UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Processed Strong-Motion Records
From Monasavu Dam, Fiji; Earthquakes
of February 13, 14, and 23, 1983

Barry Silverstein

Open-File Report 85-375

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

Menlo Park, California
1985
ABSTRACT

The U.S. Geological Survey (USGS) has maintained limited contact with operators of other strong-motion accelerograph networks throughout the world. As a result, the USGS occasionally receives a small number of records for routine processing. This report describes the processing of three records from Monasavu Dam, Fiji, on February 13, 14, and 23, 1983.
Processed Strong-Motion Records from Monasavu Dam, Fiji:
February 13, 1983, 0953 UTC; February 14, 1983, 1218 UTC;
and February 23, 1983, 1517 UTC

Earthquake and Station Data

In February 1983, three small earthquakes were recorded by a strong-motion
accelerograph at Monasavu Dam on the island of Fiji (see figs. 1 and 2). The
source parameter information for these events is listed in Table 1. The site
is located at 17.76° S. lat. and 178.06° E long.*.

DIGITIZING AND PROCESSING

The computer plots provide a visual description of the recorded
accelerations and their processed results; they are reproduced in the
appendix. These plots may be used to measure specific earthquake or record
parameters directly and to select records for further study using available
digital data.

The steps currently used for processing are:
1. A commercial digitizing firm (IOM-TOWILL in Santa Clara, California)
digitizes the records on a trace-following, computer-controlled laser
scanner. The data is digitized at unequal time intervals, at an
average of 600 samples per second.
2. If a strong-motion record has a duration longer than about 10 s, then
it is divided into approximately 10 s segments, each segment being
digitized separately. The segments are reassembled using specially
inserted vertical lines, the lines mark the end and/or beginning of
each segment. Each vertical line is digitized twice, once in each
adjacent segment, and then used in reassembling the record.

3. The UNCORRECTED DATA are prepared by subtracting the digitized reference traces from the data traces, and using the digitized time marks to determine the time scale. The instrument sensitivities are used to scale the ordinates to accelerations.

4. The data are passed through a correction algorithm that applies a high-frequency filter (25 Hz in this case), instrument corrections, baseline correction (in the form of a low frequency filter), and decimation to 200 samples per second. Plots of the CORRECTED ACCELERATION, VELOCITY, and DISPLACEMENTS for the three components of each recording are included.

5. The maximum relative velocity response spectra (RV) are calculated for damping values of 0, 2, 5, 10 and 20 percent of critical. These RESPONSE SPECTRA are calculated for a period range starting at 0.04 s and ending with the long period corresponding to the low frequency filter limit used in the baseline correction algorithm. The dashed curve on this plot is the unsmoothed Fourier amplitude spectrum, FAS, calculated at the same periods as the relative velocity response spectra.

The second RESPONSE SPECTRUM plot is that of the pseudo-velocity response spectra, PSRV, calculated for the same five damping values used in calculating the RV spectra. This tripartite plot also has the values for the maximum relative displacement response spectrum (RD) as well as the pseudo-acceleration spectrum (PSAA).

6. FOURIER AMPLITUDE SPECTRA, calculated by FFT, are presented on linear and log-log axes to accent the particular characteristics at each end of the spectrum.

Initial selection of filters for Step 4 are based on the convention of retaining a period content somewhat longer than the strong-motion duration of the records. The final Butterworth filter parameters are chosen to eliminate any apparent serious noise content in the calculated displacements.
Table 2 presents the peak values obtained through processing.

The digital data from which these plots are produced are available on tape from the National Geophysical Data Center (NGDC), NOAA, Mail Stop E/GC11, 325 Broadway, Boulder, Colorado 80303.

