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SEISMIC ENGINEERING DATA REPORT

STRONG-MOTION EARTHQUAKE ACCELEROGRAMS

DIGITIZATION AND ANALYSIS

1971 RECORDS

OPEN FILE REPORT

No. 76-609

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature

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This is the first of a series of reports planned to include the results of digitization and routine analyses of strong-motion earthquake accelerograms. Serving as a model for this effort is the collection of data reports published by the Earthquake Engineering Research Laboratory during the years 1969 to 1975 and covering significant records of the period from 1933 up to the San Fernando Earthquake of February 9, 1971. This report covers the significant records of 1971 subsequent to the San Fernando Earthquake. The following five records are included: Isabella Dam, California, March 8, 1971; Adak, Alaska, U.S. Naval Base, May 1, 1971; Santiago, Chile, University of Chile, July 9, 1971; Ferndale City Hall, California, September 12, 1971; and Lima, Peru, Institute Geofisico, November 29, 1971. An arbitrarily selected peak amplitude of 5% g has been chosen as the main criterion for a record to be considered significant, if it is ground level record, and 10% g if an upper story structural record. The standard data processing for accelerograms is explained.

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Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Brady, AG

PREFACE

This is the first of a series of reports planned to include the results of digitization and routine analyses of strong-motion earthquake accelerograms published by the U.S. Geological Survey. Serving as a model for this effort is the collection of data reports published by the Earthquake Engineering Research Laboratory of the California Institute of Technology during the years 1969 - 1975 and covering the significant records of the period from 1933 up to the San Fernando earthquake of February 9, 1971. This report covers the significant records of 1971 subsequent to the San Fernando earthquake. The following five records are included:

1. Isabella Dam, California (auxiliary dam abutment), March 8, 1971.
2. Adak, Alaska, U.S. Naval Base (seismic vault), May 1, 1971.
3. Santiago, Chile, (University of Chile), July 9, 1971.
4. Ferndale City Hall, California, (ground level pier), September 12, 1971.
5. Lima, Peru, (Instituto Geofisico), November 29, 1971.

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INTRODUCTION TO THE DATA MANAGEMENT PROJECT

A five year project for the continued operation and development of the national program in strong-motion instrumentation and data management was initiated in 1974 through an inter-agency agreement between the National Science Foundation and the U.S. Geological Survey. The present operation has overall direction and funding provided by the National Science Foundation while day-to-day management is provided by the U.S. Geological Survey. The total program is divided into four projects: Project Management, Network Design, Network Operations, and Data Management. The first provides the administrative function for the other three, whose functions are indicated by their names.

Data Management is concerned with archiving the original records, processing the significant records, and disseminating the resulting data and other information to the user community. One objective of data management is to develop a complete and unified processing system for the strong-motion data recorded by the networks of instruments. This report contains the results of some of the processing, the details of which appear in subsequent sections.

An arbitrarily selected peak amplitude of 5% g has been chosen as the main criterion for a record to be considered significant, if it is a ground level record, and 10% g if an upper story structural record. This holds for the 1971 post San Fernando records of this report and may be altered for future reports if the number of records designated "significant" by the 5% criterion becomes greater (or less), than the current staff and program can expeditiously handle. The current plan is for a report of perhaps up to three or four times this size to be published for each of the years subsequent to 1971.

One aspect of the archiving system for the significant records is the preparation of full-size contact film negatives from the original records which were recorded in the field on photographic paper or film. This reproduction process is carried out under the supervision of the staff of the Seismic Engineering Branch by one of several commercial photographic concerns in the Bay Area, using the original records. From these film negatives, contact prints are made on Mylar-based film, either translucent frosted film for subsequent hand digitizing, (e.g., 6 in. or 12 in. records), or clear film for automatic digitizing procedures (e.g., 70 mm records). Measurements have shown that these prints differ in size from the film negatives by less than 0.1%, and the distortion involved in going from the original paper record to the contact negative is no larger than this. The Mylar film is mechanically strong, dimensionally stable, and affords excellent optical contrast. Experiments on photographic development techniques have resulted in standard methods for producing an optimum balance between contrast and trace width.

For 6 in. and 12 in. photographic paper records a choice is made, depending on the convenience of the digitizer, whether to digitize from the original or a contact print. For 70 mm or 35 mm film records, digitizing by hand requires enlargement of the original. The enlargement is 2X or 3X for 70 mm film, and 3X for 35 mm film, these being a compromise between the resultant effective sensitivity of the acceleration traces, the original length, and the size of the vacuum table carrying the copying film. Without compromise is the requirement that the enlargement be performed in one step, using a lens of absolute minimum distortion, and viewing the entire original length in one frame.

Digitizing options. All the records analyzed in this report have been digitized at Dynamics Graphics, in Berkeley, California, on a Calma digitizing system. This includes a hand-held restrained cursor moving on a 60"-long table with resolution of 1000 points per inch and an RMS error of perhaps 0.003". Digitized output, selected at approximately 50 points per second of record time, is recorded on magnetic tape compatible with the U.C. Berkeley 6600 computer.

For 70 mm film, another digitizing facility is currently used. The I/O Metrics Corporation in Sunnyvale, California has a trace-following, laser scanning system, capable of handling a record in 12 cm sections, with a resolution of 1 micron (10^{-6} meter) and an RMS error of the order of 10 micron. Digitized output at approximately 500 points per cm of record path length is recorded on computer compatible magnetic tape. A projected report will cover the detailed investigation of the accuracies of these two systems, and of other systems which may be called on in the future, for example, Environmental Data Service in Boulder, Colorado, and the Earthquake Engineering Center at Stanford University, California.

STANDARD DATA PROCESSING FOR ACCELEROGRAMS

All processing of the raw digital tapes is done at the U.C. Berkeley computer center and Lawrence Berkeley Laboratory facilities. The programs developed at Caltech during the years 1968 to 1972 (Trifunac and Lee, 1973), have been adapted for use with the CDC 6C00 and 7000 computer systems. The total programming package includes the following phases:

Phase 1: processing to obtain "uncorrected" acceleration data.

Phase 2: introduction of instrument correction and baseline correction to obtain corrected acceleration, velocity, and displacement.

Phase 3: calculation of response spectra and Fourier amplitude spectra at the same values of period.

Phase 4: note that the results of the fast Fourier spectra have not been adapted for inclusion in this report.

Phase 5: calculation of time-dependent spectra.

Phase 1 - Uncorrected Accelerations. This first phase of processing presents the digitized accelerograms of strong earthquake ground motions as processed from records obtained from the strong-motion accelerograph network maintained by the U.S. Geological Survey. No base-line or instrumental corrections or adjustments have been made at this stage - the data may thus be regarded as "uncorrected" in the sense that no modifications have been introduced which involve any hypotheses as to the character of the ground motions or instruments involved. This digitized data is thus believed to be as close a representation of the original, raw information as it is feasible to achieve with digital processing.

The records have been digitized on an unequal time basis, which gives, if the points are well chosen, the best definition of the trace for a given number of data points. All visible local peaks and changes of slope have been picked, along with as many intermediate points as are needed to maintain an average number of points per second of record of at least 50 throughout the accelerograms. If equispaced data is needed for a particular computer program, it is a relatively simple matter to set up an interpolation program as the first step in the computation.

Considerable thought has been given to the length of record to be digitized. Although the actual strong-motion portion of the record is the most important part for engineering purposes, a sufficient length of the later lower amplitude accelerations have been included to permit studies of long-period characteristics. Such studies are, of course, limited by other factors of instrument characteristics and accuracy. For certain investigations for which the longer-period components are not important, only a fraction of the whole digitized record might be used.

Most records contain several traces produced by "fixed" mirrors rigidly attached to the accelerograph frame. In some cases, these fixed traces depart measurably from straight lines, usually involving long-period components to be ascribed to paper distortion, motions of the paper in the drive mechanism, etc. For all records on which fixed traces are present, the fixed traces are digitized at intervals of the order of one half-second, smoothed by weighted averaging over every three consecutive points, and subtracted from the accelerometer traces as a first step in the data processing.

Timing marks on the record were also digitized and smoothed by a 1/4, 1/2, 1/4 running average to form the basic time coordinate.

To fix the particular values of the digitized ordinates, some more-or-less arbitrary decision has been made as to the position of a straight reference line. When the record is placed on the table of the digitizing machine, it is lined up with the horizontal axis of the machine as closely as can be judged by eye. For this purpose the fixed traces serve as useful guides, as do the zero trace sections at the beginning of the record before the triggering of the instrument. It must be realized, however, that imperceptible shifts of the horizontal axis in translation or rotation lead to large deviations in double integrated displacement curves, so some technique which assures a uniform result is needed. For this purpose, the following procedures have been adopted. The film record is first placed on the digitizing table with the horizontal axis lined up by eye parallel to an estimated zero axis. If the record trace and the fixed mirror traces have been digitized without moving the record on the table of the digitizing machine, then the subtraction of the two traces will correct for any slight rotation of the record on the table, so that only translation of the horizontal axis is required. This axis is therefore translated to a position which makes the integral of the digitized acceleration curve, over the length of the record, zero. This is, in principle, the same as making the mean acceleration value zero, or making the sum of the squares of the deviations from the horizontal axis a minimum. Although this means physically that the change in ground velocity from beginning to end of the record is zero, which is actually not the case for records triggered by the excitation itself, this method for selecting the horizontal axis position would seem to be the most logical choice for a standard procedure.

For those few records for which fixed traces are not available, or for which the record has been moved on the table between the digitizing of the record trace and the fixed trace, the horizontal axis is not only first translated to make the mean zero as above, but then a very small rotation is introduced to make the sum of the squares of the deviations from the zero line a minimum. This removes the effects of any slight rotational misalignment without interfering with the basic data.

It is believed that the above data processing techniques represent a minimum adjustment of the data, which consequently may be referred to as the basic "uncorrected" data.

Computer plots of the uncorrected data are included in a later section of this report. The three components of each record are shown, except for those records where fewer than three components were digitized. The scales on the two axes are standard throughout, wherever possible, so that a quick glance shows immediately the relative amplitudes, and whether or not there were particularly high frequency or long period ground motions present.

The components mentioned, e.g. S44W, N46W, Up, indicate the direction of the transducer pendulum motion when moved by hand, for the trace to be deflected upwards on the record as it is viewed in the normal way with time increasing from left to right and the emulsion side up. This has been the standard practice since the strong-motion program began in the early thirties under the name of the Seismological Field Survey. A true ground acceleration, during earthquake motion, will be positive (or upwards) on these plots when in the opposite direction to these component labels.

Phase 2. - Corrected accelerations. The processing necessary to correct accelerograms includes the corrections for instrumental response and true baseline. Preliminary smoothing is carried out first. From the uncorrected accelerograms, digitized at unequally spaced points, equally spaced data with 100 points per second are interpolated. This is low-pass filtered using an Ormsby filter (Ormsby, 1961), having a cutoff frequency of 25 cps and a roll-off termination frequency of 27 cps. Decimation follows, selecting every second point, resulting in smoothed data with 50 points per second, corresponding to a Nyquist frequency of 25 cps.

The instrument correction affects particularly those frequency components higher than about 1/2 of the natural frequency of the instrument transducer, and is particularly important towards the upper limit of the frequency band retained, i.e., 25 cps. The correction is performed using the standard second-order differential equation governing oscillator motion together with the natural frequency and fraction of critical damping obtained from calibration tests of each accelerograph component. Differentation of the instrumental response that is required for this correction is carried out by the simplest central difference method.

The baseline correction removes from the accelerogram all Fourier components with periods longer than an upper period limit chosen on the basis of careful tests. The standard upper limit for hand digitized paper records has a cut-off period of 14 sec, and roll-off termination at 20 sec — the corresponding frequencies are 0.07 and 0.05 cps. This correction procedure, developed in the Caltech standard data processing project, replaces the earlier systems of baseline correction that consisted of the least squares fitting of a constant, a straight line, or a parabola, etc. The details may be found in the reports from the Caltech data processing project (see References, Phase 2) but in general terms the procedure is made up of the following steps:

1. Least square fit a straight line to the uncorrected acceleration as an initial baseline and initial correction to the acceleration.
2. Compute the velocity, assuming a zero initial value, and least square fit a straight line to the velocity.
3. Add the slope of this fitted line to the acceleration obtained in step 1.
4. Low-pass filter the acceleration of step 3 with a running mean filter, decimate it, and low-pass again with an Ormsby filter using the cut-off and roll-off termination frequencies (.07 and .05 cps) given above. The remaining very long period components form the new baseline, which is subtracted from the acceleration of step 3. This complete step consequently results in a high-pass filtered acceleration.

5. Again compute the velocity, assuming zero initial values, and least square fit a straight line to the velocity.
6. Incorporate the slope of this fitted line into the acceleration of step 4.
7. Apply the complete step 4 to the velocity of step 5, resulting in a high-pass filtered velocity and a particular initial value of the velocity.
8. Compute the displacement from the velocity of step 7, assuming a zero initial value, and apply the high-pass filter of step 4 to this displacement, which also results in a particular initial value of the displacement.

The instrument correction and baseline correction outlined above result in a corrected accelerogram which represents the acceleration of the instrument support in the frequency band between 0.07 cps and 25 cps. The accuracy of the long period Fourier components of displacement has been extensively investigated (Hanks, 1973) using results obtained from the San Fernando earthquake. The accuracy is estimated to be somewhat better than 1 cm in the period range of 5-8 seconds, approximately 2 cm at periods near 10 seconds, and several (2-4) cm in the 10-15 second period range. It is evident here also in some of the displacement plots of stage 2 processing that some long period noise is still present. There are no components remaining with periods longer than the cut-off period of 14 seconds (and roll-off termination at 20 seconds), but it is evident that for short records and some long records this cut-off period is in fact too long if displacement errors are to be kept smaller than the estimates indicated above. The cause for this lies in the presence of noise arising primarily from random digitization noise, independent of the acceleration amplitudes. The very low amplitude of long period accelerations throughout the record therefore gives a low signal-to-noise ratio at these long periods. With this in mind, the displacement plots indicate that a cut-off period lower than 14 seconds could perhaps be used to remove these components from the acceleration data. Routine processing of subsequent records will include the ability to make a preliminary selection of a cut-off period optimal for a particular record by viewing displacements during computing runs and phase 2 processing will incorporate this selection.

Computer printout of the corrected data of phase 2 are included in a later section of this report. The corrected acceleration is listed in units of mm/sec/sec, so that space-saving integers can be used, retaining the precision of the original digitizing machine, whose least count corresponds to about 3 mm/sec/sec. The equal time interval is 0.02 seconds. Identification labels, instrument characteristics, peak values, and initial values are included in the headings for each component. Plots of acceleration, velocity, and displacement are shown with axes and scales selected suitably to show the entire record. Peak values are indicated. The definition of component direction has been described previously for the phase 1 plots. For the phase 2 plots, the same component name is retained. But for the corrected data, in order for the component name to indicate the direction of positive ground acceleration, velocity, and displacement, the signs on the vertical axes have been changed. All ground motions, both portrayed in the plots and listed in tables, are now positive when in the direction of the named component direction, and such a positive motion is plotted downwards. As examples of this convention, if the vertical component is labelled "Down", then a phase 2 plot will present an actual downward ground displacement (or velocity, or acceleration) with a curve that is down below the axis. If a horizontal component is labelled "East", a phase 2 plot will present an eastward ground displacement with a curve that is down below the axis.

Phase 3 - Response spectra. An introduction to response spectrum techniques as they are commonly applied in the earthquake engineering field may be found in the references, particularly the Caltech report, Volume IIIA. The following remarks apply primarily to the influence of the data processing techniques on the computation of these spectra.

The component directions have been described in the earlier sections of phase 1 and 2. The spectral calculations of phase 3 are concerned with absolute values of response and the particular component sense is thus immaterial.

The earthquake response spectrum was originally introduced as a means of characterizing the response of structures to the exciting ground motion, and hence such spectra are calculated from ground motions. There are many instances, however, in which a structural motion is the excitation, for example, of mechanical equipment or other objects attached at upper story locations in buildings. In such cases it may be useful to calculate a response spectrum based on an acceleration-time function which is in itself a response to the earthquake ground motion. Such response spectra of the motion of a particular structure will ordinarily contain predominant peaks corresponding to structural frequencies and will consequently appear very different from ground spectra.

Response spectra calculated from the corrected accelerograms of phase 2 are presented in the data section of the report. They represent the best combination of accuracy and frequency range that it is feasible to achieve with the currently available instrumentation and data processing. As future investigations improve these data processing techniques, and as more refined instruments make it possible to attain higher levels of accuracy and a wider frequency range, such calculations can no doubt be extended to take advantage of such improvements.

The long period noise described in the section on phase 2, and evident in some of the displacement plots appearing in this report, have an effect on the appearance of the phase 3 plots. Only experience can help in determining if the high spectral amplitudes at long periods correspond to the evident long period oscillations in some of the displacement plots. The extent to which long period noise plays a part in this behavior also becomes clear with experience and is discussed in the references under phase 2.

A number of accelerograms have been obtained from instruments located in upper floors of buildings, and upper levels in dams, and it has been decided to include response spectra computed from these structural responses in the same form as the response spectra from ground level records. Such building spectra will be useful in estimating the response of equipment and contents to the motions of particular buildings excited by earthquakes. The reader is cautioned to keep this point in mind and to avoid such building spectra when studying the characteristics of the ground motion itself.

The phase 3 plots and printouts are presented later in this report. For each component there are two figures showing response spectra and two pages of tables containing the spectral ordinates. These are described in detail in the following paragraphs.

The first plot is that of the true relative velocity response spectrum, RV, with an identifying descriptive title. The five continuous line plots correspond to damping values of 0, 2, 5, 10 and 20 percent of critical and these curves will usually be easily distinguishable, with the zero damped curves having the greatest ordinates.

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 ordinates for the spectra are in units of cm/sec, in accordance with current scientific practice, while the scale is chosen to fill the available space.

The periods extend to 15 seconds, close to the long period cut-off point in the corrected data of phase 2, but the axis is divided into two separated linear portions. From 0 to 3 seconds takes up three-quarters of the axis, and from 3 to 15 seconds takes up the remainder.

The second plot is that of the pseudo velocity response spectrum, PSRV, together with the relative displacement spectrum, RD, and the pseudo acceleration spectrum, PSAA, in the tripartite logarithmic plot versus period. This convenient plot is made possible by the relationships between PSRV, RD, and PSAA:

$$PSRV = (2\pi/T)\ RD$$

$$PSAA = (2\pi/T)^2 RD$$

The units used are cm/sec, cm, and g.

The two pages of tables contain values of the ordinates for the previous plots. After the titles there are arranged, in columns, the periods (PER), Fourier amplitude spectrum (FAS), and then sets of four columns containing RD, RV, absolute acceleration spectra (AA), and PSRV for all of the five damping values. The units are indicated and each value is followed by a multiplicative power of 10, e.g., 432-1 represents a value of 43.2.

Phase 4 Fourier spectra. As indicated earlier in this section, the Fourier spectra calculated by fast Fourier transform subroutines are not included in this report. They will be incorporated in a subsequent report devoted solely to Fourier spectra.

Phase 5. Time-dependent Spectral Analysis. The response spectrum was first introduced into earthquake engineering by Benioff (1934) and refined by Biot (1941). With improvement and refinement by others (Alford et al., 1951; Housner et al., 1953; Hudson, 1956), this technique has become an important tool in the design of earthquake resistant structures when dealing with buildings of simple design and special structures such as elevated water tanks. The response of each mode of multi-degree-of-freedom systems such as tall buildings, chimneys or towers can be calculated utilizing the same equation of motion used to obtain response spectra. Each modal response can then be superposed to obtain the total response of the system (Merchant and Hudson, 1962). When the approximate design method utilizing response spectra is not sufficiently accurate and the more involved and costly technique of time-history dynamic response is needed, a response spectrum can be used for the preliminary design. Considering the importance of the response spectrum in seismic engineering, a maximum amount of information should be extracted from it. One method involves the study of response as a function of time (Perez, 1973a; Trifunac, 1971; Hays et al., 1973; Blume and Associates, 1973).

The response spectrum is a plot of the maximum response of a single-degree-of-freedom oscillator, subjected to the particular earthquake, for a given damping factor and for a spectrum of frequencies. However, this focusing on the maximum value ultimately ignores any relationship that exists between the time history of the response and the ground motion. In particular, no information is retained on the difference in time between the strongest part of the ground motion and the strongest part of the resulting response. This type of relationship can be qualitatively investigated using time-dependent spectral analysis, which helps in understanding the effects of high levels of ground acceleration on the response spectrum (Perez, 1973b). The understanding of high levels of ground acceleration is critical, as values have been recorded as high as 1.25 g for Pacoima Dam in 1971 (Trifunac and Hudson, 1971), and 0.7 g for Melendy Ranch in 1972 (Morrill et al., 1974). It can be expected that higher peak accelerations will continue to be recorded.

Important structural engineering information can be obtained by studying in detail the length of time that the general level of velocity response, as indicated by its envelope, is greater than particular predetermined levels. Although certain levels of shaking may do minimal damage to structures at the onset of an earthquake, prolonged shaking at those levels could cause extensive damage due to progressive failure. At the present time, the correlation of building damage versus levels of response and their respective time duration has not been developed. However, attempts in these two areas are being made by several investigators. For example, Matthiesen and Rojahn (1972) have made estimates of threshold structural damage levels for various classes of buildings. The structural response duration at different levels and its relation to structural damage by low-cycle fatigue has been studied by Kasiraj and Yao (1968); Suidan and Eubanks (1973) have studied the cumulative fatigue damage in seismic structures; Popov and Bertero (1973) have studied cyclic loading of steel beams and connections.

The Velocity Response Envelope Spectrum (VRES). This section describes the contour plots of the velocity levels attained by the velocity response envelopes. The original response spectrum is based on the response of the single-degree-of-freedom, viscously-damped, linear oscillator subjected to earthquake ground motion. Such an oscillator acts as a narrow-band filter which amplifies the input frequencies centered around the natural frequency of the oscillator (Trifunac, 1971). To study the response as it varies with time, the envelope of the response is used instead of the actual response. The envelope contains all of the important information required to calculate the maximum relative velocity as normally defined, while maintaining the history of the response as it varies in time. For any particular oscillator those times at which the envelope of the oscillator response rises above or falls below predetermined velocity levels are noted and the results are plotted in the VRES two-dimensional contour plots. The plots are shaded for clarity.

The following method was used to calculate the VRES as a two-dimensional function of time and natural period. The oscillator response was computed for 41 natural periods. The periods selected were: 0.05, 0.075 seconds; from 0.1 to 1.0 seconds at 0.05 second intervals; from 1.0 to 2.0 seconds at 0.1 second intervals; and from 2.0 to 4.0 seconds at 0.2 second intervals. This scheme was chosen to obtain an appropriate density distribution at the higher frequency end of the spectrum. For each period the response envelope was approximated by connecting the absolute value of the local peaks of the response curve. The envelope curve was then interpolated at 160 equal intervals regardless of length of time (i.e. if length of time was 16 sec, then interpolation interval was 1/10 sec). Levels were chosen according to the maximum response, with no more than six levels, regardless of amplitude.

These 41 periods, with their respective VRES calculated at equal time intervals, represent a rectangular grid of spectral values. Contours of equal amplitude were produced by plotting interpolated values from the grid, giving a contour map of the VRES amplitude values as a function of time and period. The maximum relative velocity response spectrum is plotted to the right of each contour map. The contour map shows the peaks and valleys of the VRES as a function of time and period, while the maximum relative velocity response spectrum shows the silhouette of the peaks. The input acceleration is plotted below the contour map to show the relationship between acceleration and the VRES as they vary in time.

In most instances, connecting the local peaks of the response is a good approximation to the response envelope (Perez, 1974). In some instances, the high frequency content in the response gives an envelope of these high frequencies and not of the period being analyzed. A better approximation to the envelope of the response would be obtained by filtering out frequencies appreciably higher than the ones being studied, without altering either the phase or the magnitude of the response of a given oscillator. Since filtering would eliminate the high frequency information that exists in the response of longer period oscillators, and since the VRES plots can easily be inspected when these high frequencies are present, no smoothing of the response is contemplated at the present time.

Displacement and Pseudo-absolute Acceleration Response Envelope Spectrum (DRES AND ARES) Time-dependent spectral analysis may be expressed not only as relative velocity (VRES), but also as relative displacement (DRES) and absolute acceleration (ARES). Relative displacement is important because the shear force exerted by the columns of a structure on the ground are directly proportional to the relative displacement. The absolute acceleration is a measure of the seismic forces acting on the mass of a structure.

A partial solution to obtain VRES, DRES, and ARES is to approximate these quantities through a calculation commonly used by structural engineers. If the response is assumed to be approximately sinusoidal, then the displacement response can be approximated by dividing the velocity response by $\omega_0 = 2\pi/T_0$(T_0 is the natural period of the oscillator) and the absolute acceleration response can be approximated by multiplying the velocity by ω_0. Because velocity response is calculated as a function of time for specified levels, a nomograph may be constructed with curves relating velocity to the corresponding values of displacements and pseudo-absolute accelerations. The method is somewhat similar to the tripartite logarithmic plots used by structural engineers. The curves of the nomograph are based on the different levels of the relative velocity response envelope as a function of time. Note the ordinate of the nomograph on the right of the VRES plots is drawn to the same scale as the contour map and the maximum velocity response spectrum. The left side of the nomograph's contour level represents the lower velocity ranges. An example of using the nomograph is as follows:

for a velocity level of 2.5 cm/sec and 3.0 second period, the equivalent pseudo-absolute acceleration is about 0.005 g; for the same velocity level and same period, the equivalent displacement is about 1.2 cm.

The damping of structures undergoing small amplitude oscillations is generally found to be in the range of 1 to 5 percent critical damping; for structures behaving in the nonlinear and plastic range, the damping can be 10 percent or more (Trifunac, 1971). In this analysis, 5 percent critical damping was used in calculating the VRES.

Since the period range for the VRES is between 0.05 and 4.0 seconds, harmonic theory indicates that the response delay to any significant pulse should be no more than 0.0125 to 1 second (i.e., period/4). However, an examination of the VRES and the acceleration record incorporated alongside shows that the maximum acceleration and the maximum velocity response need not be separated by this delay time interval (Perez, 1974).

Time Duration Spectrum of the Response Envelope. From an engineering point of view, it is important to study not only the peak response and time of occurrence, but also the time duration above a given level of response (Perez, 1973a). The time duration spectrum is defined as the cumulative total time that the VRES equalled or exceeded a given level during the entire acceleration record. In the time duration spectra plots, note that levels of response chosen are identical to those chosen for the computation of the VRES plots. The total time duration of different amplitude levels of the VRES can also be expressed in terms of the number of cycles that occurred at or above a particular level. Due to the filtering properties of a simple harmonic oscillator, the period of the velocity response is approximately equal to the natural period of the oscillator. Therefore, by dividing the duration by the period of the oscillator, a family of straight lines indicating the number of cycles for a given velocity response level can be generated.

The nomograph in the time duration spectra may be used to convert envelope levels of the velocity response to corresponding envelope levels of displacement and pseudo-absolute acceleration response. Because approximate sinusoidal motion is assumed for the velocity response, the time duration and the number of cycles for a given amplitude level also hold true for the corresponding levels of the displacement and the pseudo-absolute acceleration response envelope.

