Station Number	Station Name	Coordinates (degrees)		Epicentral Distance (km)	S-t ¹ Interval (sec)	WWVB ² Trigger Time	Maximum Acceleration		
		North	West				Azimuth ³	Ground (g)	Structure (g)
55098	Mono Lake	37.940 N	119.065 W	36	-	-	Station not accessible		
55031	Tioga Pass	37.940 N	119.190 W	41	-	-	Not	Triggered	
54100	Benton	37.818 N	118.475 W	46	*	radio inoperative	-	#	-
54428	Chalfant	37.662 N	118.398 W	48	-	-	Not	Triggered	
54388	Bishop Office Bldg	37.370 N	118.396 W	56	*	no radio	360 UP	< 0.05	< 0.05
54171	Bishop	37.360 N	118.396 W	57	-	-	270	"	0.05

¹S-wave arrival minus trigger time.
* S-t is not recognizable.

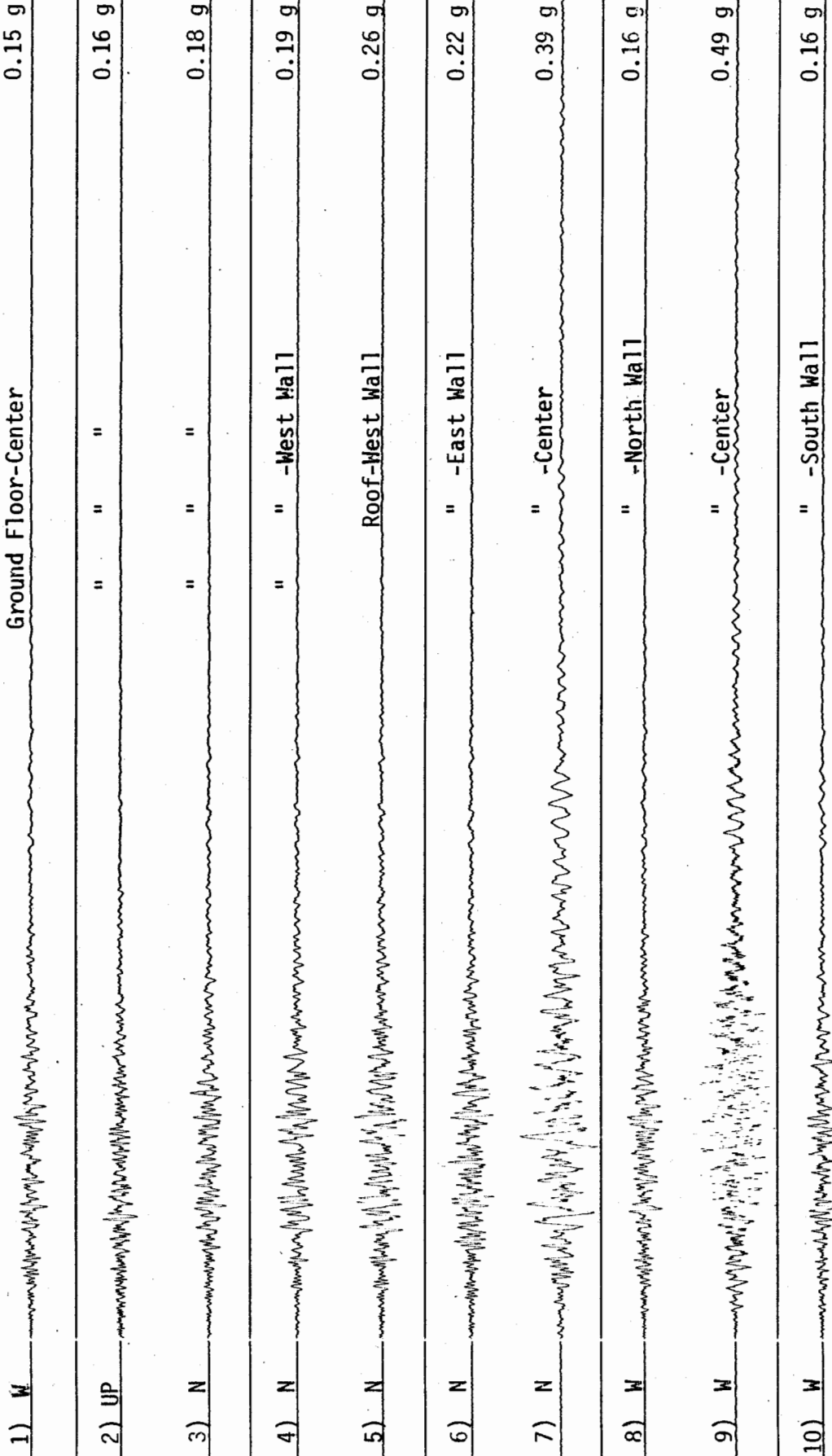
²Trigger time in minutes and seconds after 19:00 hours (PST) on 6 January 1983 as determined from WWVB time code.

³Azimuthal direction of ground or structure acceleration for upward trace deflection on accelerogram (degrees clockwise from north).