Computer Plots

The Appendix contains computer plots for the following processing stages:

Uncorrected accelerogram.
Corrected acceleration velocity and displacement.
Relative velocity response spectra linear plot.
Response spectra, tripartite log-log plot.
Fourier amplitude spectrum calculated by FFT, linear plot.
Fourier amplitude spectrum calculated by FFT, log-log plot.
Table 1: Source Parameters for Fiji Island Events*

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FIGURE 1. MAPS SHOWING LOCATION OF FIJI, EPICENTER, AND MONASAVU DAM.
FIGURE 2. COPIES OF ORIGINAL RECORDS.
## Appendix for Computer Plots

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UNCORRECTED ACCELEROMETER
MONASAVU DAM, FIJI
WEST, UP, SOUTH
EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
PEAK VALUES (CM/SEC/SEC): -49.91 36.08 -125.99

FIGURE 3.
UNCORRECTED ACCELEROGRAM
MONASAVU DAM, FIJI
WEST, UP, SOUTH
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
PEAK VALUES (CM/SEC/SEC): -30.16 29.83 65.16

FIGURE 4.
UNCORRECTED ACCELEROMGRAM
MONASAVU DAM, FIJI
WEST, UP, SOUTH
EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC

FIGURE 5.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI
WEST
EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
PEAK VALUES: ACCEL=-49.67 CM/SEC/SEC, VELOCITY=-1.79 CM/SEC, DISPL=-0.21 CM

FIGURE 6.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI

EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
PEAK VALUES: ACCEL=33.99 CM/SEC/SEC, VELOCITY=1.35 CM/SEC, DISPL=0.16 CM

FIGURE 7.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI
SOUTH
EARTHQUAKE OF FEBRUARY 13, 1983, 0953 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
PEAK VALUES: ACCEL=-124.57 CM/SEC/SEC, VELOCITY=3.53 CM/SEC, DISPL=-0.15 CM

FIGURE 8.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI WEST
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
PEAK VALUES: ACCEL=-20.38 CM/SEC/SEC, VELOCITY=-1.29 CM/SEC, DISPL=-0.14 CM

FIGURE 9.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM. FIJI

EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
PEAK VALUES: ACCEL=28.36 CM/SEC/SEC, VELOCITY=0.96 CM/SEC, DISPL=0.11 CM

FIGURE 10.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS

EARTHQUAKE OF FEBRUARY 14, 1983 SOUTHERN SULU ARCHIPELAGO, SOUTHERN PHILIPPINES

BUTTERWORTH FILTER AT 0.50 HZ ORDER 4

VALUES: ACCEL = 63.46 CM/SEC/SEC, VELOCITY = 1.81 CM/SEC, DISPL = -0.08 CM

FIGURE 11.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI
WEST
EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 Hz, ORDER 4
PEAK VALUES: ACCEL=17.56 CM/SEC/SEC, VELOCITY=0.65 CM/SEC, DISPL=0.04 CM

FIGURE 12.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAYU DAM, FIJI

EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 HZ, ORDER 4
PEAK VALUES: ACCEL=-9.03 CM/SEC/SEC, VELOCITY=0.33 CM/SEC, DISPL=-0.03 CM

FIGURE 13.
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
MONASAVU DAM, FIJI
SOUTH
EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 HZ, ORDER 4
PEAK VALUES: ACCEL=-38.59 CM/SEC/SEC, VELOCITY=1.22 CM/SEC, DISPL=-0.06 CM

FIGURE 14.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI WEST 02/13/83 0953 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 15.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI UP 02/13/83 0953 UTC
0.2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 16.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI SOUTH 02/13/83 0953 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 17.
FIGURE 18.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI SOUTH 02/14/83 1218 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 20.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI, 2/23/83, 1517 UTC WEST
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 1.000 HZ; ANTI_ALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 21.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI, 2/23/63, 1517 UTC UP
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 1.000 HZ; ANTI ALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

UNDAMPED NATURAL PERIOD-SECONDS

FIGURE 22.
RELATIVE VELOCITY RESPONSE SPECTRUM
MONASAVU DAM, FIJI, 2/23/83, 1517 UTC SOUTH
0, 2.5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 1.000 HZ; ANTIALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 23.
RESPONSE SPECTRA
MONASAVU DAM, FIJI WEST 02/13/83 0953 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTI-ALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 24.
RESPONSE SPECTRA
MONASAVU DAM, FIJI UP 02/13/83 0953 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 Hz; ANTI-ALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

FIGURE 25.
RESPONSE SPECTRA
MONASAVU DAM, FIJI SOUTH 02/13/83 0953 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 Hz; ANTIALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