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SUMMARY OF RECORDS INCLUDED IN THIS REPORT

The data on the records and the earthquakes providing them are summarized in Tables 1, 2, and 3. Additional information on some of the records follows.

1037 Isabella Aux. Dam:

Five records were recovered from the Isabella array, although only the one from the abutment of the auxilliary dam was considered significant, with an initial scaling of the peak acceleration of 0.11 g.

4400 Santiago, Chile:

Only one trace was legible enough to digitize, the N10W horizontal trace. It was considered impossible to recover the other two traces with sufficient confidence in their accuracy.

Table 1

EARTHQUAKE DATA

No.	Date, Location	Origin time Local and GMT	Epicenter	Depth	Magnitude	Max MMI	Felt Area
1.	8 Mar 1971 Central Calif.	15:08:07.7 PST (23:08 GMT)	35°40.0'N 118°24.2'W	6 km (PAS)	4.1 (PAS) 4.7 (BRK)	V	10,400 km^2 (4000 mi^2)
2.	1 May 1971 Andreanof Islands	20:08:27.3 AST (2 May, 06:08 GMT)	51.4°N 177.2°W	43 km (ERL)	7.1 (M_s, ERL) 6.8 (PAS) 7.0 (BRK) 6.0 (ERL)	VI (BSSA) IV (USE)	—
3.	8 July 1971 Off Central Chile coast	23:03:18.7 Local (9 July, 03:03 GMT)	32.5°S 71.2°W	58 km (ERL)	6.6 (ERL) 7.5 (PAS) 7.5 (BRK)	X	—
4.	12 Sep 1971 Northern Calif.	11:32:38.0 PST (19:32:38.0 GMT) (19:32:33.9, ERL)	41°17.9'N 123°40.4'W (41.5°N, 123.7°W, ERL)	20 km (ERL)	4.6 (BRK) 4.5 (BRK) 4.9 (ERL)	V	7800 km^2 (3000 mi^2)
5	29 Nov 1971 Off Peru coast	—	11.2°S 77.8°W	—	5.3	—	—

Notes:
PAS - Seismological Laboratory, Caltech, Pasadena
ERL - Environmental Research Laboratories, "Preliminary Determination of Epicenters".
BRK - Seismographic Station, UC Berkeley.
BSSA - "Bulletin Seis. Soc. Amer."
USE - "United States Earthquakes," NOAA.

Table 2

EARTHQUAKE RECORD INFORMATION

Station No.	Station Name	Site Charact.	Structure Type/size	Instr. Location	Eq. No.	Epi. Dist. (km)	MMI at Site	Dig'd Length (sec)	Total Record Length (sec)
1037	Isabella Aux. Dam;	—	earth dam	abutment (A)	1	—	V	9	9
2701	Adak, Alaska, U.S. Naval Base	basalt	instrument shelter (C)	ground level	2	70	IV (USE) VI (BSSA)	25	49
4400	Santiago, Chile, Engineering Bldg, UC		3-story bldg.	basement	3	120	VI	50	125
1023	Ferndale, Old City Hall, Brown St.	Alluvium	2-story bldg.	ground floor	4	—	IV	20	78
4302	Lima, Peru, Geophysical Institute, Avenida Arequipa	—	1-story bldg.	ground level	5	125	—	40	62

Notes:
(A) - in small prefab. bldg.
(C) - in concrete vault
(USE) - "US Earthquakes," NOAA
(BSSA) - "Bulletin," Seis. Soc. Am.

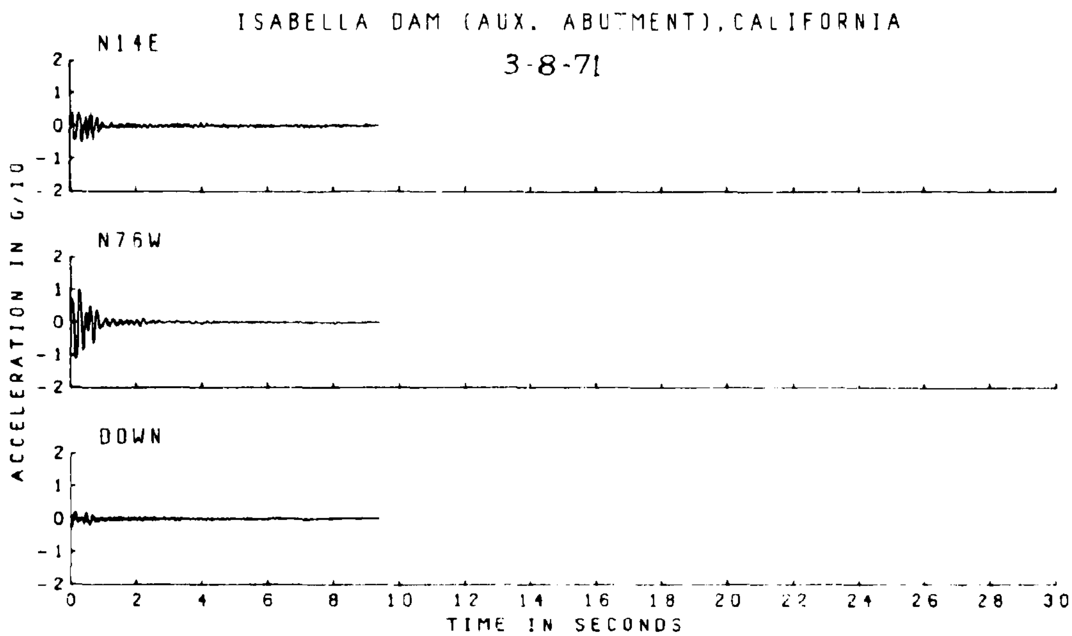
Table 3

INSTRUMENT CHARACTERISTICS

Station Identification			Instr. owner Serial no.	Components			Sens. cm/g	Period sec	Damping fraction
No.	Name	Coord							
1037	Isabella Aux.	35.64N	RFT 250	L	36	N14E	1.91	.047	.55
	Dam	118.47W	AE-112	V	63	Down	1.95	.047	.55
				T	33	N76W	1.82	.048	.59
		Installed:	1-19-68;	Removed - No					
2701	Adak, Alaska	51.88N	AR 240	L	235	N	8.2	.055	.59
	US Naval Base	176.58W	FS 141	V	409	Down	6.5	.051	.59
				T	232	W	7.5	.055	.59
		Installed:	1-24-67;	Removed - No					
4400	Santiago, Chile	33.47S	S-M	V	271	Up	Not digitized		
	Engr. Bldg, UC	70.67W	FS 50	L	272	S80W	Not digitized		
				T	273	N10W	13.0	.062	.57
		Installed:	0-0-44;	Removed - No					
1023	Ferndale	40.58N	S-M	V	247	Up	13.8	.068	.57
	Old City Hall	124.26W	FS-23	L	248	S44W	13.3	.067	.57
	Brown St.			T	249	N24W	12.3	.065	.59
		Installed:	5-0-33;	Removed - No					
4302	Lima, Peru	12.07S	S-M	V	205	Up	12.4	.065	.55
	Instituto	77.04W	FS 44	L	204	N82W	12.9	.065	.61
	Geofisico			T	203	N08E	12.9	.066	.55
	Avenida Arequipa								
		Installed:	0-0-44;	Removed - No					

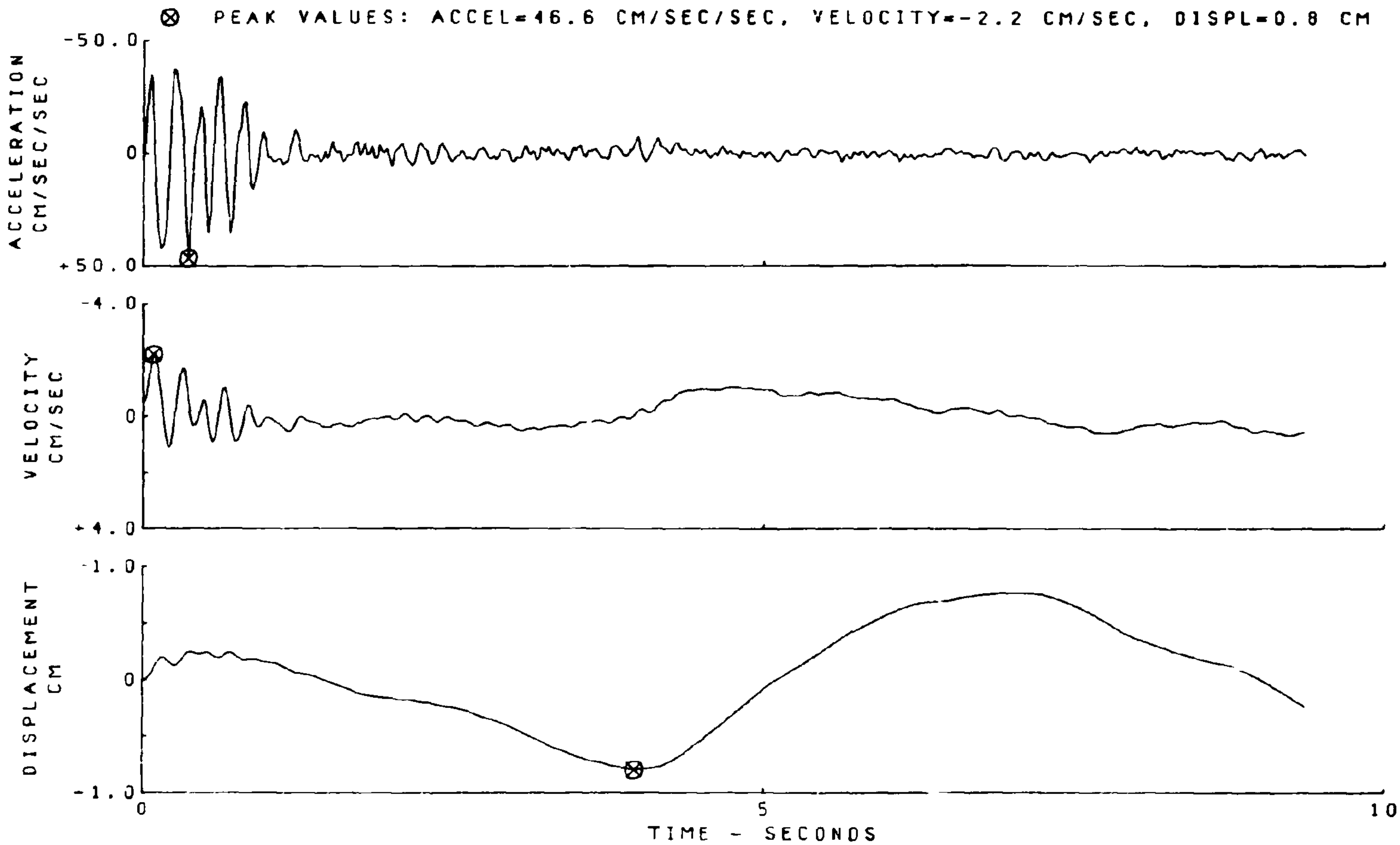
Notes:
AE: Corps of Engineers, US Army
FS: Seismic Engineering Branch, USGS
RFT 250: Teledyne
AR 240: Teledyne

UNCORRECTED ACCELEROGRAM



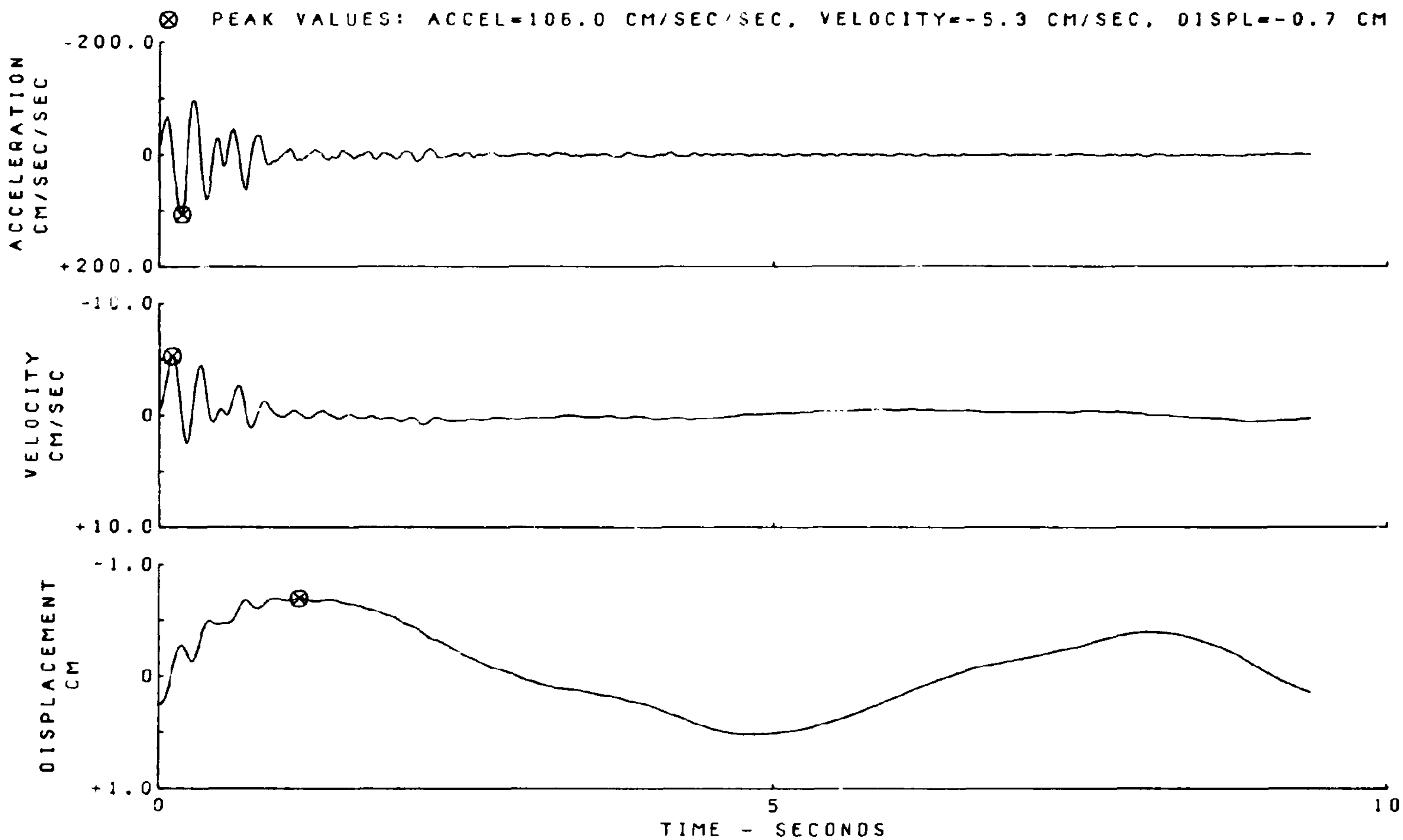
CORRECTED ACCELERATION, VELOCITY DISPLACEMENT

ISABELLA DAM, CALIFORNIA EARTHQUAKE OF MARCH 8, 1971
AUX. ABUTMENT, COMP N14E



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

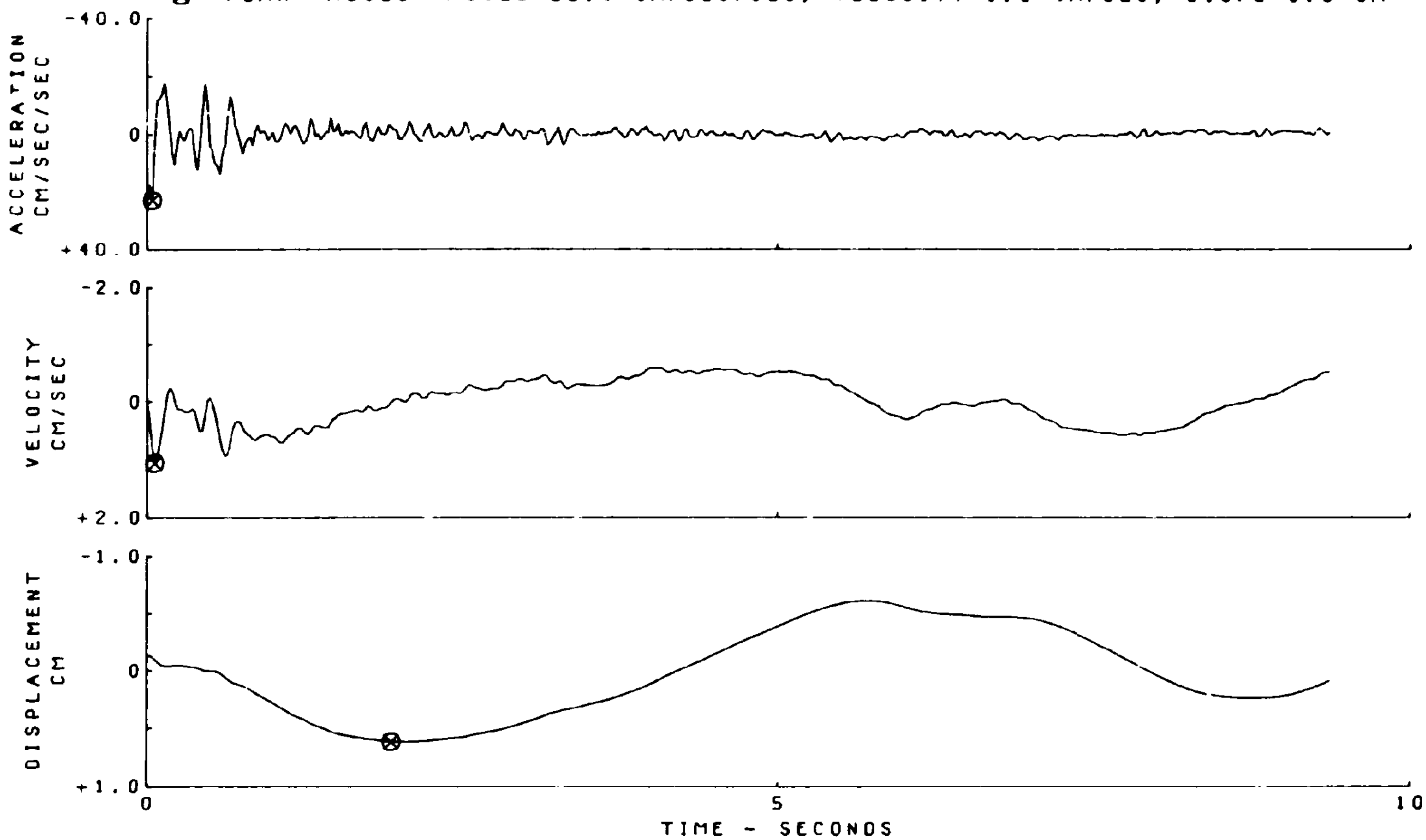
ISABELLA DAM, CALIFORNIA EARTHQUAKE OF MARCH 8, 1971
AUX. ABUTMENT, COMP N76W



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

ISABELLA DAM, CALIFORNIA EARTHQUAKE OF MARCH 8, 1971
AUX. ABUTMENT, COMP DOWN

⊗ PEAK VALUES: ACCEL=22.9 CM/SEC/SEC, VELOCITY=1.0 CM/SEC, DISPL=0.6 CM



CORRECTED ACCELERATION ORDINATES

ISABELLA DAM (AUX.ABUTMENT),3/8/71,N14E
INSTR PERIOD = .0470 SEC DAMPING = .560 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 46.6 CM/SEC/SEC AT .36 SEC VELO = -2.2 CM/SEC AT .08 SEC DISP = .8 CM AT 3.96 SEC
LENGTH OF RECORD = 9.36 SEC INITIAL VELO = -.52416 CM/SEC INITIAL DISP = .00265 CM
469 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	27	-147	-291	-351	-136	137	345	425	409	351	118	-187	-375	-374	-286	-235	-57	262	466	310
.4	52	-75	-118	-211	-149	200	354	263	4	-198	-332	-346	-149	104	247	353	289	36	-85	-114
.8	-223	-229	-60	130	162	117	47	-54	-98	-49	18	12	36	36	25	23	54	39	31	-12
1.2	-74	-110	-81	-8	31	35	35	3	4	18	7	38	25	-13	22	-7	-52	-14	-6	-11
1.6	36	29	3	4	7	-43	-50	11	-13	-48	5	-2	-33	20	19	-36	-6	-5	-24	21
2.0	59	-6	-17	-30	-47	-17	21	40	54	41	-9	-47	-35	-20	-14	27	49	40	19	-29
2.4	-47	-27	-11	16	40	23	8	6	-13	-1	25	17	24	30	0	-19	-22	-26	-3	19
2.8	21	10	25	8	-16	-17	-10	-5	33	40	14	19	17	-19	-34	0	5	-14	27	20
3.2	-25	-19	-6	-27	3	10	-18	-16	3	-5	14	30	2	-25	-13	-27	-34	4	15	-13
3.6	-7	-18	-19	-1	15	18	19	26	-23	-30	-32	-27	-13	9	12	9	-13	-23	-55	-77
4.0	-20	15	37	20	-2	-20	-52	-73	-34	-23	-17	-5	3	-24	-48	-48	-21	-11	-18	-2
4.4	8	6	-18	-9	2	-7	-14	8	20	6	-2	10	-15	-33	-10	3	-13	1	4	6
4.8	23	-7	-2	-1	-4	10	14	11	-4	-2	18	-3	-6	9	23	37	31	15	-6	-17
5.2	2	9	4	6	-9	-18	-20	-18	-7	14	21	7	-10	-16	-6	-2	1	0	-8	-9
5.6	12	40	12	5	23	22	-5	4	7	-12	-1	20	10	-3	-8	2	18	2	1	-4
6.0	-13	-3	9	7	35	24	1	16	17	5	25	20	7	14	4	8	17	16	11	2
6.4	2	5	-17	-20	-21	-18	-9	5	-3	-9	2	1	1	7	22	10	10	9	12	18
6.8	17	-11	-25	-28	-13	22	37	33	21	4	-8	-11	-10	-3	16	27	19	-6	9	12
7.2	-8	9	28	32	27	7	-6	11	14	14	13	10	5	-0	-3	-3	-1	5	7	8
7.6	18	39	24	8	8	-6	-10	9	14	-8	-5	-6	-1	-6	-20	-25	-12	-4	-1	-19
8.0	-32	-7	-3	-16	8	10	-9	-15	-12	-9	21	26	9	1	13	-5	-22	-14	-2	-14
8.4	-1	-11	-16	-2	3	1	-1	8	-5	-1	-2	-4	-14	-15	0	9	27	21	27	31
8.8	14	-2	-0	4	17	25	33	17	-5	-5	-26	-11	23	11	3	1	16	1	3	22
9.2	14	4	-4	-7	-18	-17	-18	-4	10											

CORRECTED ACCELERATION ORDINATES

ISABELLA DAM (AUX.ABUTMENT),3/8/71,N76W

INSTR PERIOD = .0480 SEC DAMPING = .590 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 106.1 CM/SEC/SEC AT .18 SEC VELO = -5.3 CM/SEC AT .10 SEC DISP = -.7 CM AT 1.14 SEC
LENGTH OF RECORD = 9.38 SEC INITIAL VELO = -.44227 CM/SEC INITIAL DISP = .25547 CM
470 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	-171	-430	-598	-687	-525	-192	295	761	1051	1060	786	145	-581	-960	-977	-795	-403	204	670	812
.4	724	320	-99	-298	-274	-29	204	157	-138	-408	-474	-304	-100	263	583	630	429	111	-186	-329
.8	-357	-313	-127	78	178	162	109	108	83	25	-5	-50	-75	-126	-81	54	96	67	99	60
1.2	4	-7	-71	-111	-85	-54	-18	58	89	85	34	57	64	12	-82	-83	-15	-4	26	85
1.6	44	4	9	-2	-48	-66	-28	60	85	41	-11	-49	-27	-1	0	41	76	63	22	-44
2.0	-75	-74	-38	17	100	126	99	43	-41	-97	-121	-92	-37	31	55	50	37	21	15	-6
2.4	-21	-17	19	10	-16	-58	-31	22	47	7	-14	3	2	-22	-39	-46	-40	3	26	17
2.8	10	27	22	15	6	-1	-11	-19	-18	-14	-27	-14	4	11	10	-12	-12	-1	18	10
3.2	-18	-38	-31	-18	-17	-16	-6	20	20	9	11	26	17	1	-13	-5	-7	0	5	-6
3.6	-20	-22	-8	6	19	31	37	34	19	-14	-42	-41	-13	1	6	9	9	12	26	37
4.0	37	21	-2	-4	-0	10	-4	-29	-50	-24	12	24	12	22	31	23	-5	-29	-34	-6
4.4	18	-1	-22	-22	-3	10	-1	-19	-19	-1	-9	-21	-16	-2	-12	-24	-26	-24	-10	6
4.8	15	6	-14	-9	0	0	-16	-14	1	-1	-5	-17	-18	-4	26	13	-2	-4	-8	-15
5.2	-27	-14	5	2	-4	-1	-15	-14	-15	-10	14	12	-7	-19	-3	16	17	-4	-20	-13
5.6	5	3	-9	-16	-6	-0	-5	-5	-8	1	13	-10	-15	-3	-1	1	10	20	20	5
6.0	-4	-21	-27	-6	0	-9	-4	7	31	14	4	-17	-17	-2	16	22	18	7	1	-4
6.4	-6	1	2	-7	-1	18	8	-11	-5	12	17	10	3	9	12	11	9	5	3	4
6.8	-6	1	-0	-18	-20	-1	19	21	-0	-8	-5	0	-3	-2	0	5	-1	-11	-15	-2
7.2	14	4	-8	-8	5	3	10	5	2	17	4	-11	-16	-17	-18	-16	-12	-1	-0	-5
7.6	-3	7	15	20	15	9	0	-7	-5	1	9	20	13	-0	3	11	18	10	-7	-1
8.0	14	29	31	25	13	-5	-9	-7	-3	-1	11	21	9	12	20	13	10	10	13	7
8.4	7	2	-6	0	16	5	0	6	15	12	-1	1	3	-2	10	13	15	12	10	15
8.8	18	20	14	-1	-10	5	2	-8	-8	1	6	-9	-7	-1	-6	-24	-15	-5	-1	-3
9.2	2	1	-10	-14	-16	-22	-8	-1	-7	-8										

CORRECTED ACCELERATION ORDINATES

ISABELLA DAM (AUX.ABUTMENT),3/8/71,DOWN

INSTR PERIOD = .0470 SEC DAMPING = .560 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.

