PROCESSED CSMIP STRONG-MOTION RECORDS FROM
THE NORTHRIEDGE, CALIFORNIA EARTHQUAKE
OF JANUARY 17 1994: RELEASE NO. 1

R. DARRAGH
T. CAO
C. CRAMER
M. HUANG
A. SHALAL

Report No. OSMS 94-068

California Strong Motion Instrumentation Program
California Department of Conservation
Division of Mines and Geology
Office of Strong Motion Studies
801 K Street, MS 13-35, Sacramento, California 95814-3531

February 7, 1994
INTRODUCTION

The digitized and processed records obtained from 5 CSMP stations during the Northridge earthquake of January 17, 1994 are included in this first release. Four of these stations are in the epicentral area and one is in Santa Monica. They range in distance from 9 to 24 km from the estimated epicenter at 34.219°N, 118.538°W. The stations are:

- Sylmar - County Hospital Parking Lot  Sta. # 24516, 15 km
- Pacoima Dam - Downstream  Sta. # 24207, 18 km
- Newhall - LA County Fire Station  Sta. # 24279, 19 km
- Arleta - Nordhoff Ave Fire Station  Sta. # 24877, 9 km
- Santa Monica - City Hall Grounds  Sta. # 24538, 24 km

Information on the earthquake and recording stations are given in the 5 Quick Reports (OSMS 94-01, -02, -03, -04 and -05) and more details will be provided in the full report on all CSMP records to be completed in mid February. This processed data report is a more detailed version of OSMS 94-06A that was released on February 4, 1994. Details on accelerograph digitizing and processing will be presented in a forthcoming final CSMP processed data report.

PLOTS OF PROCESSED DATA

For each ground-response station the plots are numbered in the upper right corner at each page. The first page for each station is given below as:

<table>
<thead>
<tr>
<th>Page No.</th>
<th>Station Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Sylmar - County Hospital Parking Lot</td>
</tr>
<tr>
<td>13</td>
<td>Pacoima Dam - Downstream</td>
</tr>
<tr>
<td>22</td>
<td>Newhall - LA County Fire Station</td>
</tr>
<tr>
<td>31</td>
<td>Arleta - Nordhoff Ave Fire Station</td>
</tr>
<tr>
<td>40</td>
<td>Santa Monica - City Hall Grounds</td>
</tr>
</tbody>
</table>

The order of the plots for each station is as follows:

1. Phase 1 (Vol. 1) data: Uncorrected accelerations. Acceleration for the first 30 seconds is plotted with a common scaling factor for all channels; three channels are plotted on one page. This plot is followed by a second plot of the full processed length (in general, 60 seconds) with each channel individually scaled.

2. Phase 2 (Vol. 2) data: Instrument and baseline-corrected acceleration, velocity and displacement. The data for the first 30 seconds are plotted with equal scaling for all channels. The filter frequencies determined in the processing are indicated on the plots (see Usable Data Bandwidth).

3. Phase 3 (Vol. 3) data: Response spectra. The pseudo-velocity spectra (PSV), the pseudo-acceleration spectra (PSA), the displacement spectra (SD) and the Fourier amplitude spectra (FS) are presented on a tripartite
logarithmic plot for each channel for 0%, 2%, 5%, 10%, and 20% dampings. The spectra are plotted for periods within the Usable Data Bandwidth.

4. Phase 3 (Vol. 3) data: Response spectra. The absolute acceleration spectra (5% for 0%, 2%, 5%, 10% and 20% dampings are plotted against period with linear-linear scaling from 0 to 4 seconds.

REFERENCES


DEFINITION OF USABLE DATA BANDWIDTH

The filter bands for each record are indicated on the plots for the Phase 2 and Phase 3 data. In standard processing, the digitized data are processed and filtered using Gmsby filters. The data are first low-pass filtered using a high-frequency filter with a corner frequency of 23 Hz and a roll-off termination frequency of 25 Hz. Then the data are high-pass filtered using a low-frequency filter with a corner frequency of 0.07 Hz and a roll-off termination of 0.05 Hz. Therefore, the Phase 2 data is the result of the digitized data being filtered by the bandpass filter \( H(f) \) with ramps as shown in the figure.

\[
\begin{align*}
H(f) & \approx 1.0 \quad \text{Usable Data Bandwidth} \\
0.7 & < f < f_2 \\
1.0 & < f < f_4 \\
\end{align*}
\]

The Usable Data Bandwidth is defined as the band between frequencies \( f_2 \) and \( f_4 \), where \( f_2 \) and \( f_4 \) are the -3 dB points on the high-frequency and low-frequency ramps, respectively. The value of \( H(f) \) is approximately equal to 0.7 for -3 dB (see Notes). The user should only use these data for analyses within this bandwidth.