VELOCITY RESPONSE-CM/SEC

ACCELERATION

0.2

1.0

4.0

10.0

40.0

200.0

1000.0

UNDAMPED NATURAL PERIOD-SECONDS

0.04

0.1

0.2

0.4

1.0

2.0

4.0

10.0

20.0

40.0

100.0

200.0

400.0

1000.0

FIGURE 26.
RESPONSE SPECTRA
MONASAVU DAM, FIJI WEST 02/14/83 1218 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 Hz; ANTIALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

VELOCITY RESPONSE-CM/SEC

UNDAMPED NATURAL PERIOD-SECONDS

FIGURE 27.
RESPONSE SPECTRA
MONASAVU DAM, FIJI UP 02/14/83 1218 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 Hz; ANTI-ALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

FIGURE 28.
RESPONSE SPECTRA
MONASAVU DAM, FIJI SOUTH 02/14/83 1218 UTC
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 Hz; ANTIALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

FIGURE 29.
Figure 30.
RESPONSE SPECTRA
MONASAVU DAM, FIJI, 2/23/83, 1517 UTC UP
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 1.000 Hz; ANTIALIAS 25 - 30 Hz
NATIONAL STRONG MOTION DATA CENTER

FIGURE 31.
MONASAVU DAM, FIJI, 2/25/83, 1517 UTC SOUTH
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, CAUSA 4, 1.000 HZ; ANTI-ALIAS 25 - 30 HZ
NATIONAL STRONG MOTION DATA CENTER

FIGURE 32.
FIGURE 33.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
WEST
EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 Hz.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 34.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
UP
EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 Hz.
COMPUTING OPTIONS= ZCROSS, NOnoise.
FIGURE 35.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
SOUTH EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 Hz.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 36.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
WEST
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 37.

FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
UP
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 38.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
SOUTH EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 Hz, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 Hz.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 39.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI WEST
EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 HZ, ORDER 4
DATA BAND PASSED FROM 1.00 TO 25.00 HZ
COMPUTING OPTIONS= ZCROSS, NONOISE.
Figure 40.

Fourier amplitude spectrum of acceleration.

Monasavu Dam, Fiji

Earthquake of February 23, 1983 1517 UTC

Butterworth filter at 1.00 Hz, order 4

Data band passed from 1.00 to 25.00 Hz.

Computing options: ZCROSS, NONOISE.
FIGURE 41.
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
SOUTH
EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 HZ, ORDER 4
DATA BAND PASSED FROM 1.00 TO 25.00 HZ.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 42.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI WEST
EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 43.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
UP EARTHQUAKE OF FEBRUARY 13, 1983, 0953 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 44.

LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
SOUTH EARTHQUAKE OF FEBRUARY 13, 1983 0953 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 45.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
WEST
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPETING OPTIONS = ZCROSS, NONOISE.
FIGURE 46.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 47.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MOKASAVU DAM, FIJI
SOUTH EARTHQUAKE OF FEBRUARY 14, 1983 1218 UTC
BUTTERWORTH FILTER AT 0.50 HZ, ORDER 4
DATA BAND PASSED FROM 0.50 TO 25.00 HZ.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 48.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
WINTER EARTHQUAKE OF FEBRUARY 23, 1983, 1517 UTC
BUTTERWORTH FILTER AT 1.00 Hz, ORDER 4
DATA BAND PASSED FROM 1.00 TO 25.00 Hz.
COMPUTING OPTIONS = ZCROSS, NONOISE.
FIGURE 49.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
ERUPT EARTHQUAKE OF FEBRUARY 23, 1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 HZ, ORDER 4
DATA BAND PASSED FROM 1.00 TO 25.00 HZ.
COMPUTING OPTIONS= ZCROSS, NONOISE.
FIGURE 50.
LOG-LOG FOURIER AMPLITUDE SPECTRUM OF ACCELERATION.
MONASAVU DAM, FIJI
SOUTH EARTHQUAKE OF FEBRUARY 23,1983 1517 UTC
BUTTERWORTH FILTER AT 1.00 Hz, ORDER 4
DATA BAND PASSED FROM 1.00 TO 25.00 Hz.
COMPUTING OPTIONS= ZCROSS, NONOISE.