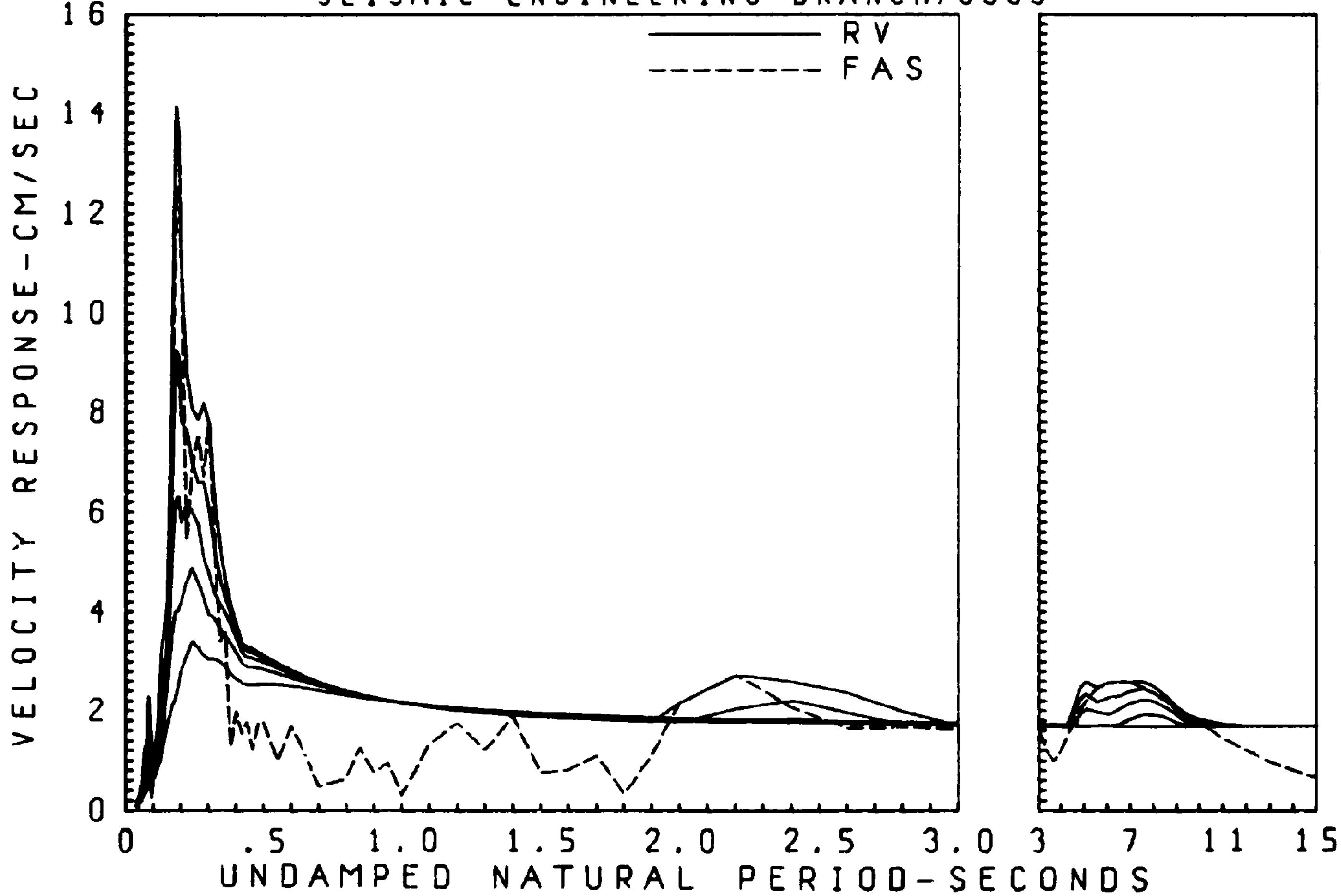
PEAK VALS ACLN = 22.8 CM/SEC/SEC AT .04 SEC VELO = 1.0 CM/SEC AT .06 SEC DISP = .6 CM AT 1.96 SEC

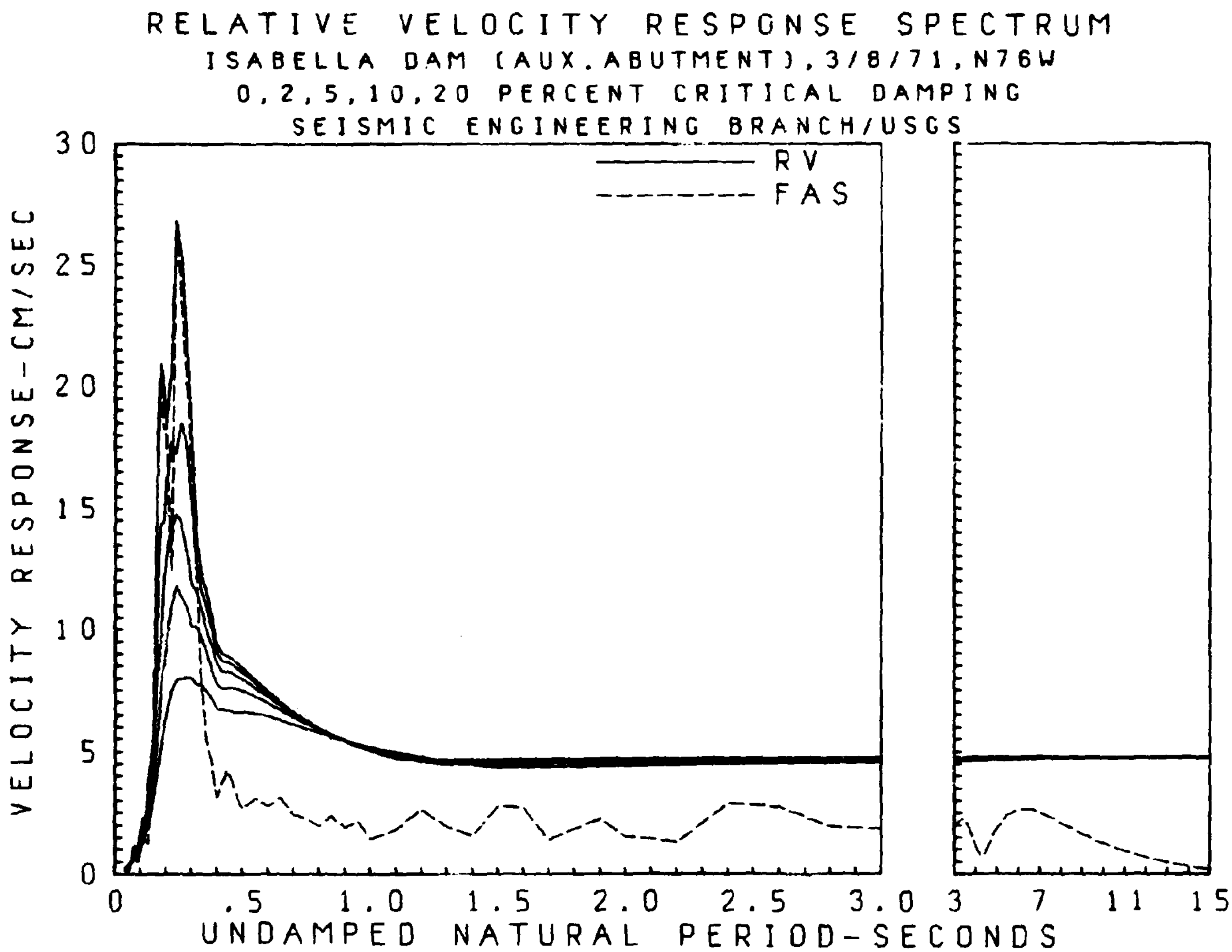
LENGTH OF RECORD = 9.36 SEC INITIAL VELO = .00159 CM/SEC INITIAL DISP = -.13204 CM

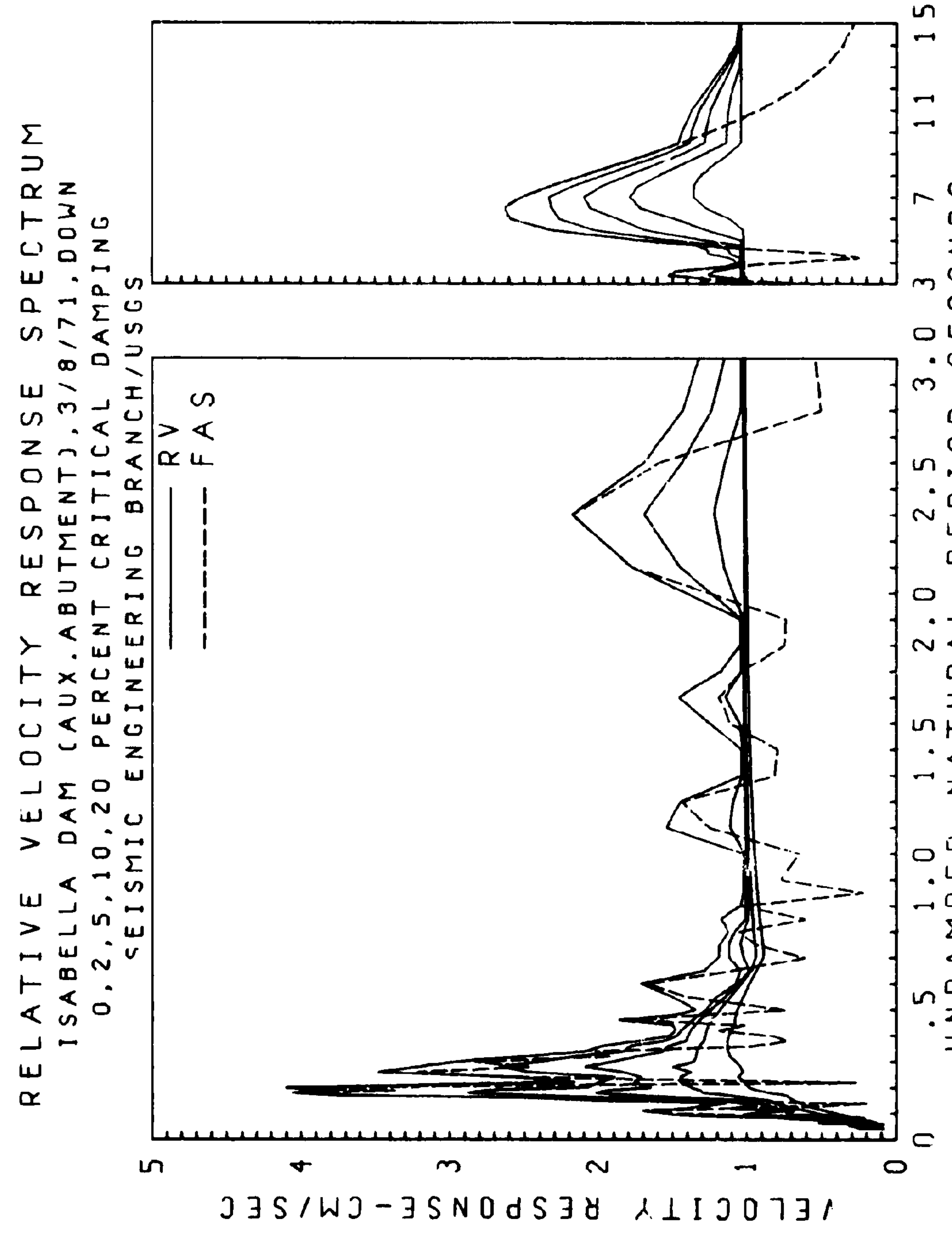
469 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	179	176	228	60	-116	-123	-142	-177	-108	-22	63	106	39	-14	15	22	-12	-22	-17	64
.4	125	47	-73	-174	-95	41	55	99	112	139	65	36	-66	-135	-91	-29	-6	26	66	30
.8	14	9	38	-12	-31	-4	-12	-7	21	9	-8	25	27	13	-21	-39	-21	-1	-23	-30
1.2	-13	14	34	23	-5	-52	-33	8	-2	18	5	-9	-8	-56	-10	-13	-36	3	1	-14
1.6	-1	-10	-7	-1	12	14	-24	-40	9	22	23	-8	-25	-0	-1	-1	-31	-23	-15	-12
2.0	17	19	4	-10	-42	-30	-0	6	21	28	-9	-20	-36	-3	15	8	-7	1	13	6
2.4	-8	-25	6	6	1	-10	-40	-27	2	23	8	3	2	17	-6	-7	-7	-0	-0	2
2.8	-12	-38	-15	-4	6	6	-17	-11	-4	17	17	-9	-14	-4	-5	-2	-16	-19	5	38
3.2	28	12	-5	-22	9	38	27	-5	-19	-17	-5	2	6	2	3	-1	5	-0	4	-9
3.6	2	-6	-3	-7	-7	-20	-23	-6	-1	13	10	-7	-18	-11	2	-2	-18	-17	-25	-7
4.0	-5	5	2	-2	4	25	15	-9	-9	-15	10	24	8	-15	-18	7	12	9	7	-15
4.4	-16	-0	4	-7	-12	-0	5	5	2	-9	2	2	-2	9	15	15	17	-6	-14	-1
4.8	20	15	-0	-7	-16	-10	-7	-7	-5	3	2	-0	4	-6	-2	2	5	5	8	9
5.2	10	1	2	-1	-1	17	12	10	-1	-13	9	29	19	8	-6	-1	22	15	13	11
5.6	17	18	11	6	13	21	9	4	11	12	13	18	21	17	6	9	8	-0	5	12
6.0	11	-4	-8	-11	-9	-6	-19	-21	-12	-8	1	-6	-14	-8	-8	-9	6	4	-9	-17
6.4	6	12	6	6	-1	1	14	-2	-10	-10	-13	-5	2	-3	-6	-5	4	-4	-8	-3
6.8	3	17	18	5	-4	-1	5	18	16	14	9	8	12	21	16	14	7	5	6	6
7.2	15	20	11	2	7	0	-0	7	5	-1	3	3	0	4	6	5	4	2	-2	5
7.6	-0	4	3	4	9	-2	-1	-2	-0	-10	-6	7	13	3	-13	-20	5	7	-0	-9
8.0	-12	-1	-2	-4	-4	-6	-5	-4	-3	-2	-8	-12	-15	-13	-12	-7	-15	-17	-16	-13
8.4	-3	-2	-9	-13	-8	-9	-13	-9	-4	-1	-1	-4	-6	-5	-2	-7	-2	-6	-16	-8
8.8	9	4	-5	-21	-14	1	-2	-8	-10	-13	-15	-11	-13	-11	-9	-12	-11	-11	-6	-3
9.2	-8	0	0	-13	-22	-18	-8	0	-6											

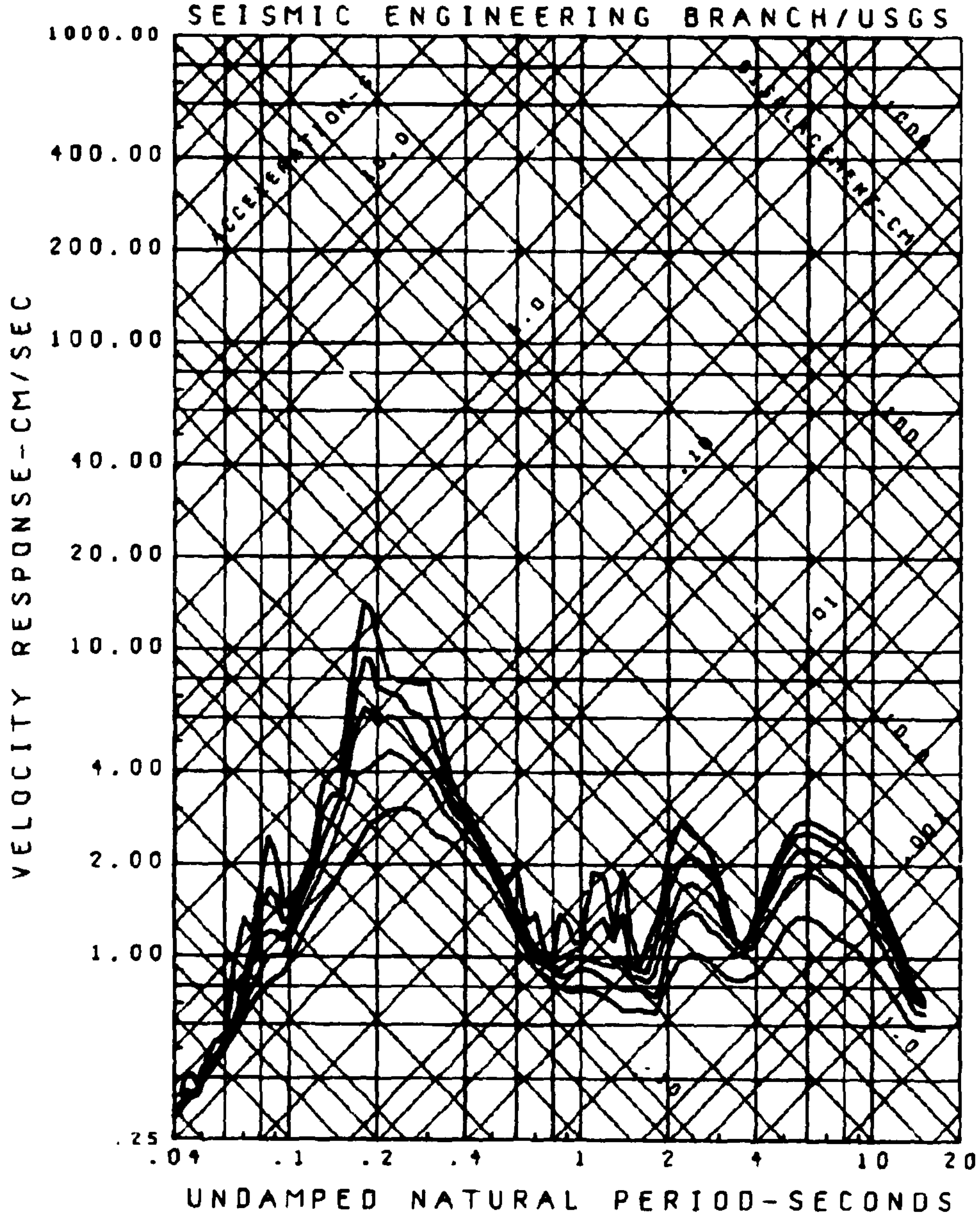
RELATIVE VELOCITY RESPONSE SPECTRUM
ISABELLA DAM (AUX. ABUTMENT), 3/8/71, N14E
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS

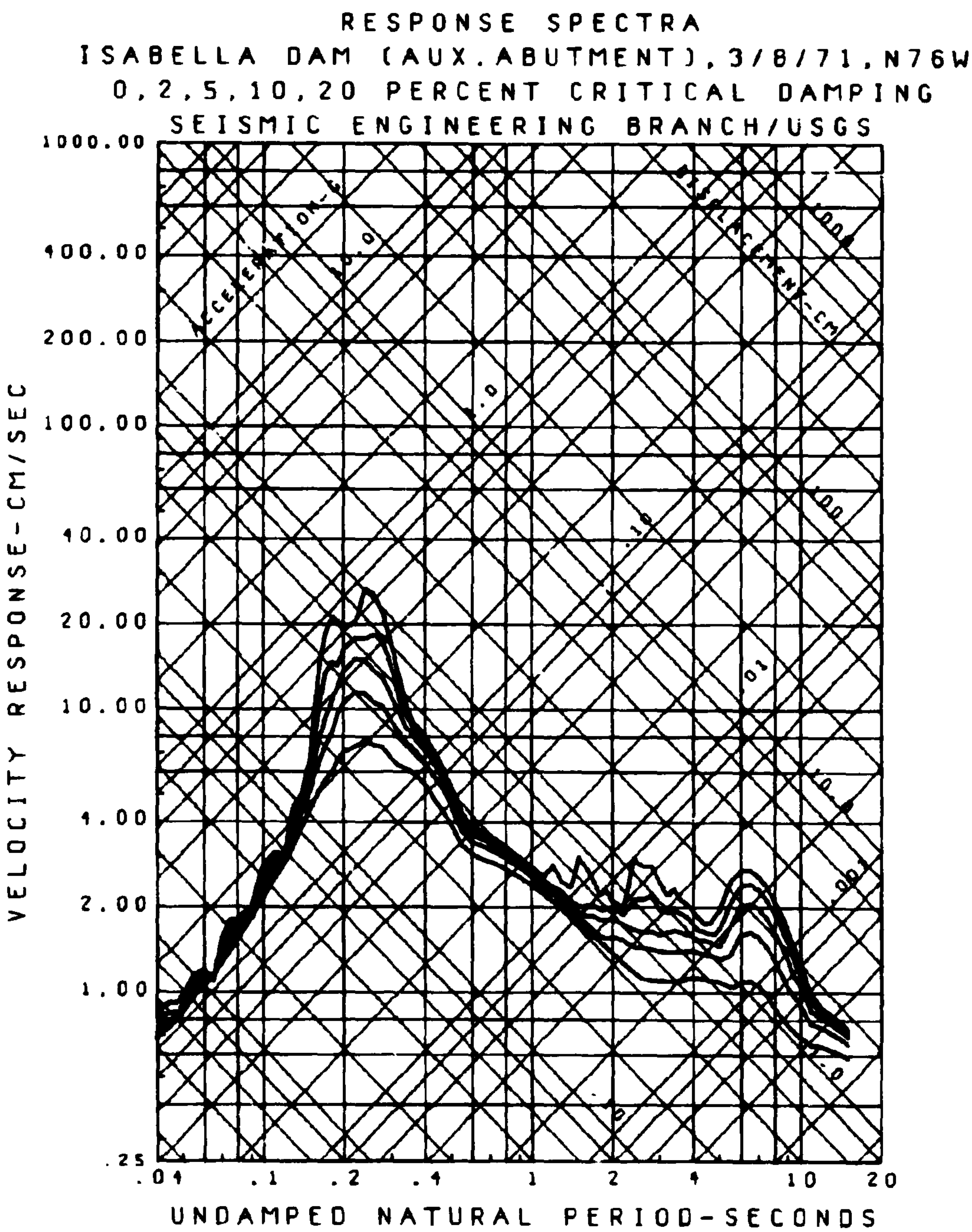


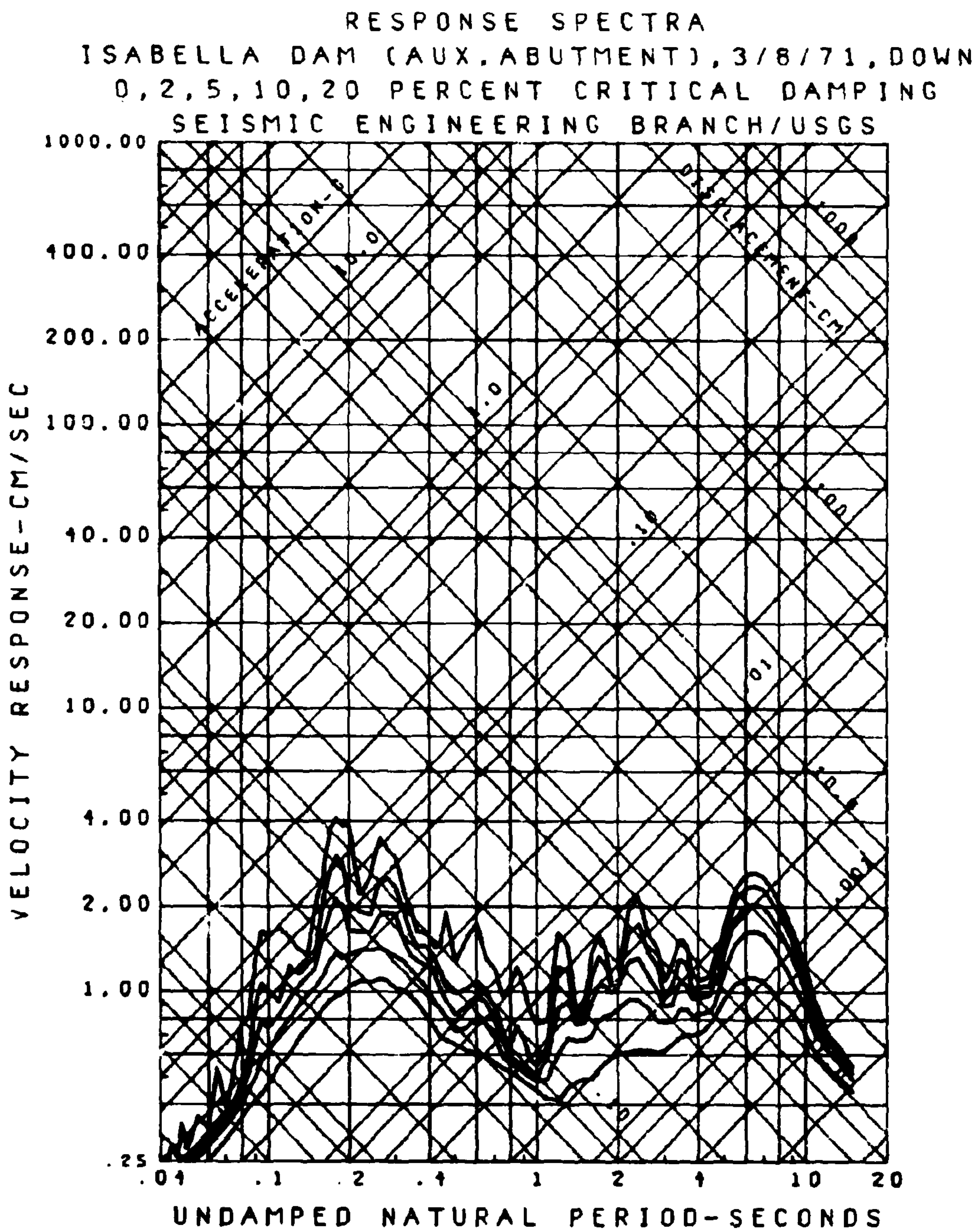

RELATIVE VELOCITY RESPONSE SPECTRUM
ISABELLA DAM (AUX.ABUTMENT),3/8/71,N76W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
0
5
10
15
20
25
30
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
UNDAMPED NATURAL PERIOD-SECONDS