Benton record cannot with certainty be associated with first or second earthquake (maximum acceleration < 0.05g).

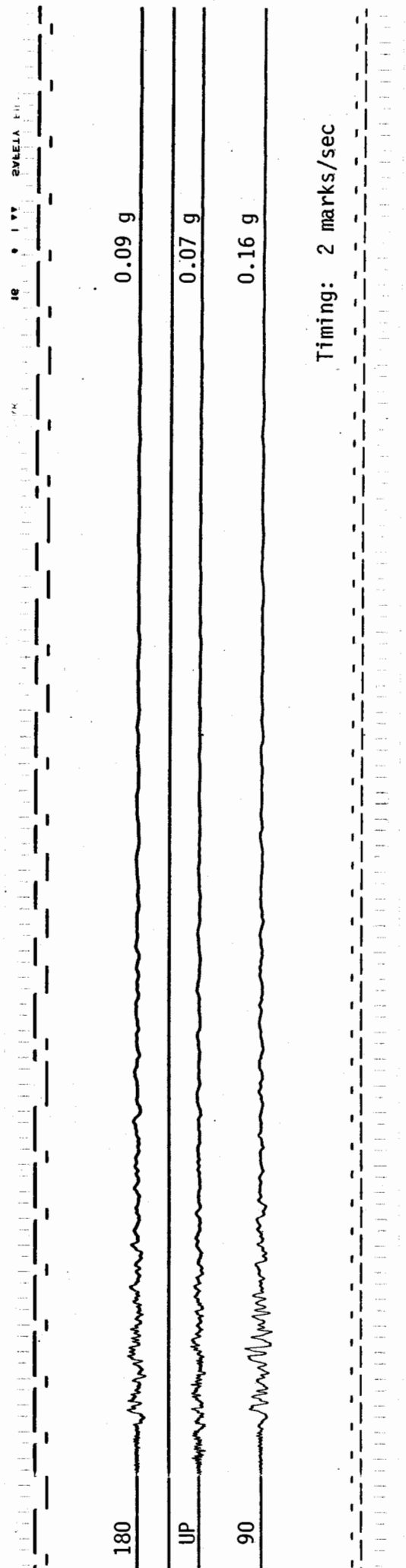
Mammoth Lakes-High School Gym
CDMG Station #54301
Record #54301-C0135-83007.05

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



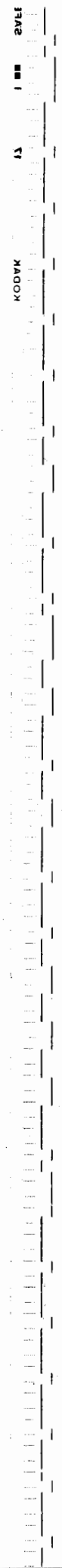
Convict Creek-UC Research Station
CDMG Station #54099
Record #54099-S2593-83008.03

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



June Lake-Fire Station
CDMG Station #54429
Record #54429-S2778-83009.02

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



360

< 0.05 g

UP

< 0.05 g

270

< 0.05 g

Timing: 2 marks/sec

Long Valley Dam
CDMG Station #54214
Record #54214-C0190-83008.02

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



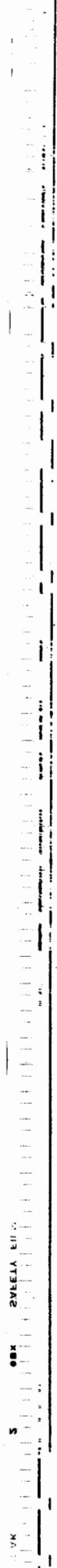
Location and Orientation	Peak Acceleration (g)
1) E Lower Left Abutment	< 0.05 g
2) UP " " "	< 0.05 g
3) N " " "	0.07 g
4) E Left Crest	< 0.05 g
5) UP " " "	< 0.05 g
6) E Center Crest	0.09 g
7) N " " "	0.13 g
8) UP " " "	< 0.05 g
9) E Downstream Face	0.05 g
10) UP " " "	< 0.05 g
11) E Tunnel in Bedrock	< 0.05 g
12) N " " "	0.06 g
13) UP " " "	< 0.05 g

Structure Reference Orientation: N=360°

Timing: 1 cm/sec (approx)