Notes:

1) The values of \( f_2 \) and \( f_4 \) can be calculated from the corner frequencies \( (f_{eq}, f_{eq}) \) and the roll-off termination frequencies \( (f_{eq}, f_{eq}) \) used in the processing by using the formulas \( f_2 = f_{eq} + 0.3 \times (f_{eq} - f_{eq}) \) and \( f_4 = f_{eq} - 0.3 \times (f_{eq} - f_{eq}) \). For example, the Usable Data Bandwidth for data bandpass filtered with ramps at 0.30 to 0.40 Hz and 23.0 to 25.0 Hz is 0.51 Hz to 23.6 Hz (0.042 to 2.0 seconds period).

2) It is common in signal processing to plot 20 \( \log_{10}[|H(f)|] \) versus frequency, and express the ordinate value in decibels (abbreviated dB). Accordingly, 0 dB corresponds to a value of \( H(f) \) equal to 1; 20 dB is equivalent to \( H(f) = 10 \), and -20 dB corresponds to \( H(f) = 0.1 \). Thus, at the -3 dB frequency point, the amplitude of the transfer function, \( H(f) \), is reduced to 0.7, while the power transmitted by the filter, \( H^2(f) \), is reduced to 0.5.
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
SYLMAR - COUNTY HOSP. PARKING LOT
CHN 1: 90 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RAMPS AT .65-.12 TO 23.0-25.0 HZ.
24514-55254-94017.03 020434.0929-06944514

--- RESPONSE SPECTRA: PSV, PSA & SD ---
--- FOURIER AMPLITUDE SPECTRUM: FS ---
DAMPING VALUES: 0, 2.5, 10, 20%
RESPONSE SPECTRA: PSV, PSA & SD
FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2.5, 10, 20x

FREQUENCY (HZ)

PSA (G)

SD (IN)

SD (CM)

PSV, FS (IN/SEC)

PERIOD (SEC)

FS, FS (CM/SEC)
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
SYLMAR - COUNTY HOSP. PARKING LOT
CHN 3, 360 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RAMPS AT .06-.12 TO 23.0-25.0 HZ.
24514-55254-94017.03  020494.0920-0944514

RESPONSE SPECTRA: PSV, PSA & SD -- FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2.5, 10, 20%
NORTH RIDGE EARTHQUAKE JANUARY 17, 1994 04:31 PST
PACOIMA DAM - DOWNSTREAM CHN 1: 265 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .08-.16 TO 23.0-25.0 HZ. 24207-S1572-94021 02 020494.1009-QM4A207

ACCELERATION (CM/SEC/SEC)
MAX = 425.6

VELOCITY (CM/SEC)
MAX = 30.6

DISPLACEMENT (CM)
MAX = -4.99

TIME (SEC)
0 5 10 15 20 25 30
HORSEHEAD EARTHQUAKE JANUARY 17, 1994 04:31 PST
PADILLA DAM - DOWNSTREAM
CHN 1: 265 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RAMP AT .08-.16 TO 23.0-25.0 HZ.
24207-51672-94021.02 920494.1014-0944207

RESPONSE SPECTRA: PSV, PSA & SD
— FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%

FREQUENCY (HZ)

PSA (G)

SD (IN)

SD (CM)

PSV FS (IN/SEC)

PSV FS (CM/SEC)

PERIOD (SEC)
RESPONSE SPECTRA: PSV, PSA & SD — — FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%
NORTH RIDGE EARTHQUAKE  JANUARY 17, 1994  04:31 PST
NEWMALL - LA COUNTY FIRE STATION
UNCORRECTED ACCELEROMETER 24279-52499-54021.02  020194.1150-0N94A279

CHN 1: 90 DEG  MAX = -0.610 G

CHN 2: UP  MAX = 0.605 G

CHN 3: 360 DEG  MAX = 0.598 G

ACCELERATION [G]

TIME (SEC)

0  5  10  15  20  25  30
NORTH RIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
NEWHALL - LA COUNTY FIRE STATION  CHN 3: 360 DEG
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .05-.12 TO 23.0-25.0 HZ.  24279-S2490-402102 020394.1998-QN94A279