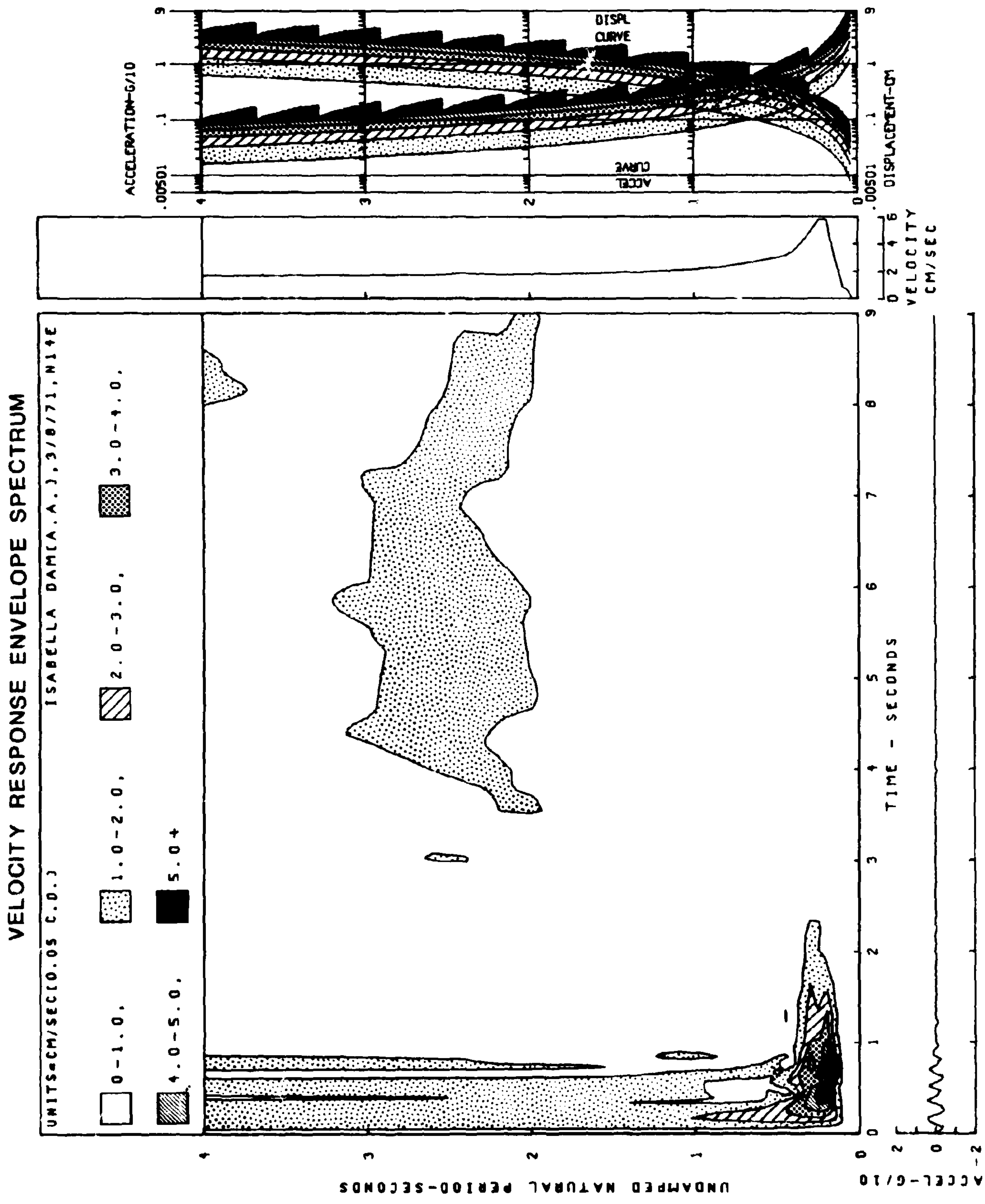

RELATIVE VELOCITY RESPONSE SPECTRUM
ISABELLA DAM (AUX.ABUTMENT),3/8/71,DOWN
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
0
1
2
3
4
5
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
UNDAMPED NATURAL PERIOD-SECONDS

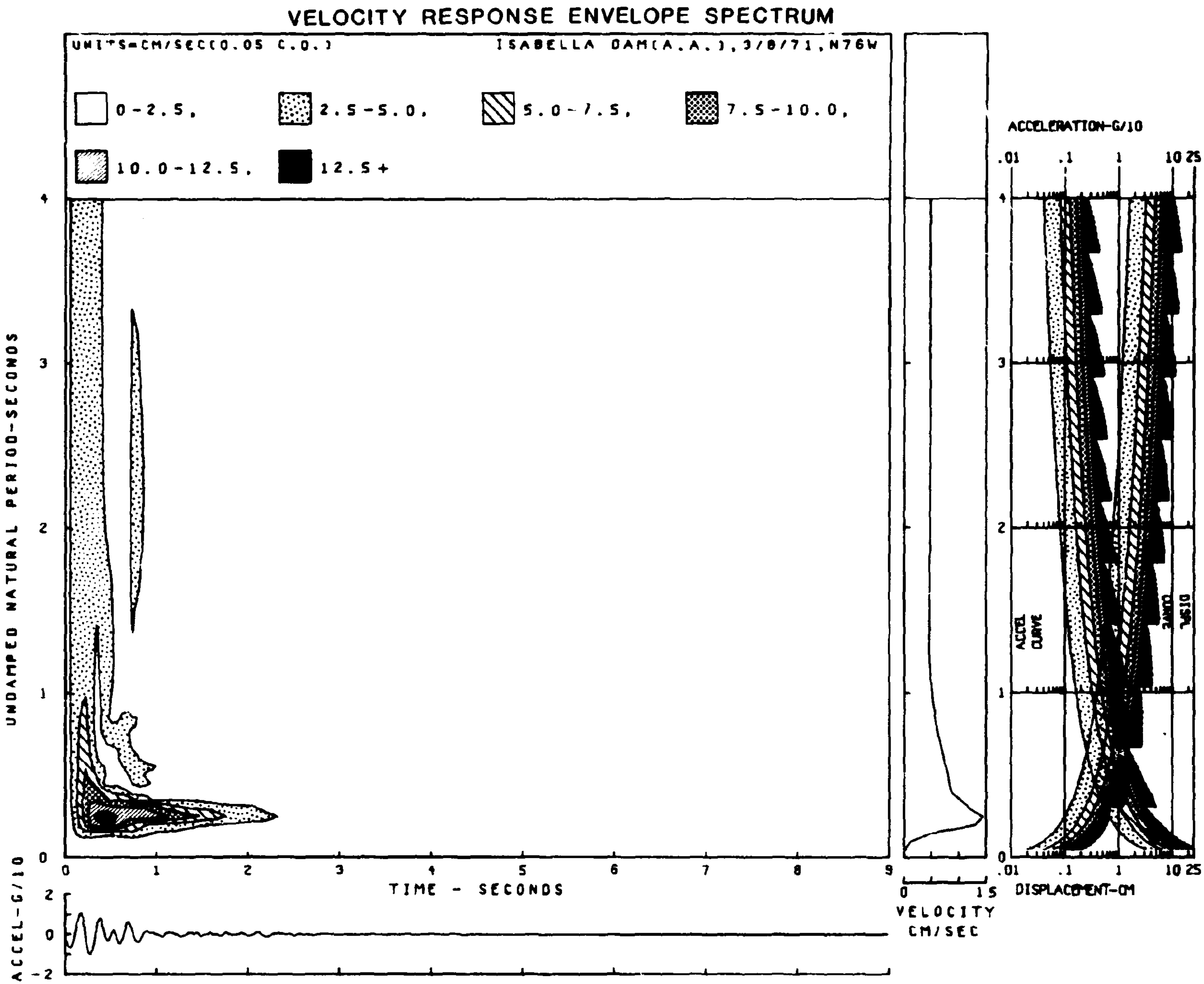
RESPONSE SPECTRA
ISABELLA DAM (AUX.ABUTMENT),3/8/71,N14E
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS

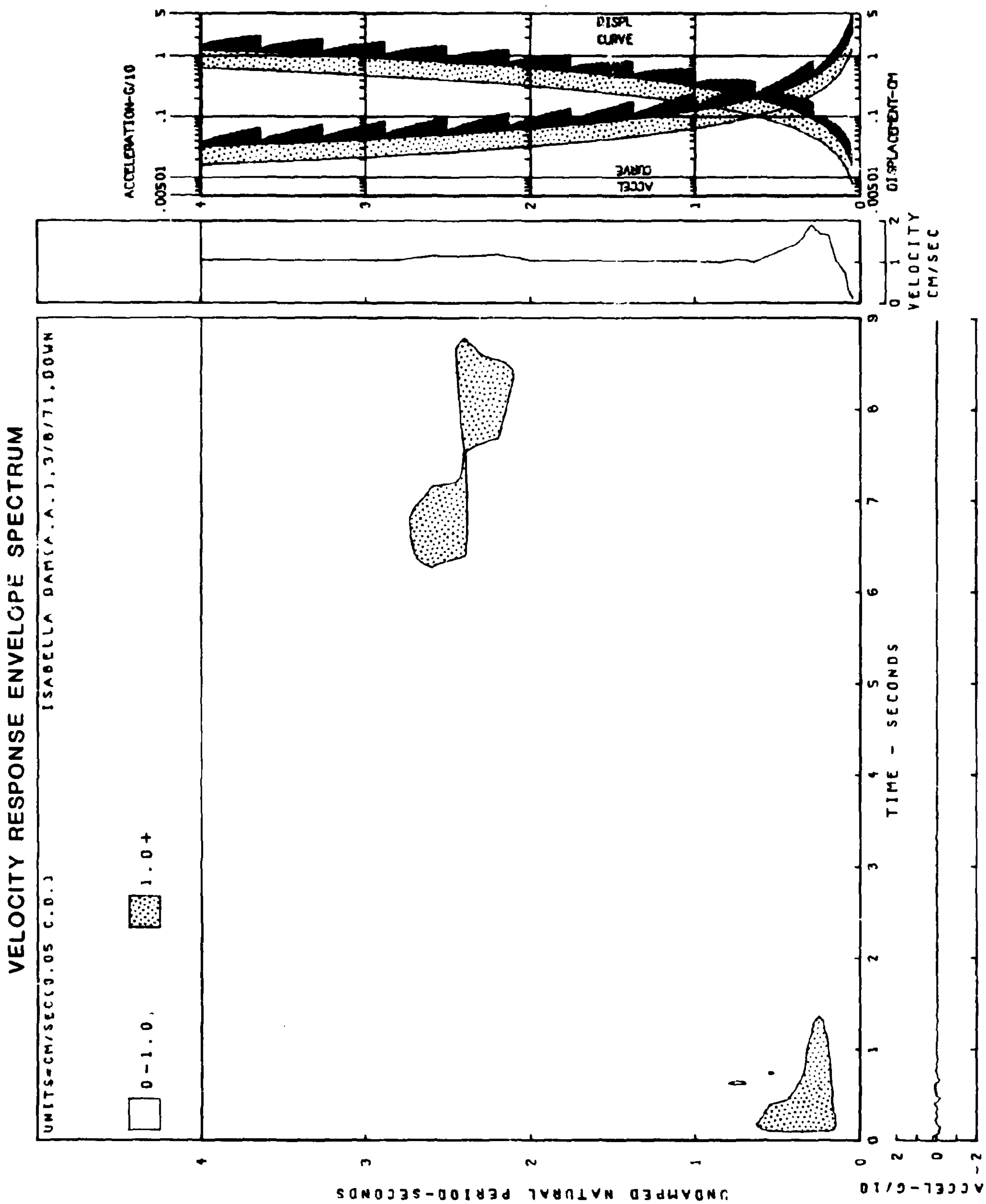



RESPONSE SPECTRA
ISABELLA DAM (AUX. ABUTMENT), 3/8/71, N76W
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20

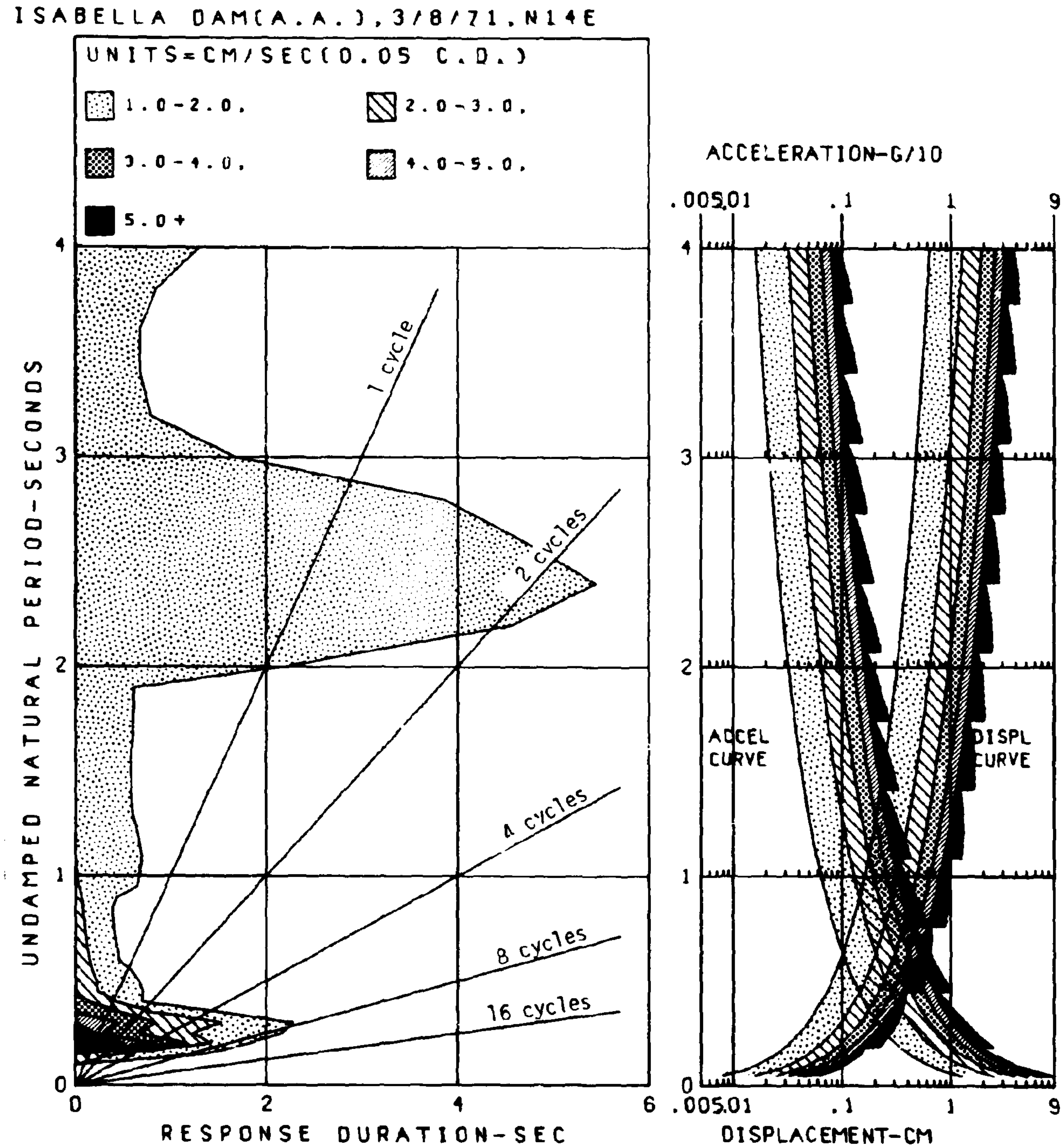

RESPONSE SPECTRA
ISABELLA DAM (AUX.ABUTMENT),3/8/71,DOWN
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20


VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
ISABELLA DAM(A.A.),3/8/71,N14E
0-1.0,
1.0-2.0,
2.0-3.0,
3.0-4.0,
4.0-5.0,
5.0+
TIME - SECONDS
UNDAMPED NATURAL PERIOD-SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
DISPL CURVE
ACCEL CURVE

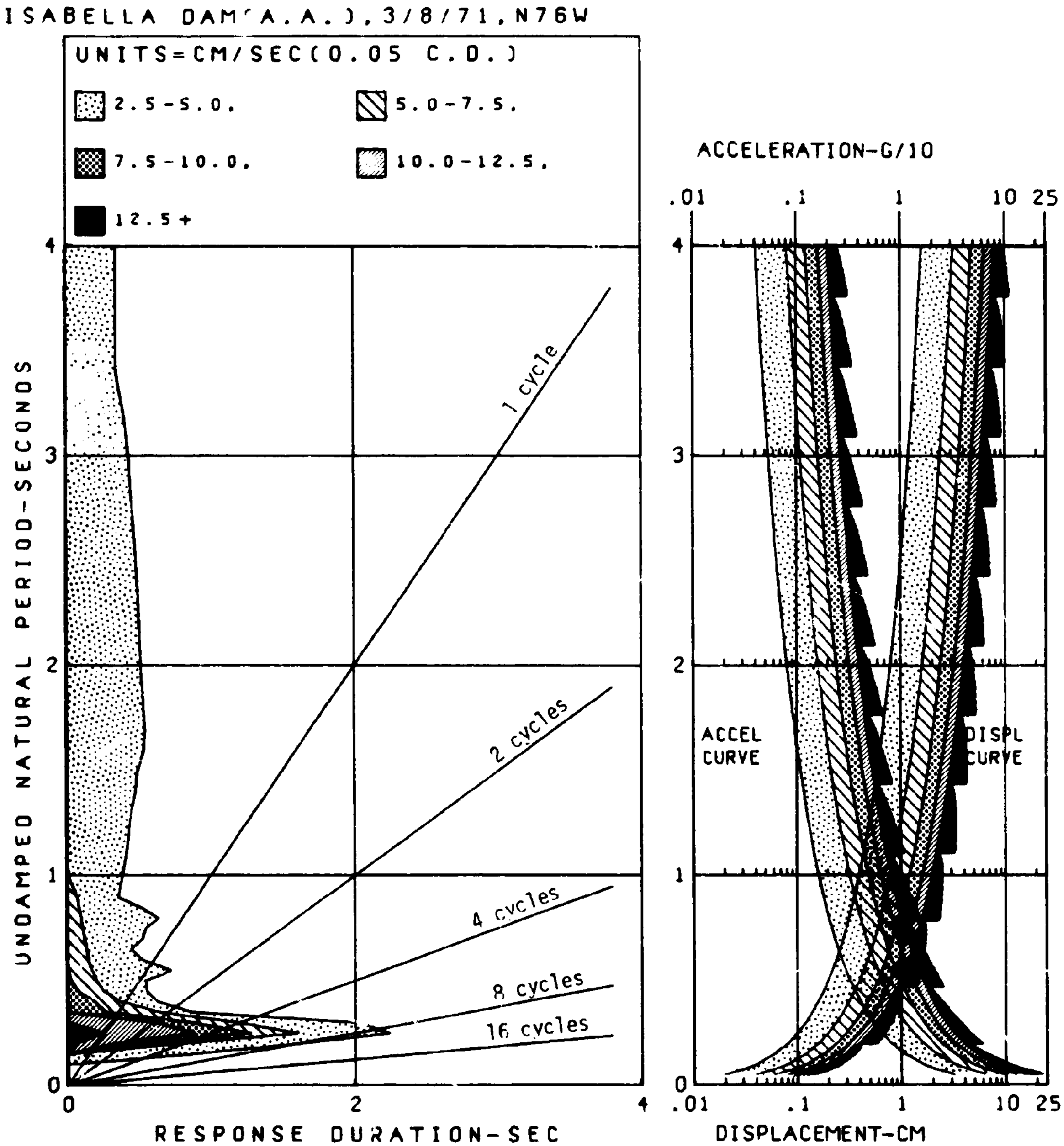

VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
ISABELLA DAM(A.A.),3/8/71,N76W
0-2.5,
2.5-5.0,
5.0-7.5,
7.5-10.0,
10.0-12.5,
12.5+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE


VELOCITY RESPONSE ENVELOPE SPECTRUM
ISABELLA DAM(A.A.),3/8/71,DOWN
UNITS=CM/SEC(0.05 C.D.)
0-1.0,
1.0+
TIME - SECONDS
UNDAMPED NATURAL PERIOD-SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
DISPL CURVE
ACCEL CURVE

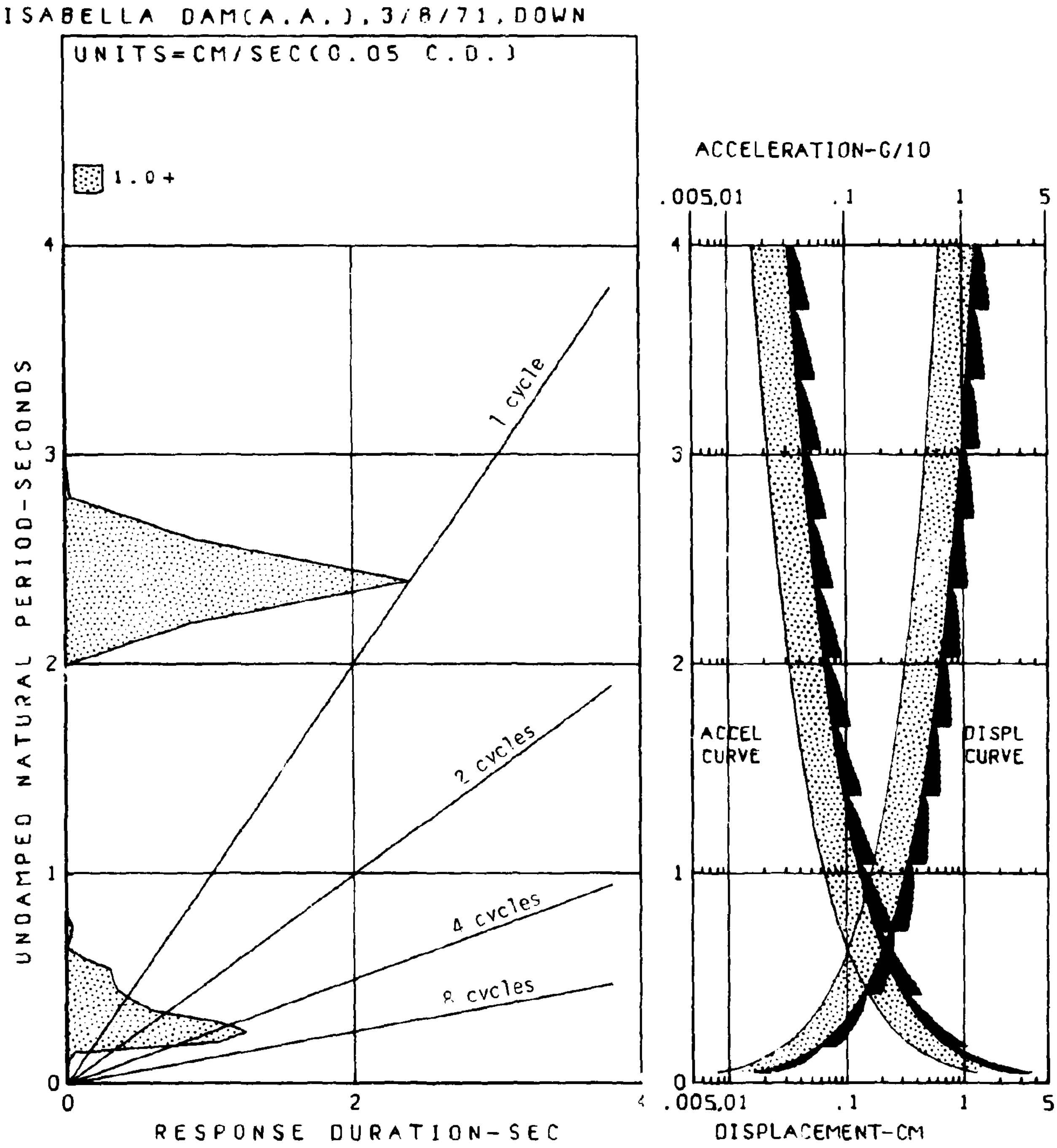
TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



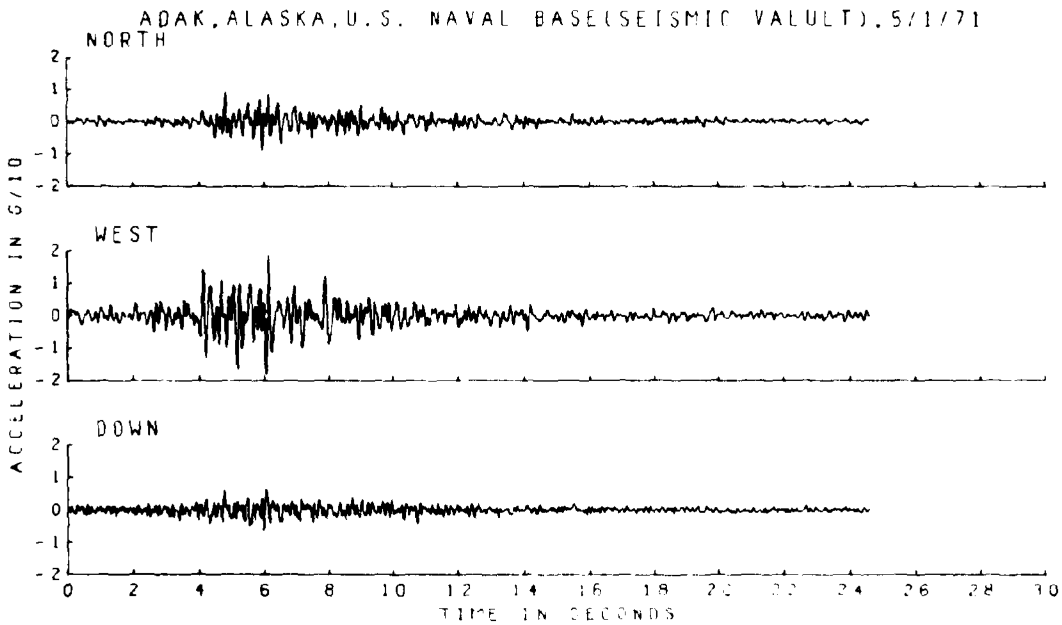
TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



UNCORRECTED ACCELEROGRAM



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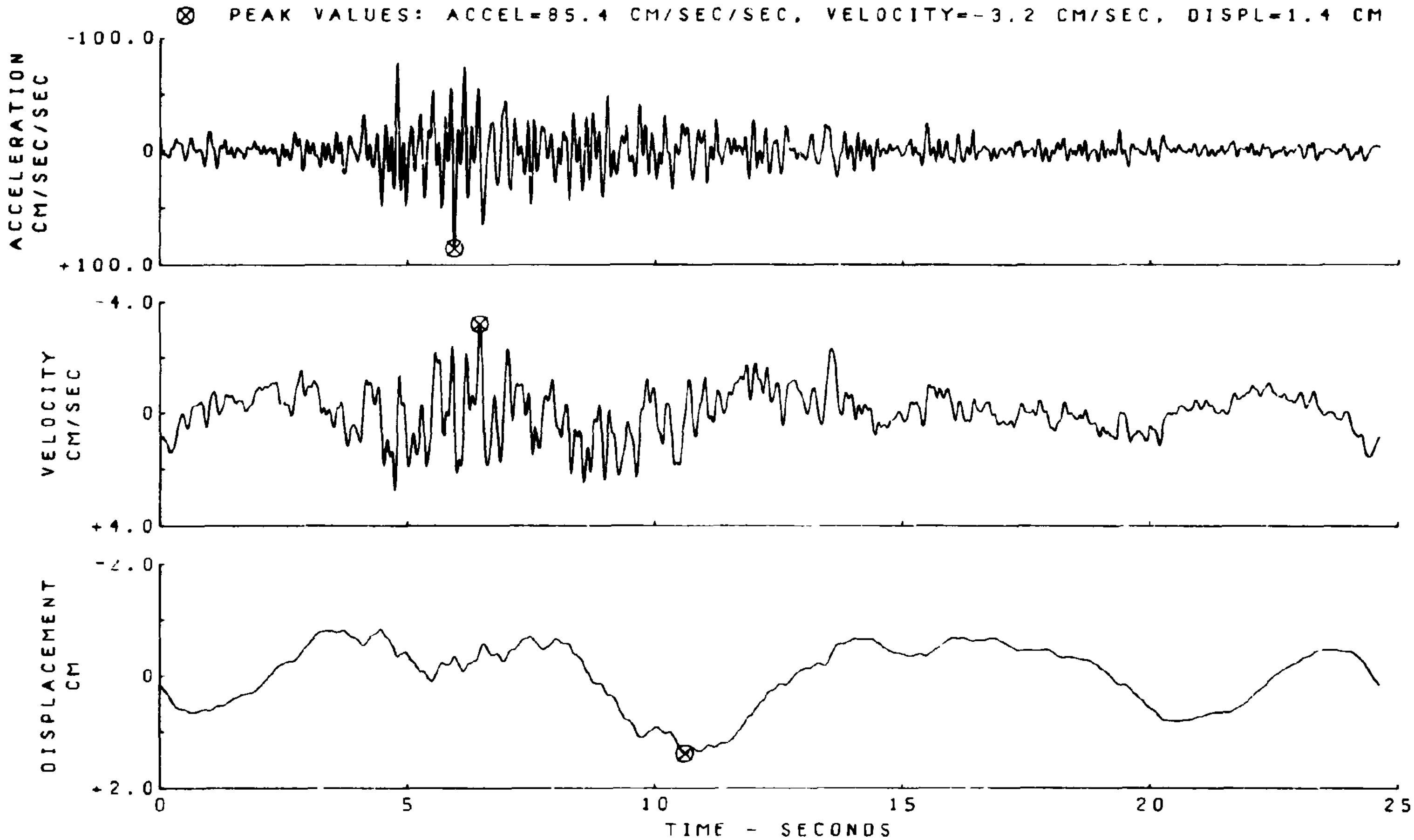
CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