Long Valley Dam-Right Crest
CDMG Station #54214
Record #54214-S3506-83008.02

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



14) E

0.07 g

15) UP

< 0.05 g

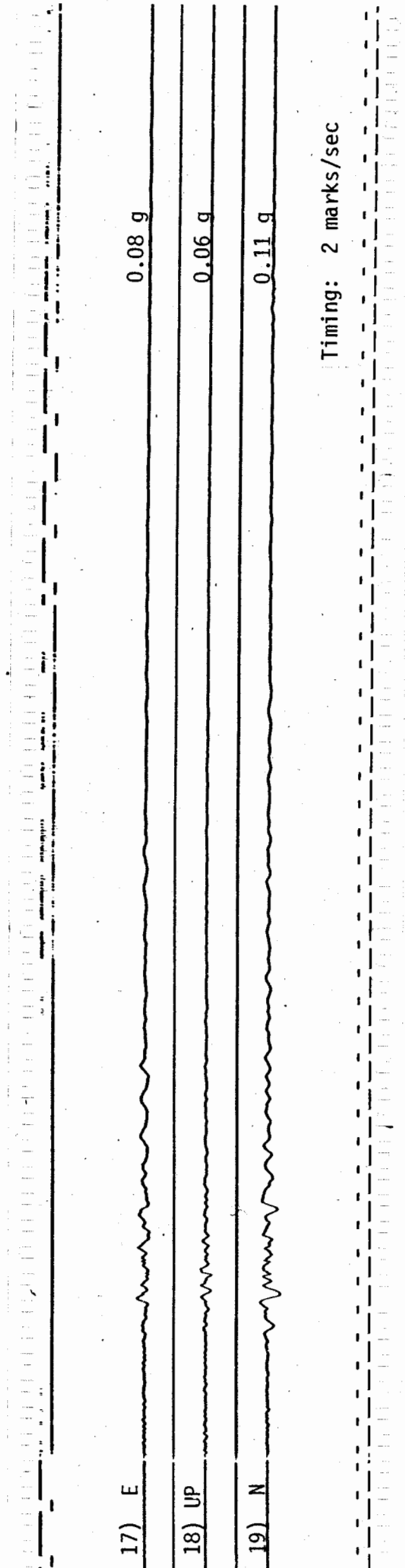
16) N

0.09 g

Timing: 2 marks/sec

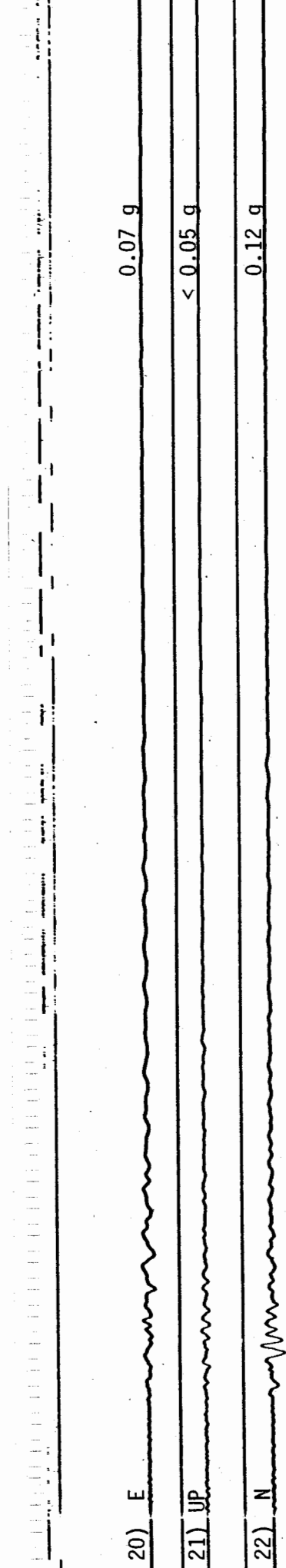
Long Valley Dam-Upper Left Abutment
CDMG Station #54214
Record #54214-S3484-83008.02

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)



Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)

Long Valley Dam-Center Crest
CDMG Station #54214
Record #54214-S3504-83008.02



Timing: 2 marks/sec

Bishop-Paradise Lodge
CDMG Station #54424
Record #54424-S1827-83008.01

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)

KODVK

160

< 0.05 g

UP

< 0.05 g

70

< 0.05 g

Timing: 2 marks/sec

Bishop-Office Building
CDMG Station #54388
Record #54388-C0183-83010.03

Mammoth Lakes Earthquake of
6 Jan 83-19:24 (PST)

1) UP	Ground Floor-Center	< 0.05 g
2) W	Roof-South End	0.05 g
3) W	" -Center	< 0.05 g
4) W	" -North End	< 0.05 g
5) W	2nd Floor-South End	< 0.05 g
6) W	" -Center	< 0.05 g
7) W	" -North End	< 0.05 g
8) W	Ground Floor-Center	< 0.05 g
9) N	Roof-West Wall	< 0.05 g
10) N	" -East Wall	< 0.05 g
11) N	2nd Floor-West Wall	< 0.05 g
12) N	" -East Wall	< 0.05 g
13) N	Ground Floor-Center	< 0.05 g

REFERENCES CITED

- McJunkin, R.D., and Kaliakin, N.A., 1981, Strong-motion records recovered from the Mammoth Lakes, California, earthquake of 30 September 1981: CDMG Office of Strong-Motion Studies Report OSMS 81-10.1, 22 p.
- Sherburne, R.W., (Ed.), 1980, Mammoth Lakes, California earthquakes of May 1980: CDMG Special Report 150, 141 p.
- Turpen, C.D., 1980, Strong-motion records from the Mammoth Lakes earthquakes of May 1980: CDMG Preliminary Report 27, 42 p.