MAX = 576.2

MAX = -94.7

MAX = 30.5
NORTHRIDGE EARTHQUAKE JANUARY 17, 1994 04:31 PST
NEWHALL - LA COUNTY FIRE STATION
CHN 1: 50 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RANPS AT .06-.12 TO 23.0-25.0 HZ.
S40279-S2489-S4021.02 020494.0947-CN44279

RESPONSE SPECTRA: PSV, PSA & SD — FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%

FREQUENCY (HZ)

PSV, FS [IN/SEC]

PSA (G)

SD (IN)

1000

100

10

1

10^{-1}

10^{-2}

10^{-3}

PERIOD (SEC)

10

1

10^{-1}

10^{-2}

10^{-3}

SD (CM)

FS [IN/SEC]
NORTHRIDGE EARTHQUAKE
JANUARY 17, 1994 04:31 PST
NEWHALL - LA COUNTY FIRE STATION
CHAN 2: UP
ACCELEROMETER BANDPASS-FILTERED WITH RAMPS AT 0.06-0.12 TO 23.0-25.0 Hz.
24279-S2499-94021.02 020494.0947-QN94A279

RESPONSE SPECTRA: PSV, PSA & SD - FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2.5, 10, 20%
NORTHRIKE EARTHQUAKE JANUARY 17, 1994 04:31 PST
NEWHALL - LA COUNTY FIRE STATION
CHN 3: 360 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RAMPS AT .05-.12 TO 23.0-25.0 HZ.
24279-S2499-94021.02 020494.0947-GN94A279

RESPONSE SPECTRA: PSV, PSA & SD
FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20\%

FREQUENCY (HZ)

PSA (G)

SD (IN)

SD (CM)

PSV, FS (IN/SEC)

PSA, FS (CM/SEC)

PERIOD (SEC)
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
ARLETA - NORDHOFF AVE FIRE STATION
UNCORRECTED ACCELEROMGRAM 24087-51594-94017.02 012694.1208-QN94A087

CHN 1: 90 DEG  MAX = 0.347 G

CHN 2: UP  MAX = -0.582 G

CHN 3: 360 DEG  MAX = 0.306 G

ACCELERATION (G)

TIME (SEC)
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
ARLETA - NORHOFF AVE FIRE STATION CHN 2 UP
INSTRUMENT-CORRECTED AND BANDPASS-FILTERED ACCELERATION, VELOCITY AND DISPLACEMENT
FILTER BAND: .06-.12 TO 23.0-25.0 HZ.  24087-51594-94017.02  020934.1759-QN84A0B7

MAX = -541.4

MAX = -17.5

MAX = -6.45
NORTHRIDGE EARTHQUAKE
JANUARY 17, 1994 04:31 PST
ARLETA - NORDHOFF AVE FIRE STATION
CHN 1: 90 Deg
ACCELEROMGRAM BANDPASS-FILTERED WITH RAMPS AT .06-.12 TO 23.0-25.0 HZ.
24087-S1594-94017.02 020494.0848-0N94A887

RESPONSE SPECTRA: PSV, PSA & SD
-- FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%

FREQUENCY (HZ)

PSA (G)

SD (IN)

SD (CM)

FS (IN/SEC)

FS (CM/SEC)

PSV, FS (PW/SEC)

PERIOD (SEC)
NORTH RIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
ARLETA - NOHOHOFF AVE FIRE STATION
CHN 2: UP
ACCELEROMETER BANDPASS-FILTERED WITH RAMPS AT .06-12 TO 23.0-25.0 HZ.
24827-51584-94017.02 025454.0848-0644-087

RESPONSE SPECTRA: PSV, PSA & SD
- FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 0.2, 5, 10, 20%
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
ARLETA - NORDHOFF AVE FIRE STATION
C3N 3: 360 DEG
ACCELEROMETER BANDPASS-FILTERED WITH RANGES AT .05-12 TO 23.0-25.0 HZ.
24087-31594-34017.62 000454.0848-GN94A097

RESPONSE SPECTRA: PSV, PSA & SD  --- FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%
NORTHRIDGE EARTHQUAKE  JANUARY 17, 1994 04:31 PST
SANTA MONICA  -  CITY HALL GROUNDS
CHN 1:  90 Deg
ACCELEROMETER BANDPASS-FILTERED WITH RAPMS AT 0.07-1.0 TO 23.0-25.0 Hz.
2450-52456-94020.06  02049A.1006-QM944538

RESPONSE SPECTRA: PSV, PSA & SD  —  FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%
RESPONSE SPECTRA: PSV, PSA & SD
FOURIER AMPLITUDE SPECTRUM: FS
DAMPING VALUES: 0, 2, 5, 10, 20%