ADAK, ALASKA EARTHQUAKE OF MAY 1, 1971

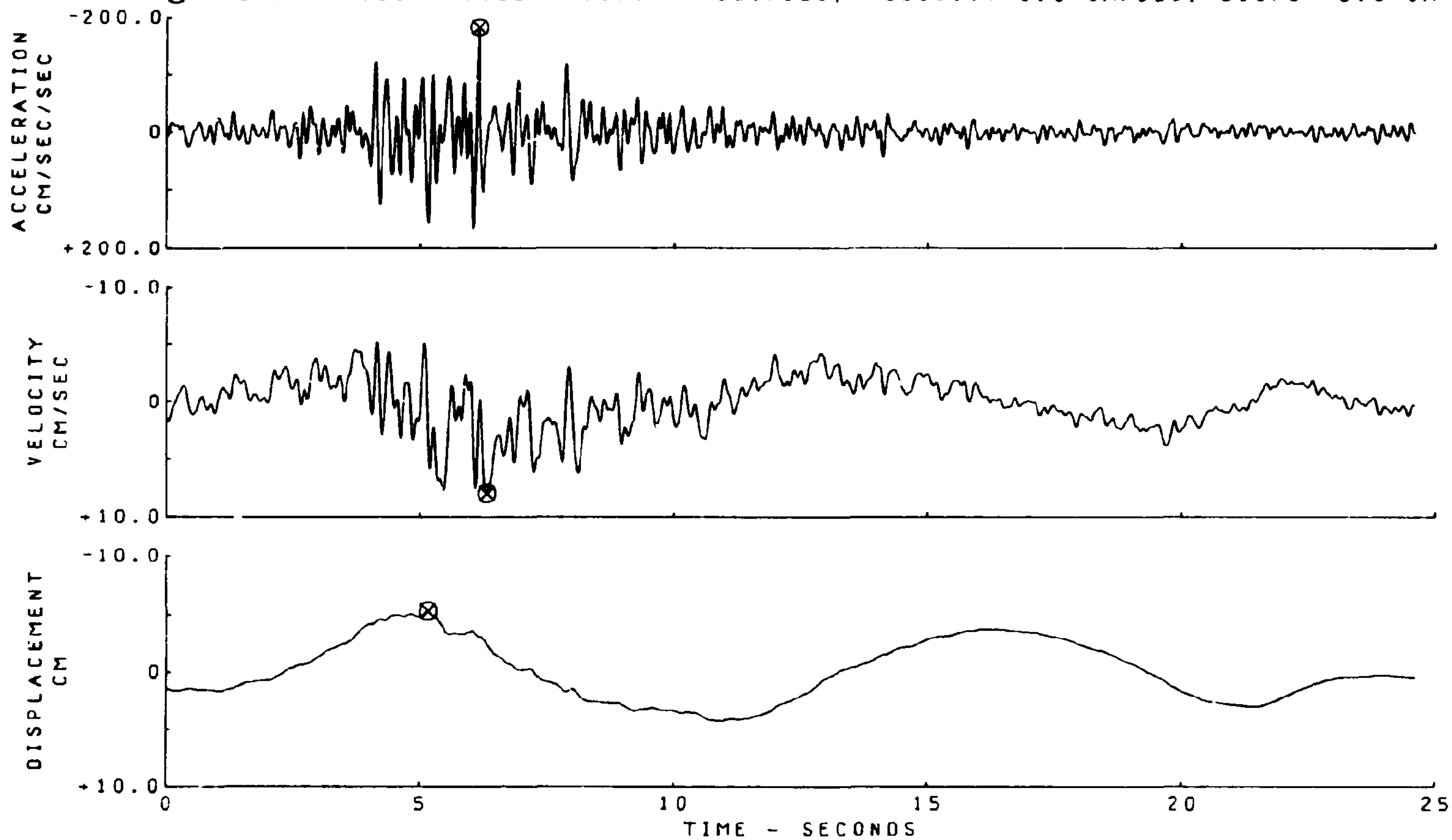
U.S.NAVAL BASE(SEISMIC VAULT),COMP NORTH



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

ADAK, ALASKA EARTHQUAKE OF MAY 1, 1971
U.S. NAVAL BASE(SEISMIC VAULT) COMP WEST

⊗ PEAK VALUES: ACCEL=-182.8 CM/SEC/SEC, VELOCITY=8.0 CM/SEC, DISPL=-5.3 CM

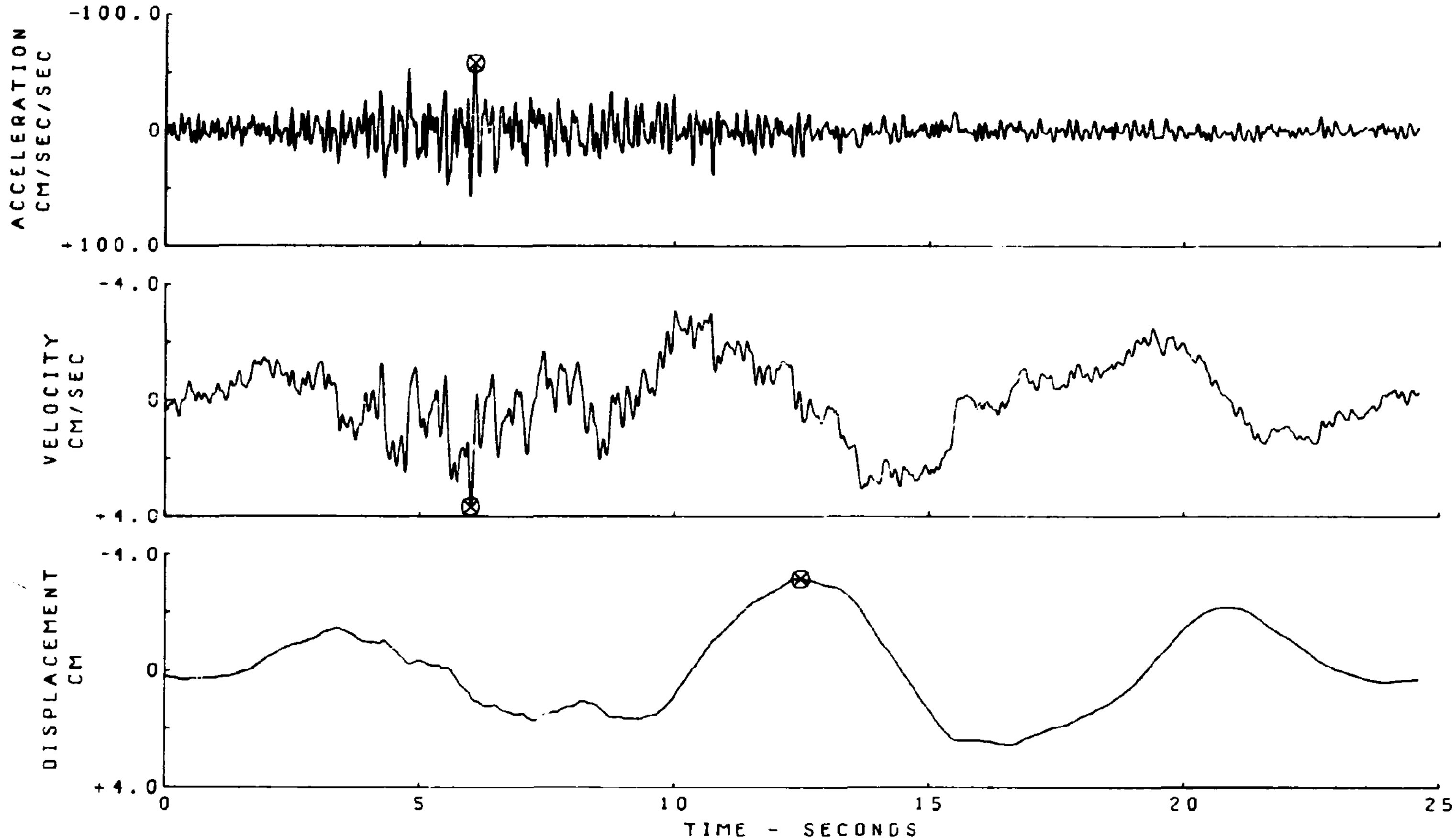


CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

ADAK, ALASKA EARTHQUAKE OF MAY 1, 1971

U.S. NAVAL BASE(SEISMIC VAULT) COMP DOWN

⊗ PEAK VALUES: ACCEL=-58.3 CM/SEC/SEC, VELOCITY=3.7 CM/SEC, DISPL=-3.2 CM



CORRECTED ACCELERATION ORDINATES

ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,NORTH

INSTR PERIOD = .0550 SEC DAMPING = .590 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 85.4 CM/SEC/SEC AT 5.94 SEC VELO = -3.2 CM/SEC AT 6.46 SEC DISP = 1.4 CM AT 10.60 SEC
LENGTH OF RECORD = 24.62 SEC INITIAL VELO = .96725 CM/SEC INITIAL DISP = .10189 CM
1232 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																								
0.	-141	-3	17	30	40	21	24	37	57	60	15	-33	-23	-20	-49	-91	-112	-83	-66	-72
.4	-70	-65	-35	16	65	86	73	44	-1	-56	-98	-115	-96	-41	-9	-15	5	2	-23	-10
.8	-18	-15	22	51	116	144	116	43	-80	-173	-172	-129	-68	-27	-26	12	97	162	137	31
1.2	-36	-48	-43	-18	-47	-98	-88	-15	31	22	18	-15	-37	25	55	67	31	-31	-36	-7
1.6	-4	12	11	15	57	76	41	0	-35	-33	-29	-12	-21	-30	-57	-94	-64	-17	-17	-42
2.0	-7	29	37	12	-31	-53	-11	26	4	-5	-22	-36	-26	3	24	-13	-31	12	59	127
2.4	140	91	11	-62	-58	31	61	25	-25	-5	65	88	67	-2	-101	-171	-151	-88	-44	-48
2.8	-98	-112	-36	88	170	170	83	-43	-47	-68	4	36	-7	-49	-72	-28	50	44	41	70
3.2	100	150	150	32	-75	-65	31	91	39	-62	-57	7	70	111	112	55	-72	-167	-140	-12
3.6	33	-37	-82	-32	95	192	208	182	133	32	-78	-140	-105	-58	-25	-5	10	33	69	104
4.0	84	29	-1	-113	-240	-321	-322	-173	28	90	18	-65	-22	82	140	151	84	-37	-159	-155
4.4	-8	91	195	385	489	284	-16	-223	-241	-39	180	173	-26	-129	55	313	340	72	-382	-727
4.8	-789	-331	242	353	117	-76	-45	225	491	400	113	-72	-176	-219	-185	-16	163	183	66	-1
5.2	-71	-153	-288	-329	-106	137	321	422	287	-14	-185	-176	-104	-163	-387	-536	-405	-142	79	135
5.6	40	-77	-3	281	506	459	205	-133	-308	-127	97	88	-204	-564	-538	-36	545	854	749	264
6.0	-188	-180	30	127	-16	-322	-616	-749	-413	131	421	396	206	-86	-220	-39	85	112	42	-136
6.4	-371	-563	-413	-36	334	568	655	558	332	129	7	-66	-141	-213	-244	-249	-255	-141	40	201
6.8	299	311	269	152	-57	-293	-361	-376	-440	-416	-191	100	300	339	357	257	14	-217	-288	-163
7.2	-31	49	35	-23	-43	7	100	196	220	98	-136	-271	-86	257	475	410	29	-283	-244	9
7.6	189	161	60	-43	-160	-216	-208	-176	-140	-54	50	80	10	-97	-153	-145	-37	110	247	291
8.0	212	72	-29	58	127	-26	-189	-163	-88	-119	-58	117	334	447	330	94	-170	-343	-286	-70
8.4	89	106	-47	-130	60	273	362	272	-1	-245	-307	-139	104	266	182	-108	-301	-342	-241	-34
8.8	82	-4	-139	-168	-13	224	401	414	284	72	-195	-481	-479	-199	103	248	145	-8	31	160
9.2	213	213	122	23	-53	-118	-133	-89	-53	-104	-223	-205	-23	83	105	88	41	59	159	239
9.6	220	46	-186	-377	-420	-258	-7	56	-91	-230	-230	-78	107	218	188	-34	-167	-101	-16	48
10.0	198	264	215	66	5	113	130	-1	-191	-311	-228	-36	22	11	18	112	250	348	313	78
10.4	-67	-37	21	45	21	-92	-211	-237	-192	-129	-128	-186	-212	-159	-22	98	190	261	261	184
10.8	83	-47	-156	-194	-128	-67	-63	-85	-159	-189	-50	180	292	240	83	-37	-46	50	95	19
11.2	-174	-278	-160	10	49	51	103	136	66	19	-18	-63	-88	-112	-98	-22	41	36	-43	-111
11.6	-83	-1	15	-37	-50	-30	-19	29	47	-23	-109	-121	-33	84	223	261	123	-79	-229	-275
12.0	-164	51	162	104	11	-9	50	117	110	-2	-153	-206	-135	21	153	209	192	90	-34	-82
12.4	-64	-94	-100	-23	65	138	199	211	162	41	-95	-210	-223	-161	-88	-24	-2	-22	-10	-6
12.8	-25	17	78	81	34	2	22	63	38	29	53	78	89	55	-6	-59	-109	-151	-130	-39
13.2	28	65	98	121	129	122	85	35	6	-28	-133	-227	-232	-189	-204	-208	-140	-34	22	54
13.6	84	155	222	242	218	131	51	25	22	-34	-147	-179	-80	24	84	36	-42	-48	-4	72
14.0	178	186	54	-49	-165	-55	71	99	42	-47	-99	-61	10	56	59	-7	-57	-11	109	191
14.4	171	58	-28	-98	-110	-27	55	50	-1	-20	-26	-7	23	37	13	-35	-66	-50	-9	7
14.8	-11	-30	-19	-31	-45	-28	-1	22	52	48	39	40	4	-46	-55	-54	-81	-110	-45	48
15.2	44	-28	-39	7	36	37	25	38	98	137	86	15	-129	-222	-239	-163	-18	52	37	-11
15.6	-31	8	79	103	37	-74	-112	-29	54	70	59	28	-36	-84	-71	-3	54	82	75	65
16.0	90	121	93	22	-78	-147	-126	-46	33	77	100	101	76	14	32	-28	19	43	-2	-114
16.4	-188	-130	14	82	83	39	7	10	15	-3	-33	-42	-45	-26	-15	-14	-3	30	75	95
16.8	52	-19	-31	16	66	71	55	11	-20	-25	-24	-15	13	31	26	14	-14	-33	-33	-4
17.2	39	67	30	-31	-81	-73	-38	-50	-87	-69	-16	30	67	49	-2	5	20	2	-3	-11
17.6	-30	-20	28	64	30	-52	-96	-100	-59	5	69	101	62	-7	-34	15	71	103	98	42
18.0	-8	-6	29	33	1	-51	-79	-51	-3	-12	-54	-101	-116	-68	15	75	91	49	-6	-26
18.4	-1	37	21	-3	26	48	14	-38	-62	-15	43	45	-29	-97	-69	37	96	77	41	27
18.8	17	4	-12	-17	-14	9	65	104	77	2	-73	-96	-27	60	70	7	-33	-11	41	52
19.2	8	-21	-4	23	40	33	-42	-147	-189	-134	-16	45	-1	-14	11	54	103	152	157	79
19.6	-18	-64	-57	-35	-5	0	-20	-28	-9	16	29	15	19	44	47	29	-6	-57	-111	-99

ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,NORTH

SEC.																				
20.0	-21	26	44	11	-11	16	69	104	93	23	-58	-118	-139	-117	-71	-43	-28	-16	-15	-8
20.4	19	23	2	-28	-14	22	6	-38	-56	-43	-15	4	11	12	16	18	19	15	-1	-22
20.8	-4	20	-8	-57	-67	-55	-17	41	54	48	36	11	-17	-35	-52	-52	-25	16	51	44
21.2	17	-18	-15	17	42	54	32	-2	-5	13	-4	-44	-23	23	35	26	10	4	-2	-44
21.6	-65	-56	-68	-88	-62	-7	43	62	33	-10	-24	-18	-15	-10	-3	-8	-33	-36	18	25
22.0	-20	-62	-65	-23	40	46	8	3	36	51	40	-2	-48	-59	-32	-9	-11	-30	-35	-26
22.4	-2	41	68	55	20	6	23	26	3	-3	9	14	0	-30	-43	-9	45	55	33	15
22.8	3	-3	-1	10	21	9	-11	-28	-45	-52	-45	-25	13	56	74	72	62	26	-29	-52
23.2	-36	-21	-42	-69	-59	5	68	97	86	47	17	14	34	38	24	-0	-9	-14	-18	-16
23.6	-13	-4	11	13	10	16	32	43	31	4	-12	0	9	-13	-48	-59	-31	-2	-8	2
24.0	48	87	90	69	55	37	16	17	36	29	-8	-45	-32	9	50	81	94	83	55	29
24.4	20	7	-14	-32	-43	-45	-46	[illegible]	-45	-41	-36	-35								

CORRECTED ACCELERATION ORDINATES

ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,WEST

INSTR PERIOD = .0550 SEC DAMPING = .540 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.

PEAK VALS ACLN = -182.8 CM/SEC/SEC AT 6.14 SEC VELO = 8.0 CM/SEC AT 6.32 SEC DISP = -5.3 CM AT 5.16 SEC

LENGTH OF RECORD = 24.60 SEC INITIAL VELO = 1.51059 CM/SEC INITIAL DISP = 1.46318 CM

1231 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	81	68	2	-107	-179	-188	-161	-118	-102	-123	-137	-104	-41	-40	-108	-121	-57	13	80	166
.4	254	276	231	167	91	35	-27	-50	-45	-79	-150	-186	-162	-98	-77	71	138	148	124	92
.8	93	-53	-130	-106	8	156	213	96	-56	-188	-260	-235	-187	-144	-97	-17	65	83	40	18
1.2	84	143	86	-71	-273	-370	-308	-120	50	93	138	122	70	4	-87	-109	-11	117	196	219
1.6	212	158	50	-70	-136	-94	-32	18	52	76	91	69	23	-36	-85	-62	-5	60	113	93
2.0	2	-121	-260	-362	-393	-262	-44	98	166	131	11	-100	-95	-72	-67	-84	-99	-67	19	166
2.4	275	283	210	94	-10	-109	-170	-175	-77	200	475	456	163	-203	-354	-255	60	203	204	21
2.8	-251	-496	-434	-270	-145	-118	-140	-77	163	407	388	163	-87	-237	-262	-139	-8	118	227	290
3.2	270	155	-17	-116	-84	49	101	-17	-231	-246	-109	53	250	374	389	229	-176	-483	-442	-166
3.6	8	-155	-339	-378	-219	-49	30	52	59	7	-79	12	249	307	174	35	20	94	152	271
4.0	504	622	398	-45	-582	-1224	-1227	-340	488	993	1269	1012	540	-51	-377	-641	-914	-927	-666	-215
4.4	205	684	754	636	342	-59	-283	-200	251	685	759	236	-498	-943	-910	-242	52	2	-40	115
4.8	542	881	836	284	-245	-494	-350	34	133	-54	-603	-947	-947	-801	-216	437	857	1331	1576	1290
5.2	271	-632	-1009	-470	259	849	909	477	21	-137	52	206	183	105	-34	-340	-723	-944	-981	-884
5.6	-637	-153	362	791	571	-17	-269	-282	-159	175	428	196	-456	-863	-759	-178	472	367	5	-346
6.0	-167	721	1678	1525	808	79	-1147	-1828	-1006	65	691	914	1058	779	393	237	54	-110	-184	-168
6.4	-221	-332	-449	-461	-345	-213	-97	-22	16	170	357	308	112	-14	-178	-318	-483	-526	-263	81
6.8	433	762	714	195	-320	-704	-917	-786	-381	73	271	190	53	-147	-284	-314	-125	353	762	930
7.2	894	632	237	-197	-413	-217	54	65	-139	-416	-540	-431	-168	48	22	-107	-95	56	140	127
7.6	11	-76	-51	55	162	242	263	211	232	343	326	-64	-699	-1195	-1126	-808	-407	39	540	847
8.0	840	724	569	519	429	226	-14	-228	-427	-560	-554	-320	45	128	41	-236	-507	-545	-264	73
8.4	197	173	103	44	83	199	249	144	-154	-434	-416	-136	133	226	168	15	-54	25	55	22
8.8	-105	-259	-342	-208	214	574	679	661	339	-145	-402	-309	-30	195	220	42	-140	-252	-186	-116
9.2	-140	-312	-540	-616	-486	-108	327	524	564	393	13	-375	-372	-149	-88	-73	39	230	361	387
9.6	391	317	90	-184	-265	-114	-41	-164	-348	-307	-29	147	217	137	-196	-351	13	276	392	377
10.0	250	81	-23	-63	-126	-237	-363	-461	-422	-219	51	206	339	371	293	170	70	-62	-248	-255
10.4	-88	194	298	264	261	289	179	27	-3	30	60	-28	-226	-400	-454	-382	-203	52	197	183
10.8	8	-163	-139	-37	16	-11	-252	-456	-329	[illegible]	134	285	249	73	46	165	277	283	149	-53
11.2	-207	-172	-102	-129	-207	-213	-128	-10	110	177	125	-28	-119	-110	-87	-92	-139	-186	-125	84
11.6	229	237	112	-44	-111	-72	-11	-4	-65	-91	-49	-19	-4	28	-62	-211	-344	-370	-230	-2
12.0	161	331	301	182	63	63	168	166	52	-75	-157	-63	87	117	34	-191	-303	-199	-31	103
12.4	164	86	-28	-129	-143	-29	154	235	200	53	-130	-248	-287	-211	-92	-40	-38	-38	-3	76
12.8	43	-66	-166	-168	-33	31	26	60	166	279	282	201	93	-13	-54	-106	-154	-157	-96	-34
13.2	-18	-29	-8	117	308	318	192	72	-70	-145	-106	28	137	119	120	145	124	11	-149	-287
13.6	-279	-164	-63	47	186	283	201	9	-129	-154	-117	-68	-38	-26	-36	-89	-180	-216	-134	7
14.0	114	90	-19	-32	178	401	438	265	-33	-288	-339	-243	-110	-52	-31	-29	-22	9	61	85
14.4	74	88	131	161	163	121	61	69	86	34	-61	-67	-27	-12	-89	-176	-210	-181	-106	-41
14.8	-4	-9	-13	26	83	78	-0	-54	-47	-45	-3	83	153	167	117	35	-42	-80	-65	27
15.2	161	231	227	157	19	-108	-150	-90	19	55	-23	-137	-164	-134	-94	-59	-17	20	20	-14
15.6	-3	79	124	41	-80	-101	-24	134	274	300	181	26	-113	-188	-220	-216	-116	-19	36	105
16.0	140	131	103	70	54	26	-18	-43	-2	107	137	64	-74	-90	-4	17	24	18	6	-38
16.4	-61	-17	88	168	148	43	-36	-33	-3	10	1	-26	-60	-107	-158	-117	20	127	157	101
16.8	44	-5	-64	-83	-50	-10	-15	-29	-25	6	30	25	15	-2	0	8	47	160	208	120
17.2	52	-45	-102	-119	-104	-4	127	129	20	-99	-111	-85	-54	-22	26	69	85	66	32	1
17.6	-30	-21	33	88	91	33	-51	-82	-60	2	44	58	89	128	154	151	79	-63	-191	-227
18.0	-135	-25	38	58	36	27	28	34	52	60	15	-69	-126	-129	-83	-28	-17	-40	-70	-53
18.4	-10	58	174	251	213	122	17	-85	-56	-49	-90	-91	4	162	169	96	26	7	4	32
18.8	24	-16	-79	-115	-94	-51	-46	-89	-107	-77	-24	81	181	174	123	34	6	58	91	37
19.2	-45	-77	-36	44	69	42	-28	-82	-77	-29	1	2	-5	-29	-40	-18	-7	4	65	143
19.6	194	212	190	124	39	-4	-59	-137	-143	-162	-221	-251	-178	0	160	190	140	60	-12	-54

ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,WEST

SEC.																				
20.0	-63	-63	-60	-70	-121	-156	-113	-53	18	56	71	79	76	70	67	73	72	37	-27	-107
20.4	-158	-145	-101	-78	-82	-80	-46	15	26	2	-37	-65	-66	-51	28	108	80	10	-21	3
20.8	22	32	23	-12	-16	25	20	-51	-103	-121	-109	-48	26	95	113	82	38	-11	-44	-67
21.2	-65	11	84	83	11	-97	-166	-153	-96	-46	[illegible]	65	72	24	-50	-107	-115	-92	-71	-68
21.6	-95	-118	-96	-39	37	117	125	11	-62	-58	-18	13	11	-19	-58	-86	-101	-91	-51	7
22.0	57	71	68	69	41	-25	-62	-50	1	36	38	16	1	-2	-6	-4	-4	-8	-20	-2
22.4	48	72	66	38	-3	-33	-69	-108	-121	-37	94	163	188	167	73	-51	-97	-94	-73	-24
22.8	31	74	85	70	33	22	43	83	63	-33	-80	-71	-19	62	84	57	-13	-70	-46	46
23.2	127	156	130	85	51	36	9	-52	-120	-162	-145	-90	-1	64	82	78	47	6	1	36
23.6	59	26	-57	-108	-70	-26	-30	-48	-45	-41	29	168	219	200	143	49	-66	-147	-143	-67
24.0	31	66	50	29	54	81	49	-33	-116	-108	-43	37	68	70	22	-57	-112	-91	-12	51
24.4	89	151	162	50	-111	-170	-154	-82	-7	32	28									

CORRECTED ACCELERATION ORDINATES

ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,DOWN

INSTR PERIOD = .0510 SEC DAMPING = .590 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.

PEAK VALS ACLN = -58.3 CM/SEC/SEC AT 6.06 SEC VELO = 3.7 CM/SEC AT 6.00 SEC DISP = -3.2 CM AT 12.48 SEC

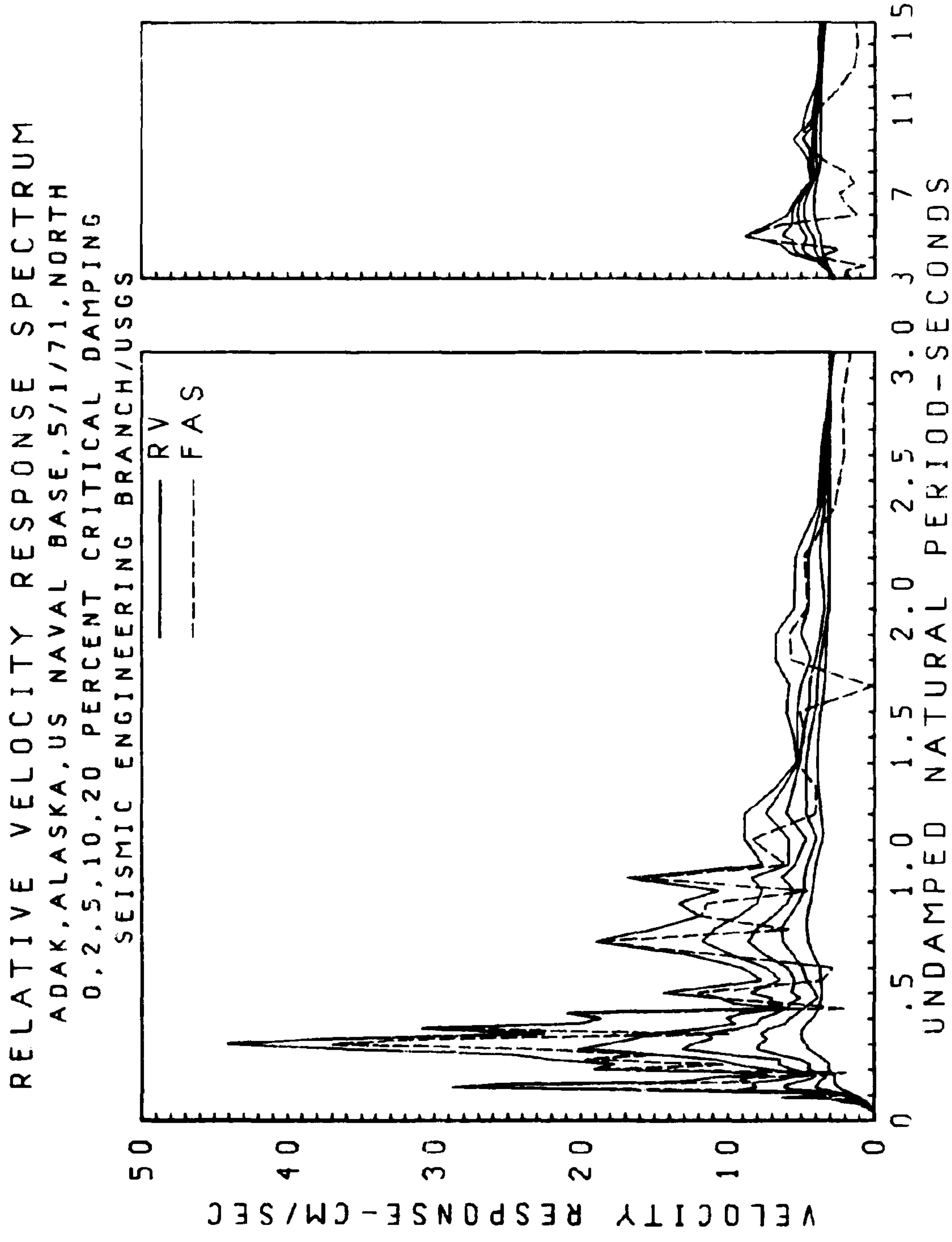
LENGTH OF RECORD = 24.60 SEC INITIAL VELO = .27483 CM/SEC INITIAL DISP = .21837 CM

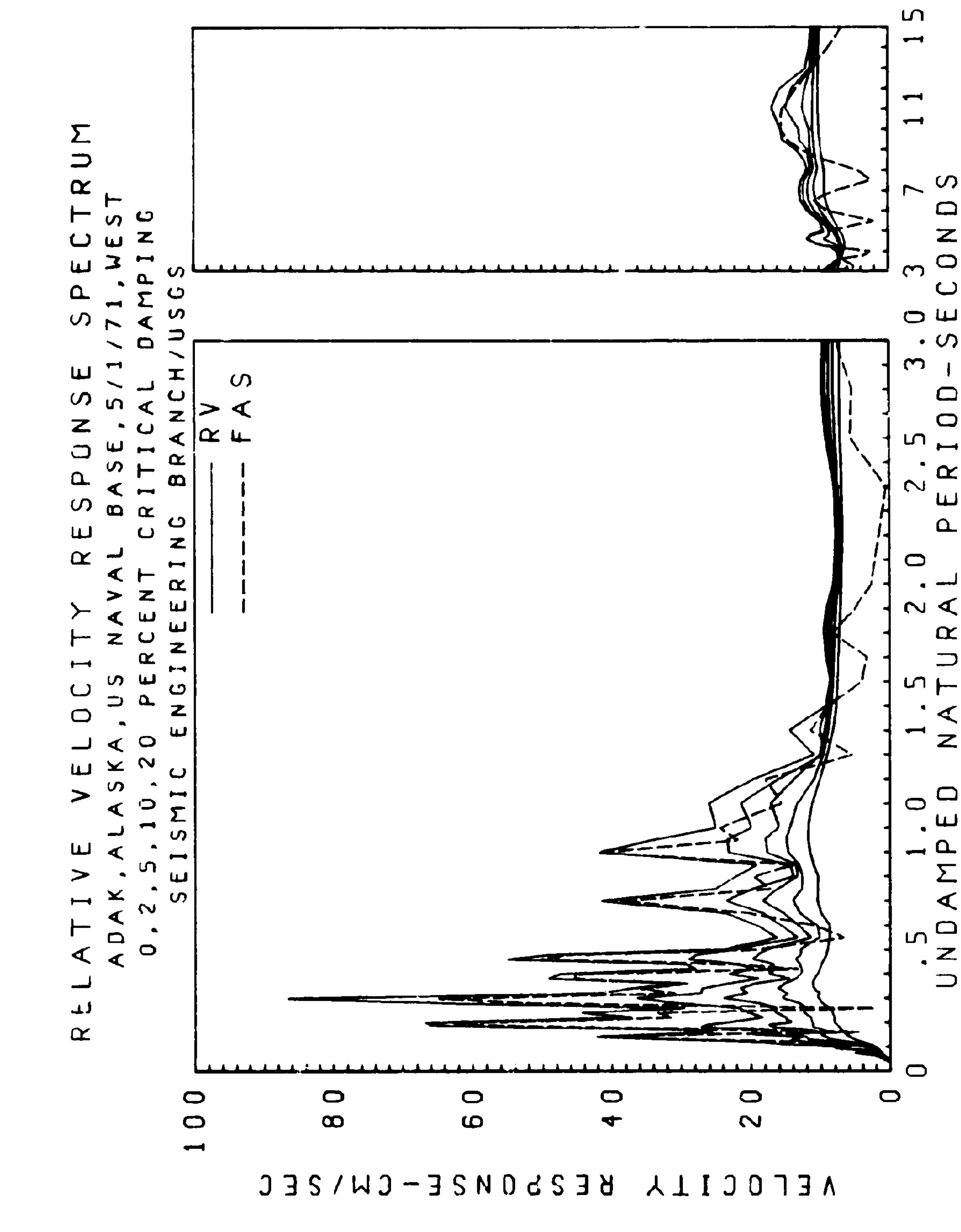
1231 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	38	1	-41	-54	-15	48	-46	-76	8	51	77	70	85	33	-120	-152	-42	22	7	-61
.4	-69	-96	-114	-22	88	104	29	-4	92	110	-87	-158	38	80	42	40	-87	-63	12	22
.8	37	39	58	22	-70	-90	-19	18	-11	-75	-109	-29	89	81	4	-30	38	51	71	54
1.2	-68	-64	-108	-120	-33	64	78	-36	-31	1	-126	-96	-22	55	143	84	-36	21	47	-3
1.6	-53	-62	-12	-47	-138	-113	-55	12	63	15	-61	-3	69	6	-59	-59	-21	-1	52	32
2.0	-45	18	123	81	39	93	-84	-172	-113	39	44	-8	65	109	37	4	-2	-30	-28	3
2.4	141	127	-71	-204	-69	116	180	65	17	10	46	60	-46	-151	-135	-4	89	83	-111	-174
2.8	-9	107	118	88	28	-37	-99	-134	-84	-88	-58	29	-20	-32	115	198	176	49	-115	-183
3.2	-14	182	39	-27	-12	-8	10	80	202	293	229	32	-145	-183	23	124	38	17	57	-47
3.6	-113	-40	6	62	158	147	58	-74	-114	-89	-44	-1	31	-0	-157	-265	-176	94	252	77
4.0	-128	-67	-157	-112	76	183	183	129	-64	-265	-351	-288	-62	143	363	420	323	184	126	128
4.4	39	-102	-219	-95	139	205	162	7	-181	-129	-89	-123	-49	159	330	260	-146	-475	-535	-304
4.8	-113	-93	-100	-31	-78	-63	183	258	223	149	195	130	-127	-156	132	241	78	-240	-220	-24
5.2	-7	-122	-73	14	-37	-119	-104	160	365	301	83	-157	-247	-352	-353	-16	480	407	365	361
5.6	205	19	-149	-198	38	239	154	-119	-203	-198	-105	-23	-31	21	152	40	-279	-45	491	574
6.0	177	-309	-569	-583	-372	-205	31	349	410	239	-118	-145	-143	-272	-196	-69	-35	21	-6	-132
6.4	-216	-74	191	378	335	311	258	30	-166	-203	-210	-120	32	-41	-44	30	-84	-123	51	169
6.8	141	-63	-247	-241	-111	7	106	72	-96	-54	202	217	107	199	313	133	-123	-292	-205	-60
7.2	-181	-113	-18	-21	-45	-141	-197	-92	-54	-122	-141	-54	36	237	327	121	-160	-131	81	83
7.6	105	229	182	-81	-274	-267	-141	-91	-45	64	103	-48	-29	75	136	227	199	22	-149	-184
8.0	-113	-60	-89	-123	-59	13	102	143	123	106	143	215	223	149	47	-73	-196	-243	-74	117
8.4	182	121	8	16	90	221	251	38	-161	-194	-72	107	161	92	-47	-191	-346	-338	-153	4
8.8	81	108	-38	-155	-59	84	134	147	199	93	-138	-282	-282	-103	100	115	110	143	145	29
9.2	-156	-233	-82	137	124	-55	-242	-241	-118	-39	43	80	88	109	107	45	-72	-80	40	111
9.6	48	-98	-180	-255	-232	-55	92	162	97	-120	-241	-227	-141	64	208	187	4	-206	-320	-231
10.0	-28	91	83	47	71	25	45	14	-45	-15	73	60	-25	-127	-152	-65	138	309	185	-48
10.4	-184	-122	-66	-73	-2	121	45	-77	-99	-36	26	32	6	-64	-115	28	358	397	181	57
10.8	33	-173	-175	75	119	-22	-100	-94	-79	-49	-56	-8	53	44	27	-17	13	68	81	-67
11.2	-167	-58	49	44	5	81	135	82	-67	-194	-130	21	112	89	-13	-4	102	172	214	128
11.6	-94	-149	-117	-26	87	150	120	-34	-143	-98	-43	-53	-4	98	145	94	1	-31	-43	-118
12.0	-112	43	33	-92	-70	-14	9	26	32	6	-21	33	46	-61	5	165	224	228	146	18
12.4	-119	-168	-64	81	191	228	97	-68	-16	-42	-148	-143	-28	48	89	68	42	36	27	-1
12.8	-29	7	77	77	-13	-50	-42	-52	-83	-72	-11	17	27	-12	-16	46	71	9	-52	-16
13.2	84	190	193	28	-38	-12	42	53	50	40	29	5	-12	-19	-13	-23	-8	39	112	139
13.6	144	138	134	90	-4	-64	-51	22	46	-19	-101	-89	-1	36	30	28	12	-5	0	18
14.0	34	12	-45	-114	-139	-113	-28	13	11	20	68	111	85	23	-45	-81	-54	19	84	95
14.4	85	65	-68	-147	-137	-37	52	44	-8	13	52	18	-25	7	52	46	13	-9	-6	-7
14.8	-36	-61	-8	-8	-71	-62	-14	33	50	62	39	-61	-62	40	48	-6	-88	-43	53	47
15.2	-53	-103	-66	-4	-2	-51	-56	-30	-4	11	-9	-54	-110	-164	-170	-160	-132	-86	-10	16
15.6	-13	-16	13	-9	-24	-22	2	16	10	10	15	25	29	-20	6	84	85	-31	-71	-59
16.0	45	79	22	-68	-82	-30	29	59	44	-11	-7	26	32	15	-25	4	72	59	-60	-104
16.4	-75	-27	39	73	-0	-58	-36	-33	-71	-75	-59	-33	-9	-22	-34	7	-3	-76	-96	-45
16.8	-7	-11	-12	-5	41	94	75	46	6	-16	-22	-12	35	68	61	31	-48	-113	-112	-42
17.2	9	14	13	15	22	20	2	-30	-30	1	66	92	82	28	-44	-13	12	1	-20	-24
17.6	-24	-18	14	51	20	-64	-108	-98	-54	1	62	78	-0	-102	-102	-48	16	39	65	85
18.0	48	-12	-25	-19	-18	7	57	60	21	-13	-52	-90	-84	-44	23	55	75	52	0	-37
18.4	-58	-35	4	8	-20	-29	-1	-26	-47	3	75	50	-82	-80	6	6	10	13	12	11
18.8	-11	-51	-71	-69	-61	-19	53	79	47	-34	-91	-105	-72	-23	13	33	30	8	-38	-68
19.2	-20	43	48	39	20	-15	-67	-110	-105	-21	50	62	53	49	56	50	47	62	53	9
19.6	-49	-111	-110	-43	-12	9	4	-6	-17	13	75	83	63	21	-43	-50	-24	-32	-9	18

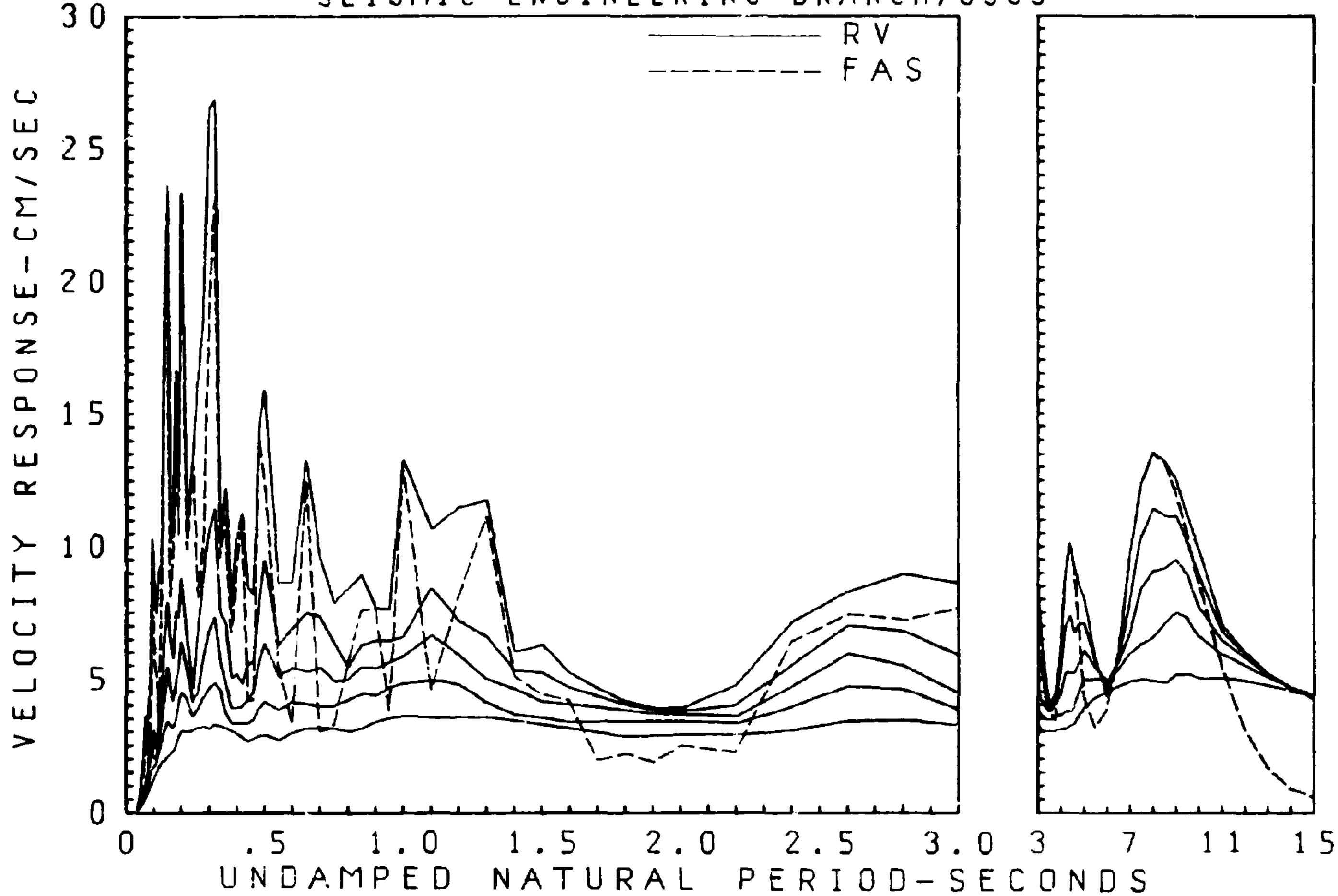
ADAK,ALASKA,US NAVAL BASE(SEISMIC VAULT),5/1/71,DOWN

SEC.																				
20.0	49	60	62	24	1	21	25	24	26	24	21	3	-45	-70	-35	21	53	43	-0	5
20.4	41	80	58	13	31	87	88	30	-46	-55	-23	19	50	55	53	51	34	15	9	-3
20.8	4	30	19	21	18	4	-3	35	77	80	58	13	-38	-77	-61	11	53	73	80	70
21.2	37	-7	-17	-11	-5	16	62	79	90	57	-15	-55	-57	28	87	48	-8	9	22	-1
21.6	-38	-39	-26	-26	-45	-66	-26	8	2	2	17	46	-7	-46	-13	-1	-4	-12	-23	-7
22.0	7	-10	-8	53	49	14	-14	16	51	56	27	-11	-33	-36	14	31	24	12	-7	-38
22.4	-27	4	19	28	26	26	20	13	4	-3	-12	-26	-68	-127	-129	-59	35	65	42	-7
22.8	-47	-46	-9	16	35	44	0	-69	-90	-62	-31	-20	-2	21	31	31	30	25	19	7
23.2	-5	-26	-62	-67	-27	8	39	45	13	3	34	21	-11	-11	3	-0	-24	-38	-29	-11
23.6	-10	-22	-16	-17	-28	-18	14	49	45	-18	-53	-25	-32	-67	-70	-31	22	26	-2	-40
24.0	-19	-2	-3	-3	-10	-32	-19	32	66	58	5	-46	-44	-29	16	59	67	54	31	-27
24.4	-68	-65	-57	-33	3	34	35	14	1	-23	-29									


RELATIVE VELOCITY RESPONSE SPECTRUM
ADAK,ALASKA,US NAVAL BASE,5/1/71,NORTH
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
0
10
20
30
40
50
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
UNDAMPED NATURAL PERIOD-SECONDS


RELATIVE VELOCITY RESPONSE SPECTRUM
ADAK,ALASKA,US NAVAL BASE,5/1/71,WEST
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
0
20
40
60
80
100
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
UNDAMPED NATURAL PERIOD-SECONDS

RELATIVE VELOCITY RESPONSE SPECTRUM
ADAK, ALASKA, US NAVAL BASE, 5/1/71, DOWN
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USCS

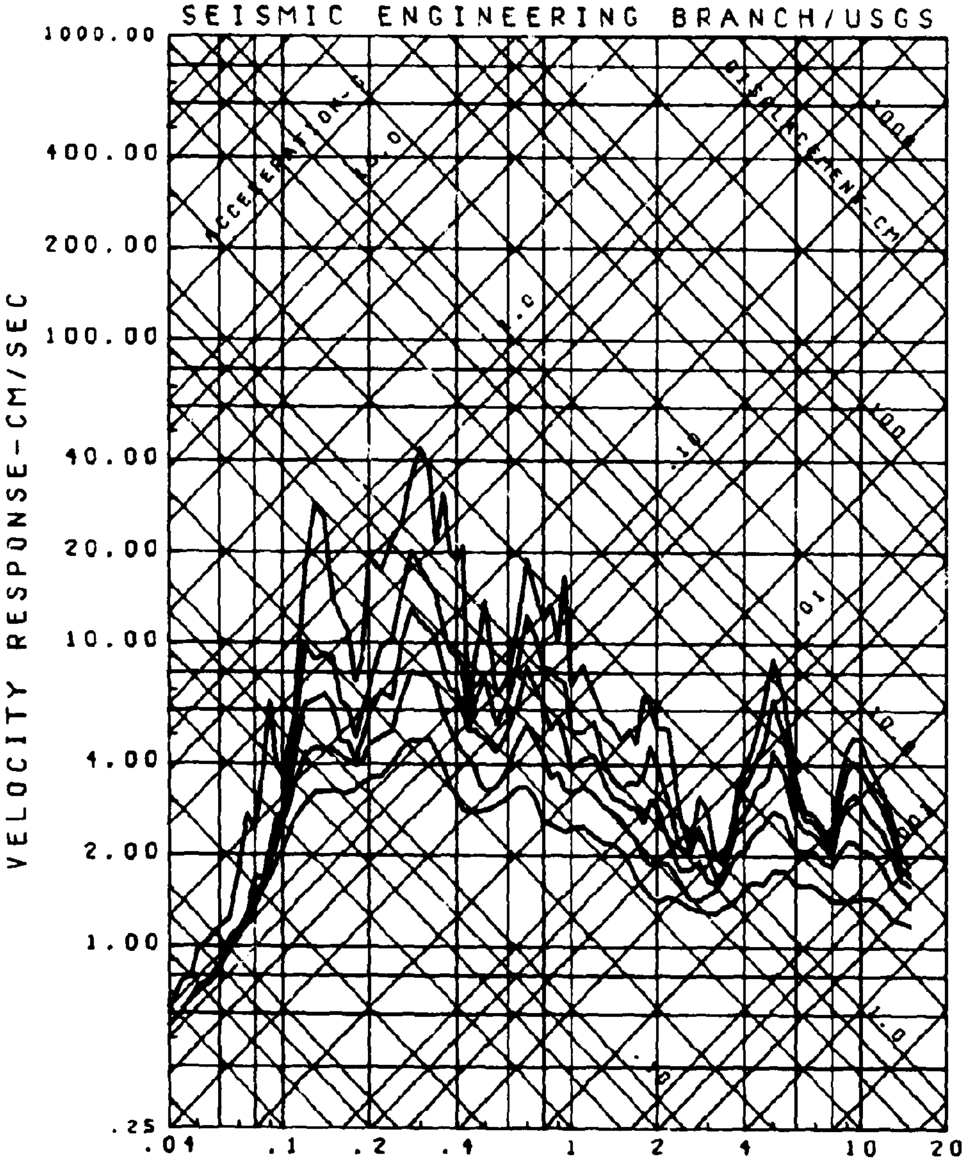


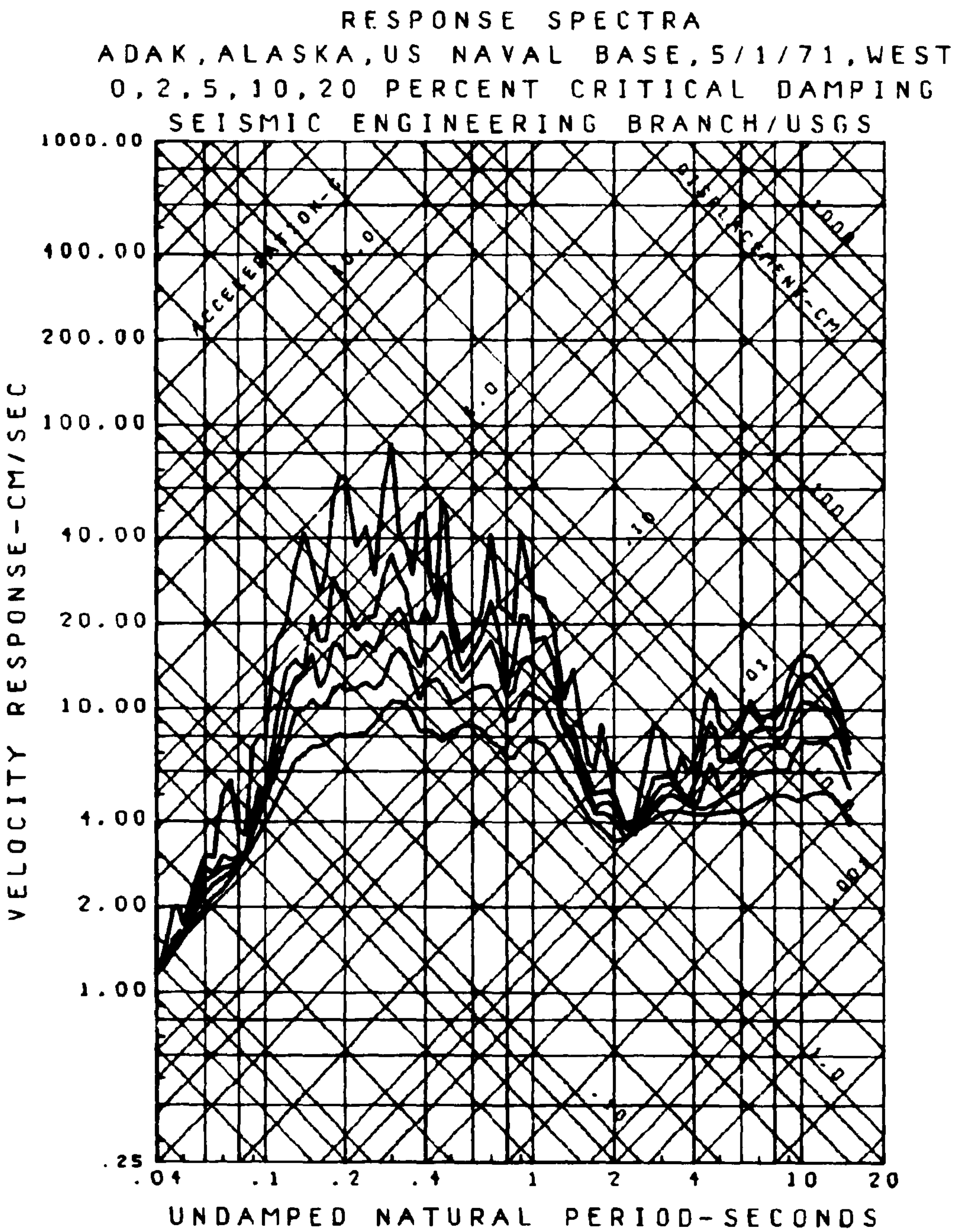
RESPONSE SPECTRA

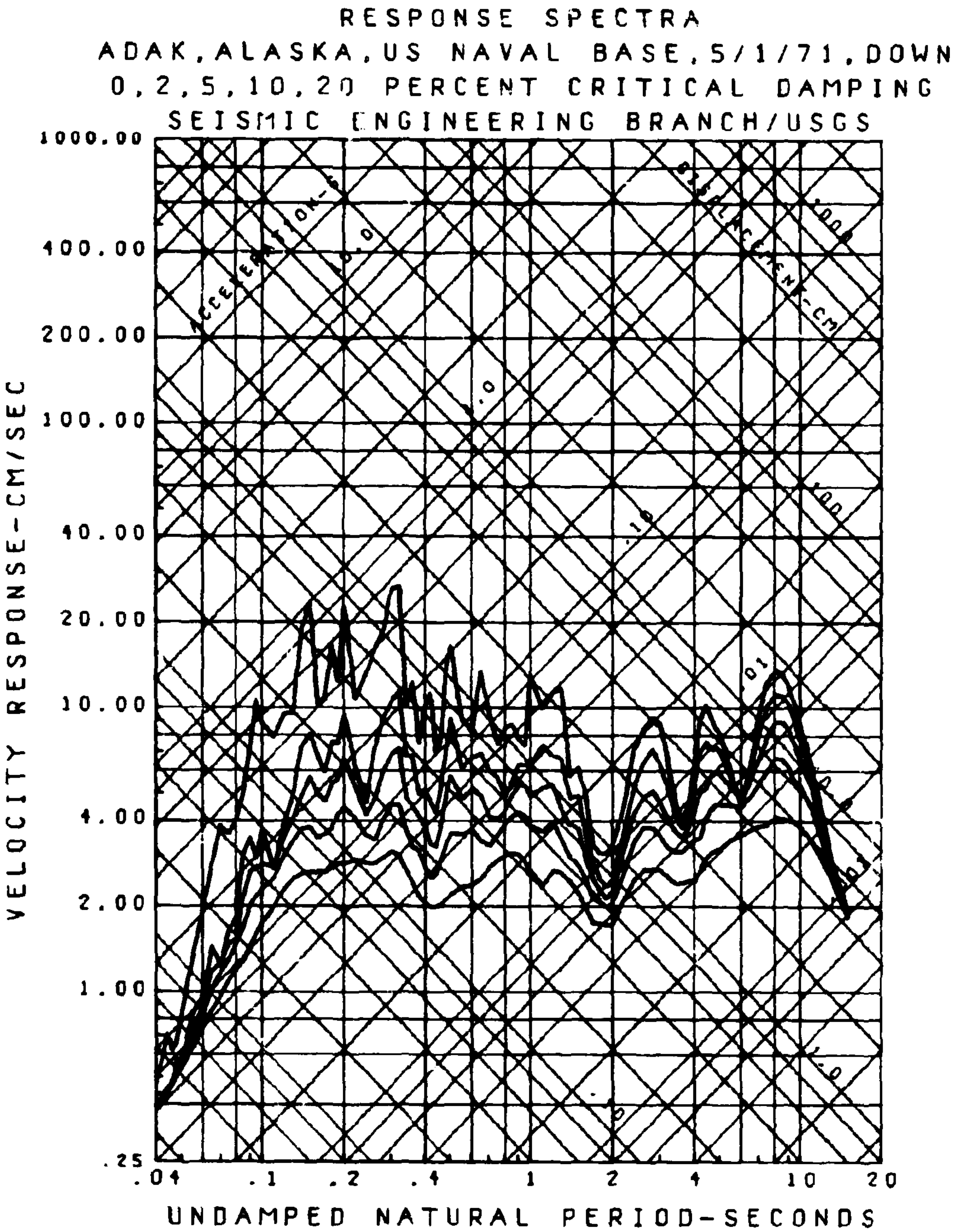
ADAK, ALASKA, US NAVAL BASE, 5/1/71, NORTH

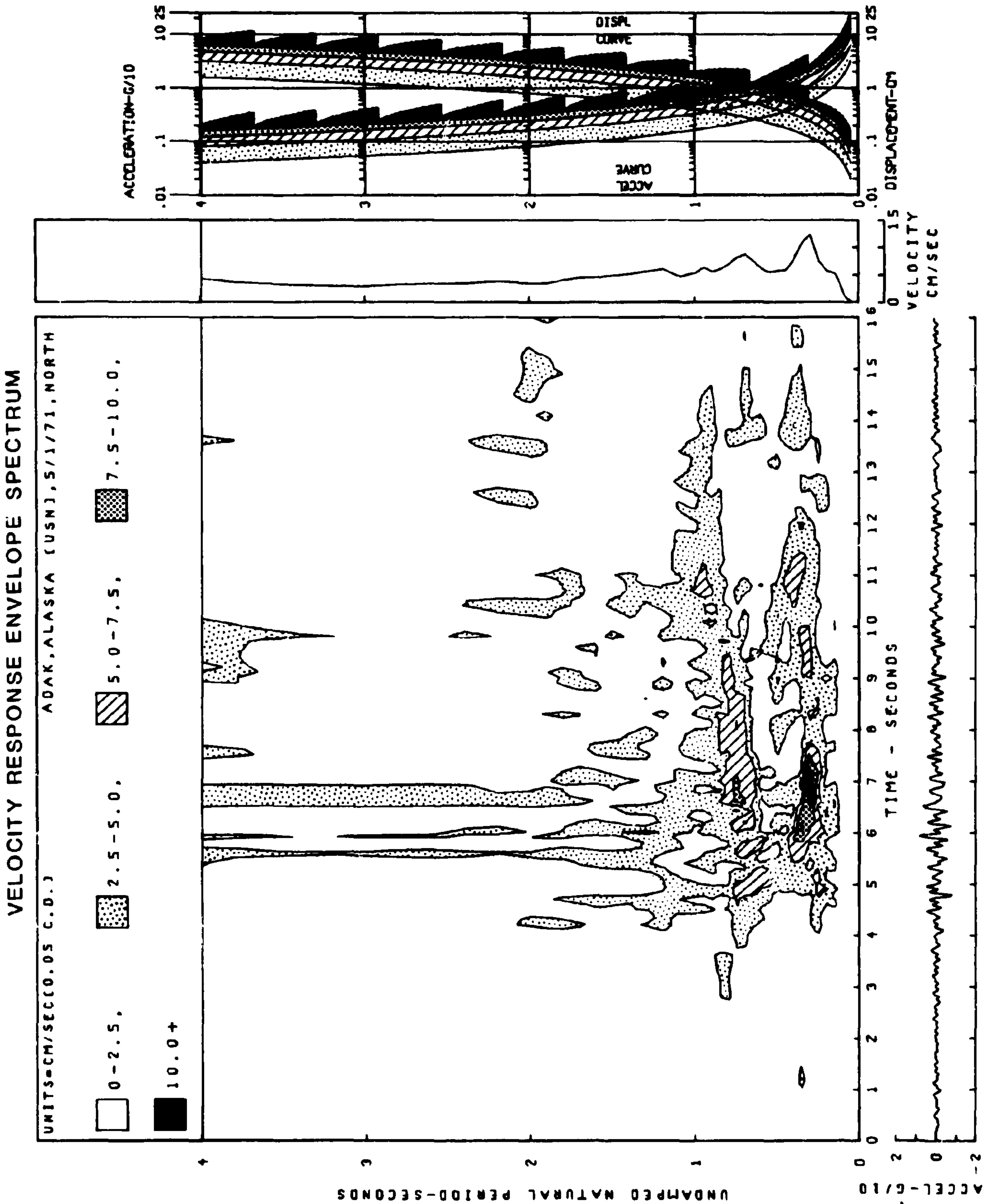
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING

SEISMIC ENGINEERING BRANCH/USGS

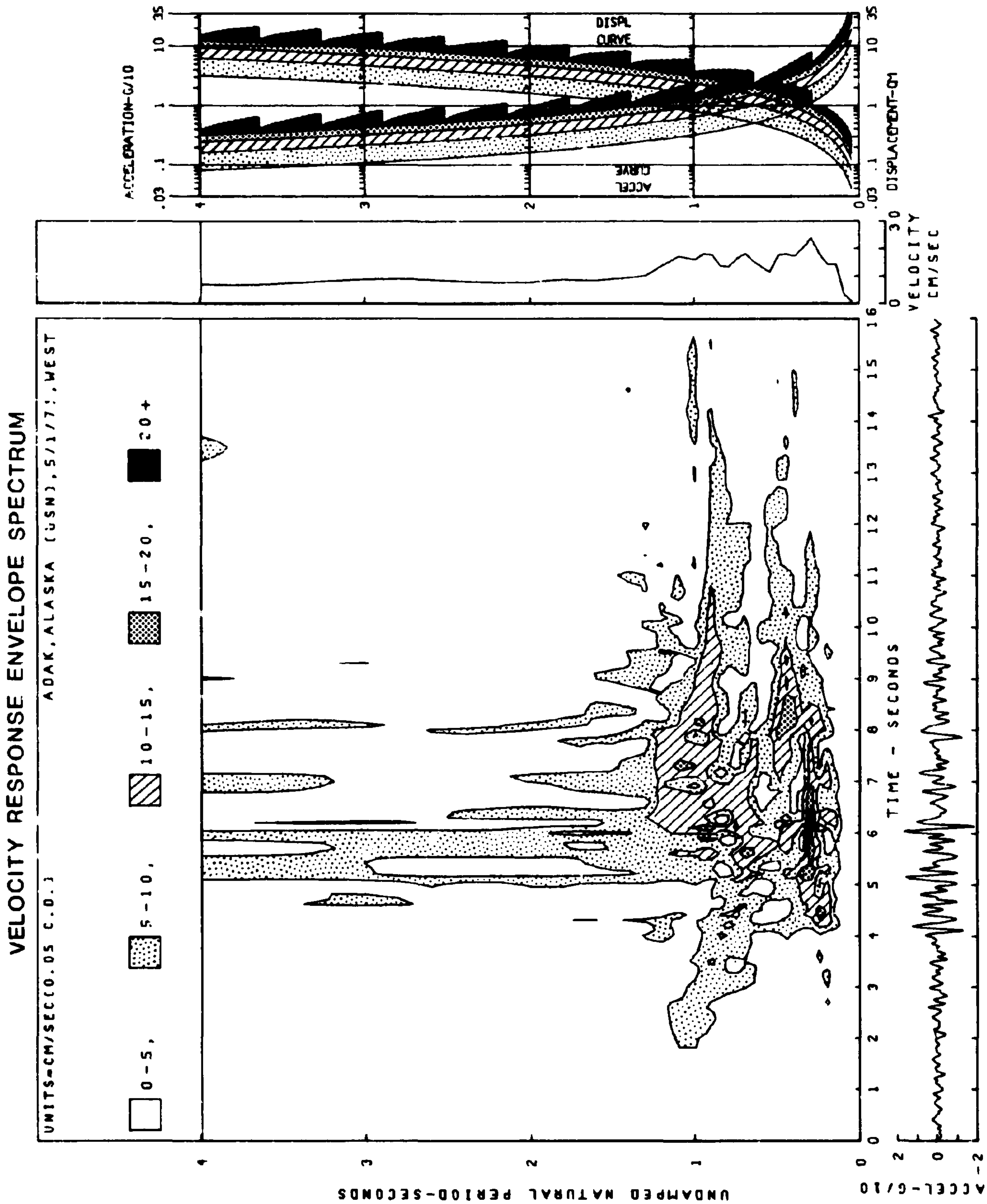


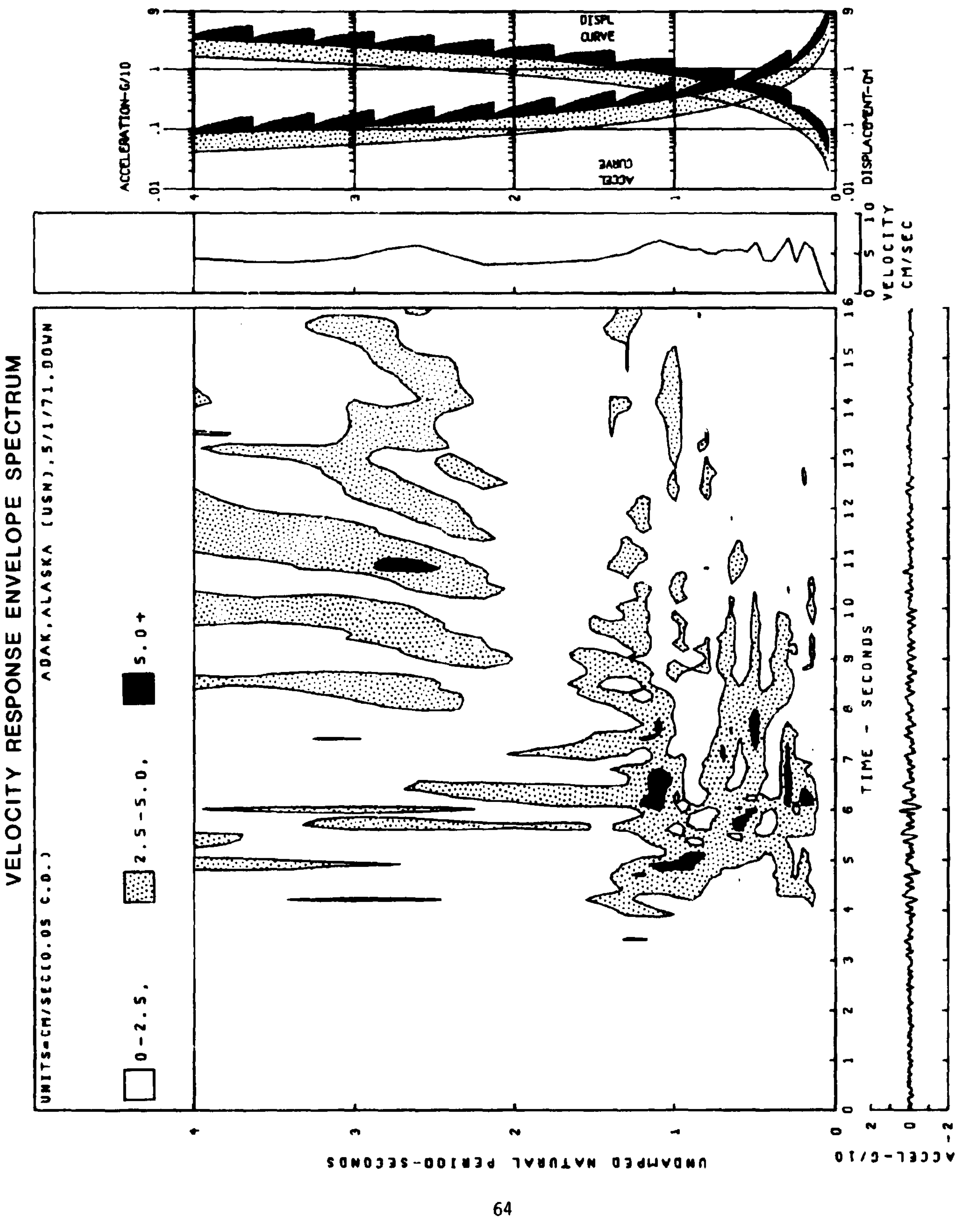

RESPONSE SPECTRA
ADAK,ALASKA,US NAVAL BASE,5/1/71,WEST
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
UNDAMPED NATURAL PERIOD-SECONDS
.04
.1
.2
.4
1
2
4
10
20
ACCELERATION-G
DISPLACEMENT-CM


RESPONSE SPECTRA
ADAK,ALASKA,US NAVAL BASE,5/1/71,DOWN
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20

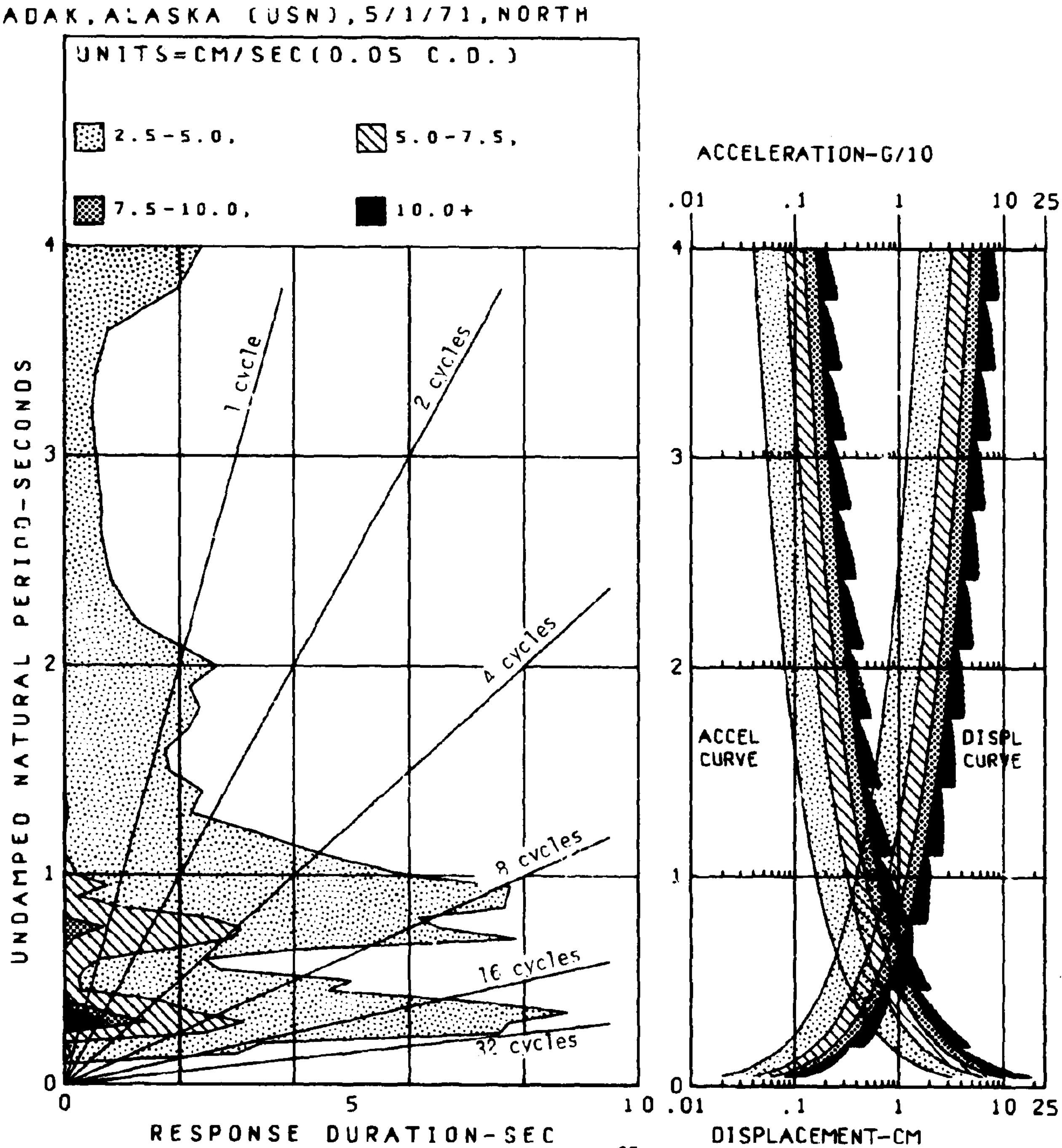


VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
ADAK, ALASKA (USN), 5/1/71, NORTH
0-2.5,
2.5-5.0,
5.0-7.5,
7.5-10.0,
10.0+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE

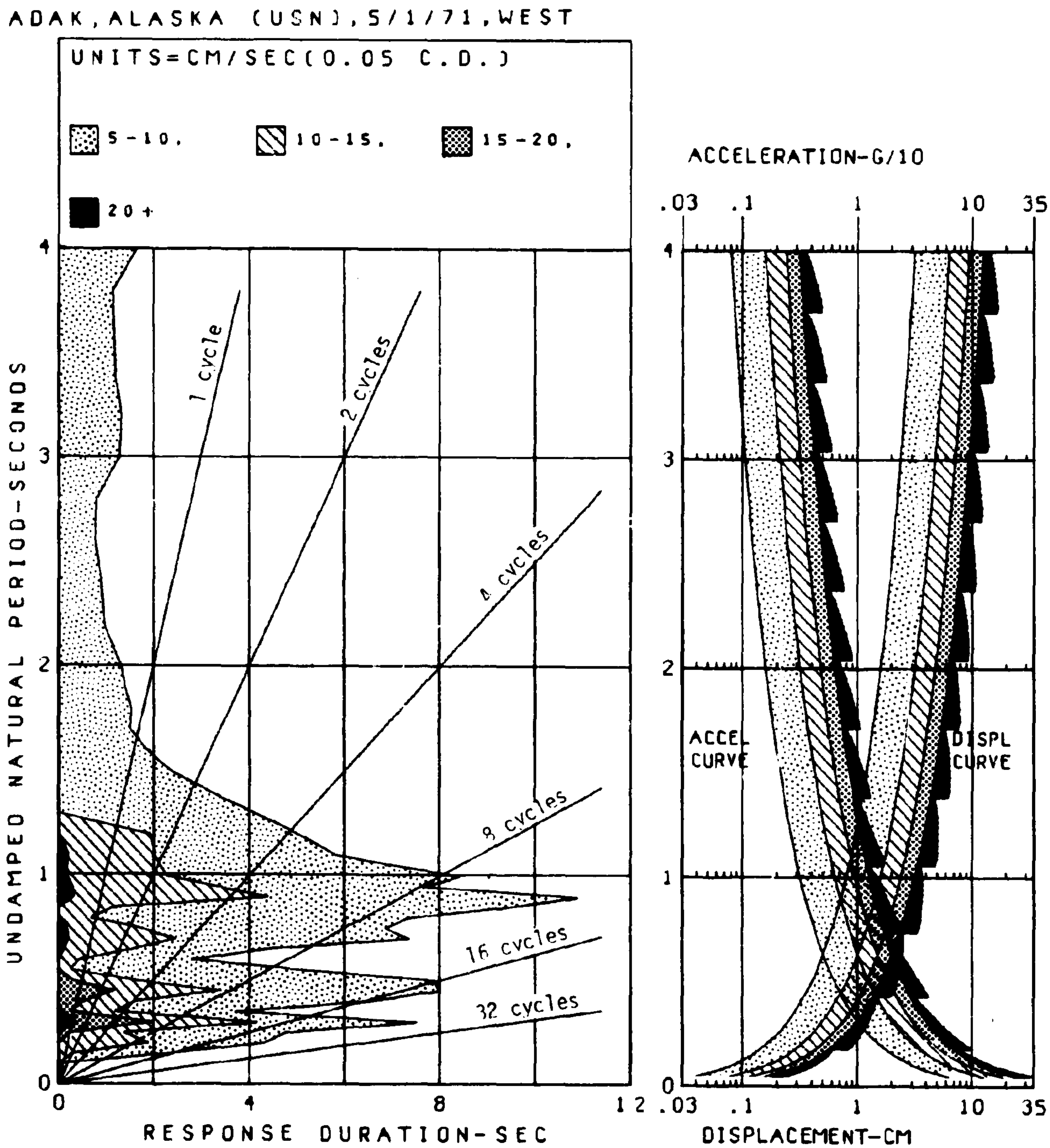

VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
ADAK, ALASKA (USN)
0-5.
5-10.
10-15.
15-20.
20+
TIME - SECONDS
UNDAMPED NATURAL PERIOD-SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
DISPL CURVE
ACCEL CURVE


VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
ADAK,ALASKA (USN),5/1/71,DOWN
0-2.5,
2.5-5.0,
5.0+
TIME - SECONDS
UNDAMPED NATURAL PERIOD-SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
DISPL CURVE
ACCEL CURVE

TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE

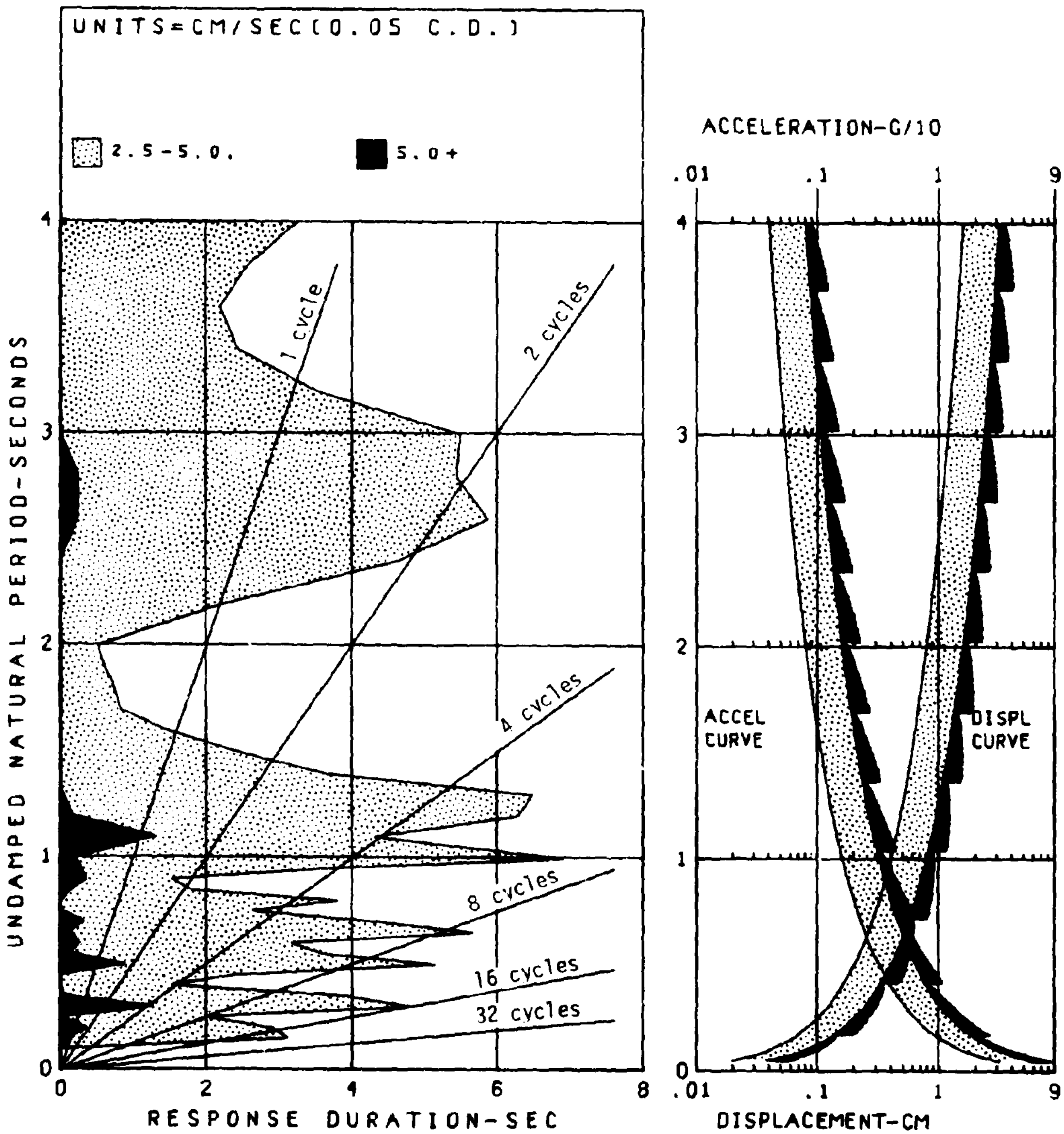


TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE

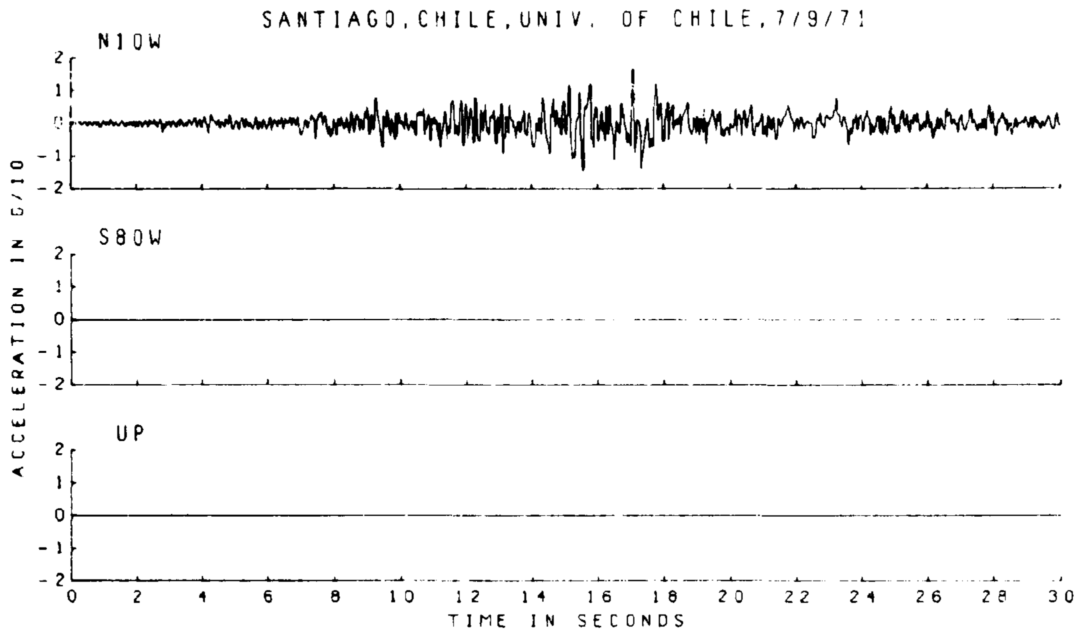


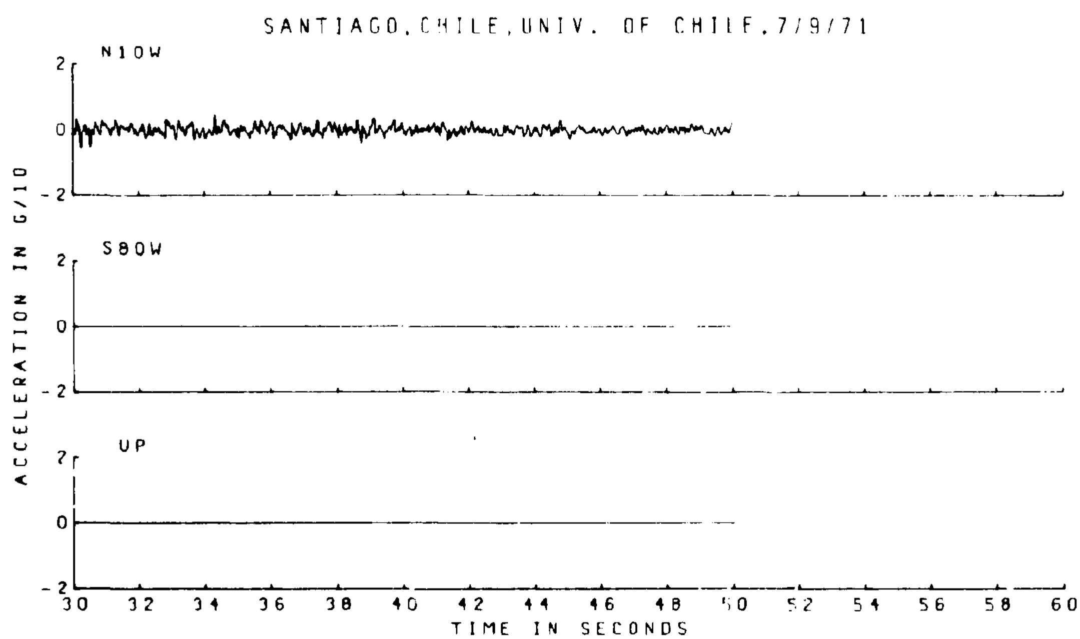
TIME DURATION SPECTRUM OF THE RESPONSE ENVELOPE

ADAK, ALASKA (USN), 5/1/71, DOWN



UNCORRECTED ACCELEROGRAM



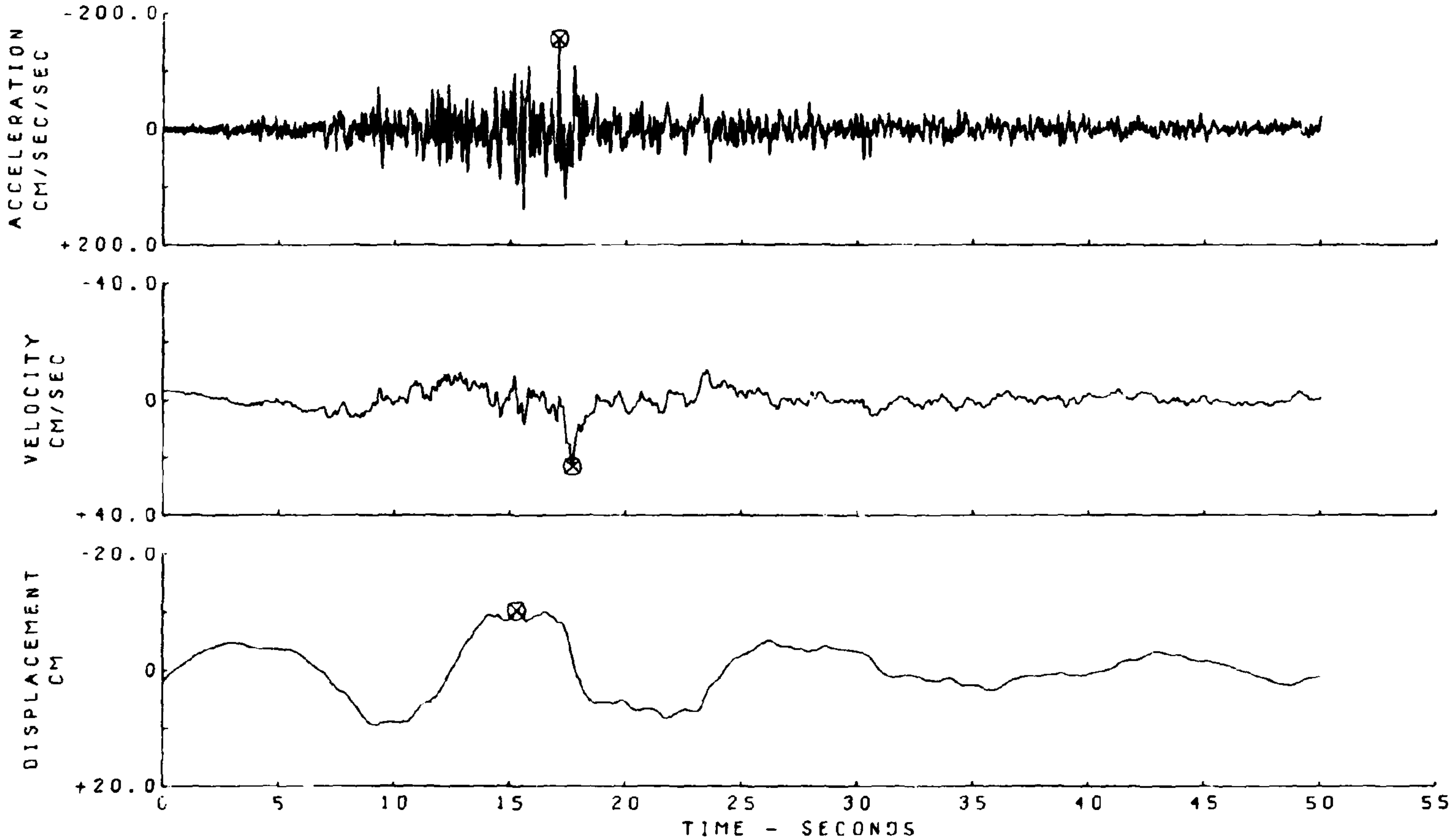


CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

SANTIAGO, CHILE EARTHQUAKE OF JULY 9, 1971

UNIVERSITY OF CHILE, COMP S10W

⊗ PEAK VALUES: ACCEL=-156.1 CM/SEC/SEC, VELOCITY=23.2 CM/SEC, DISPL=-10.3 CM



CORRECTED ACCELERATION ORDINATFS

SANTIAGO,CHILE,UNIVERSITY OF CHILE,7/9/71,N10W
INSTR PERIOD = .0640 SEC DAMPING = .530 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = -156.1 CM/SEC/SEC AT 17.06 SEC VELO = 23.2 CM/SEC AT 17.70 SEC DISP = -10.3 CM AT 15.30 SEC
LENGTH OF RECORD = 50.00 SEC INITIAL VELO = -3.32433 CM/SEC INITIAL DISP = 1.67091 CM
2501 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	-43	-5	27	13	-35	-52	-26	9	32	48	55	40	6	-27	-33	-8	31	51	36	11
.4	-10	-31	-49	-35	12	56	75	26	-46	-49	-13	21	55	71	31	-18	-47	-32	19	51
.8	42	-3	-34	4	74	109	99	63	11	-48	-63	-37	-2	37	55	12	-30	-10	39	45
1.2	-32	-96	-74	-33	20	68	62	21	-18	-27	-2	37	70	84	75	39	3	-33	-67	-69
1.6	-37	19	74	87	22	-22	6	37	44	10	-24	-7	44	67	43	-20	-40	28	75	10
2.0	-14	45	41	75	-12	-44	-44	-6	60	100	79	36	-24	-71	-59	-4	61	96	68	-33
2.4	-85	33	18	20	-18	-61	-98	-47	37	34	10	74	109	47	-20	-74	-104	-41	35	151
2.8	191	80	60	130	108	20	16	32	10	-28	-33	15	91	104	36	-37	-60	-20	33	75
3.2	120	94	5	-55	-54	13	63	-10	-88	-68	-1	58	91	79	47	20	45	79	36	-32
3.6	-84	-79	-20	32	60	35	-17	-66	-123	-160	-100	39	120	94	27	-40	-89	-109	-42	88
4.0	122	34	-58	-113	-169	-126	-16	90	89	180	229	137	22	-100	-235	-226	-134	-82	-57	-38
4.4	-5	38	48	6	-50	-66	29	140	127	17	-42	-19	10	59	106	59	-61	-93	-52	1
4.8	16	-94	-231	-224	-96	58	165	190	168	97	10	-45	-67	-51	-2	98	186	148	18	-75
5.2	-120	-162	-149	-53	44	120	64	-84	-91	-15	53	96	59	7	34	95	141	175	158	70
5.6	2	-47	-137	-112	71	180	132	20	-17	33	83	128	151	38	-72	-49	-5	57	146	171
6.0	125	78	41	-38	-134	-140	41	161	93	11	-59	-88	-46	-1	39	80	-14	-77	-19	18
6.4	6	-90	-117	-38	87	163	88	-51	-110	-58	2	17	-7	-38	-93	-139	-46	60	-27	-133
6.8	-95	-40	19	54	-20	-122	-147	-30	104	202	315	360	326	275	237	176	88	-8	-84	-77
7.2	21	118	69	-84	-102	-52	-108	-228	-236	-174	-147	-59	229	405	206	-62	-128	-194	-265	-252
7.6	-310	-339	-209	-34	3	-106	-231	-247	-139	17	135	226	250	148	167	327	373	327	256	84
8.0	-75	-56	44	162	300	253	15	-141	-119	1	-17	-156	-144	-44	11	79	118	37	-1	52
8.4	-65	-100	27	121	204	135	-89	-292	-298	-205	28	234	192	19	-181	-277	-247	-174	-77	111
8.8	121	-70	-61	30	118	91	-119	-283	-269	-177	-260	-406	-338	-36	254	304	58	-219	-254	-70
9.2	118	97	-250	-657	-746	-552	-315	-169	-49	87	213	383	543	693	428	-82	-131	13	58	73
9.6	-168	-378	-309	-105	113	270	240	-31	-96	39	137	225	378	233	-79	139	203	-190	-345	-178
10.0	-22	-13	-57	-40	24	71	132	-21	-262	-346	-290	-90	74	168	174	87	22	-17	-73	-33
10.4	90	103	41	170	328	263	-75	-327	-329	-302	-342	-379	-323	-272	-248	-323	-331	-13	117	-22
10.8	19	-49	-202	-247	-282	-173	185	481	293	-62	-80	-59	-124	-52	-46	-102	7	144	268	281
11.2	308	559	562	392	273	109	-51	-258	-366	-173	67	265	271	153	108	166	176	-73	-449	-663
11.6	-696	-650	-332	71	226	126	84	217	314	190	-173	-455	-593	-686	-440	253	650	483	25	-428
12.0	-562	-437	-156	182	226	41	-164	-372	-342	-234	22	403	589	351	-355	-780	-338	246	424	498
12.4	536	486	40	-268	-193	-19	-81	-309	-402	-434	-175	134	209	190	257	233	11	-194	-258	-228
12.8	-206	-250	-338	-110	339	557	578	278	-77	34	177	92	-106	-394	-547	116	754	596	339	314
13.2	155	-168	-165	86	242	-69	-489	-488	-289	-169	-114	-89	20	112	123	185	319	271	61	-36
13.6	-75	-12	168	214	57	-92	135	-285	-376	-130	233	310	316	135	-151	-311	-310	-218	-26	167
14.0	337	544	670	688	625	562	309	30	34	151	167	-50	-179	-23	193	-165	-711	-725	-549	-320
14.4	-2	244	395	528	595	686	826	879	431	-175	-308	-293	-451	-654	-555	-229	-3	-12	-275	-360
14.8	-171	-19	-26	-168	-1	296	249	-163	-539	-662	-588	-144	231	284	31	-301	-566	-945	-965	-154
15.2	498	722	971	996	913	902	954	694	174	-90	-150	-218	-443	-853	-491	278	636	1047	1407	913
15.6	-100	-531	-507	-498	-535	-653	-763	-998	-1117	-1031	-70	500	423	454	462	109	-263	-396	-512	-423
16.0	51	492	460	234	59	-81	-267	-116	159	87	106	388	452	-77	-450	-269	31	-86	-452	-333
16.4	-32	72	119	216	385	740	850	595	311	25	-69	43	177	251	265	37	-388	-541	-341	-215
16.8	-259	-154	27	155	309	458	399	362	475	590	564	-83	-1040	-1561	-1399	-676	25	597	732	525
17.2	208	-79	-92	-53	59	304	926	1228	1053	913	768	615	441	247	129	-24	-132	67	426	667
17.6	627	908	567	687	559	-142	-716	-902	-1091	-1099	-868	-493	-213	-222	-434	-575	-509	-294	86	464
18.0	559	464	141	173	-411	-606	-563	20	293	-77	-274	-365	-513	-450	-49	144	63	-29	-43	12
18.4	-21	-69	-22	-54	-157	-206	32	128	-79	-198	-275	-322	-365	-451	-545	-625	-537	-217	43	165
18.8	232	291	310	270	121	-99	-130	-47	130	145	-115	-194	-123	61	276	87	-138	-113	13	178
19.2	179	-118	-142	115	406	416	108	27	31	-44	-130	-193	-296	-397	-391	-261	-120	-55	59	109
19.6	-71	-232	-162	-62	-130	-294	-153	227	329	254	313	398	357	243	161	146	150	201	306	334

SANTIAGO,CHILE,UNIVERSITY OF CHILE,7/9/71,N10W

SEC.																				
20.0	149	41	96	140	148	108	54	-110	-314	-218	83	76	-116	-220	-263	-214	-138	-13	151	33
20.4	-141	-243	-361	-315	-99	111	102	-12	-91	-193	-286	-393	-489	-391	-15	299	378	378	261	112
20.8	47	35	76	95	64	-0	-54	-110	-202	-262	19	315	255	151	124	283	322	-12	-232	-213
21.2	-74	100	183	92	-77	157	-126	98	341	459	459	375	151	-92	-121	-61	24	92	76	23
21.6	-73	-154	-188	-224	-255	-321	-396	-465	-480	-411	-352	-294	-196	-122	-89	-57	70	199	166	84
22.0	-2	-82	-103	34	158	118	57	-76	-181	-167	-68	50	123	128	72	30	-0	-33	-52	-16
22.4	26	13	0	-7	107	348	456	458	443	375	230	12	-127	-152	-132	-90	-149	-277	-215	-20
22.8	59	72	100	136	114	-18	-161	-230	-211	-165	-129	-96	-83	-126	-152	-146	-173	-229	-337	-384
23.2	-500	-609	-443	-287	-264	-266	-219	-70	16	28	78	49	-72	-172	-204	-126	-10	99	187	342
23.6	569	585	379	215	202	259	221	62	-11	-13	-43	-140	-80	152	184	-3	-143	-197	-229	-147
24.0	-42	75	225	222	50	-104	-191	-240	-313	-272	-165	-118	-40	172	190	77	135	233	299	226
24.4	144	89	-37	-153	-207	-160	27	246	102	-194	-87	232	314	51	-115	45	214	270	320	332
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25.2	-145	-218	-360	-369	-204	6	91	86	-14	-142	-154	42	208	278	239	34	-62	-32	30	-9
25.6	-186	-231	-147	-42	-113	-214	-112	17	148	244	199	145	159	106	13	-9	58	134	113	-63
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27.2	93	35	-4	-51	-140	-270	-369	-287	-72	0	-46	-55	-8	75	141	209	215	108	58	86
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28.0	-272	-55	124	215	362	379	194	20	-52	-42	-56	-129	-165	-227	-274	-190	-123	-76	30	66
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30.0	126	142	157	157	35	-184	-287	-201	-153	-102	82	551	534	440	158	37	37	-32	-113	-128
30.4	30	132	121	33	59	354	504	321	101	17	25	101	108	-52	-196	-156	-83	-81	-33	52
30.8	99	132	146	-50	-255	-237	-143	-116	-148	-162	-149	-101	-46	-17	-27	-3	89	167	130	-10
31.2	-81	-70	-44	-62	-192	-298	-263	-191	-120	20	137	159	28	-118	-141	-126	-106	-77	-38	-17
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32.0	109	32	-30	-35	-14	-94	-161	-74	34	122	218	248	209	154	91	-48	-120	9	121	125
32.4	109	134	62	-49	-73	-42	21	48	17	-41	-78	-41	53	83	52	57	99	100	111	169
32.8	225	-11	-293	-257	-169	-190	-195	-122	-71	-52	-66	-102	-135	-110	3	149	252	269	198	45
33.2	-120	-241	-264	-160	-59	-16	8	-27	-53	13	66	131	146	15	-104	-132	-107	-120	-171	-178
33.6	-155	-195	-214	-96	164	304	233	123	15	-32	15	75	121	187	232	174	71	13	-21	-63
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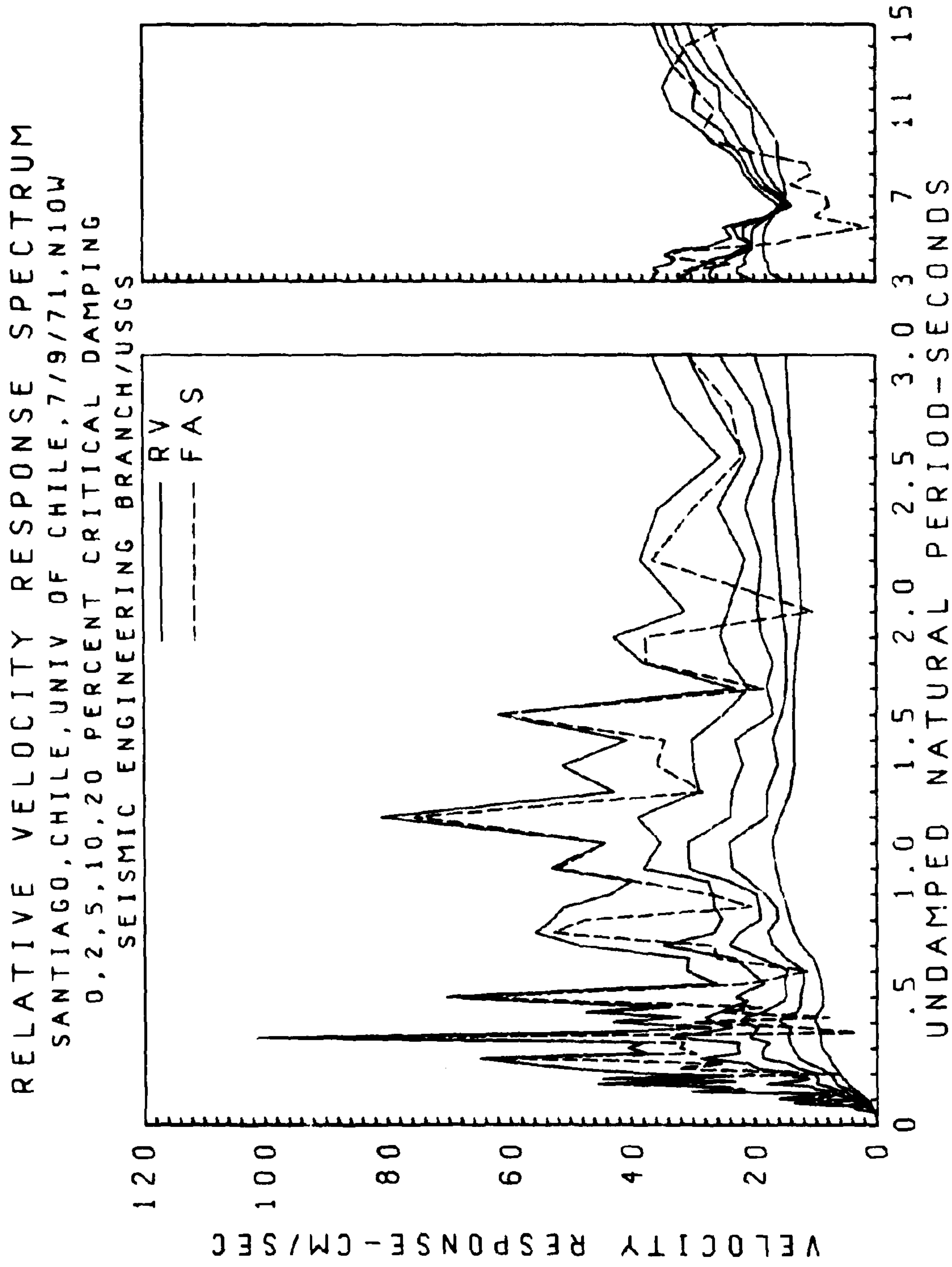
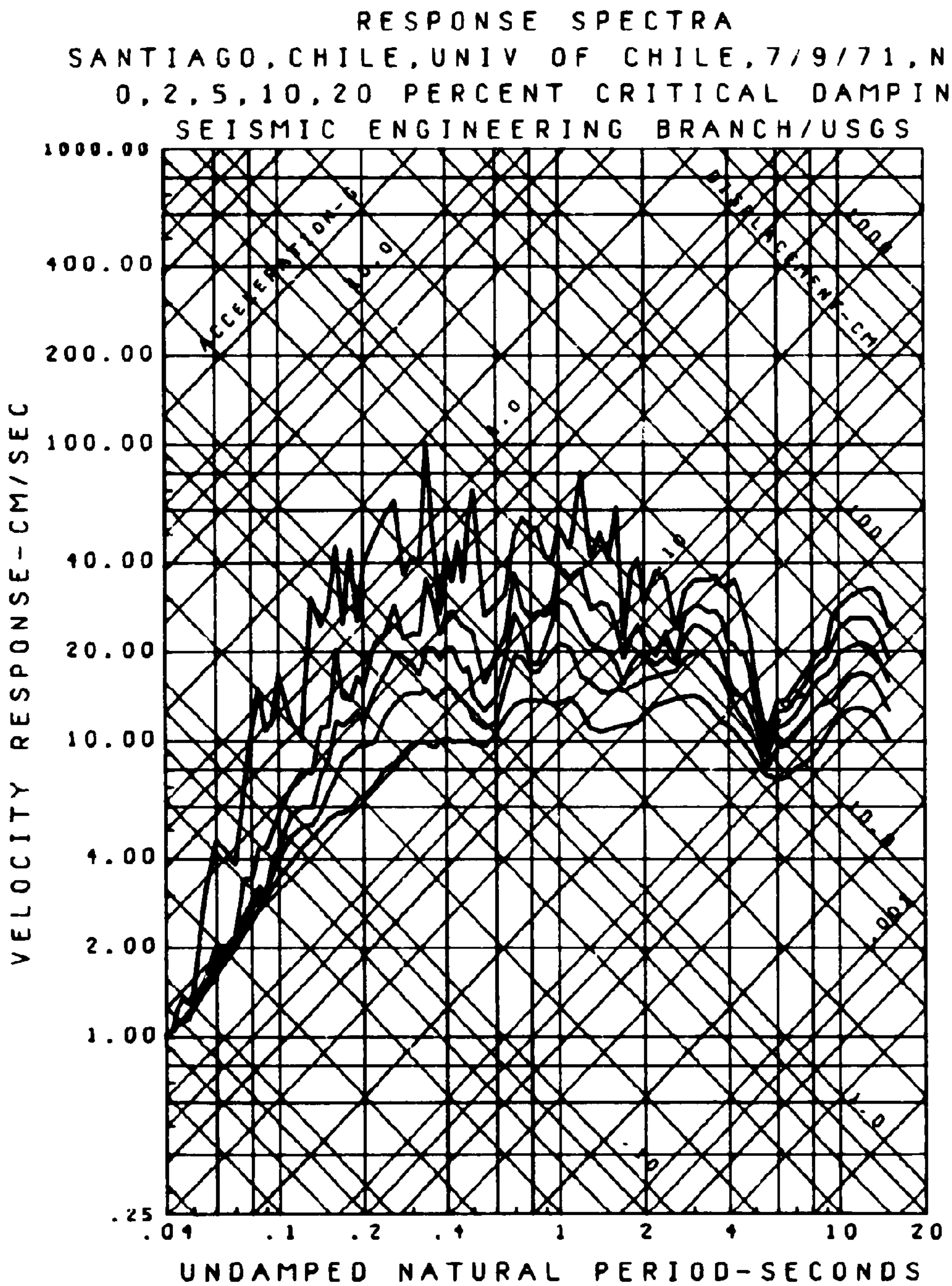
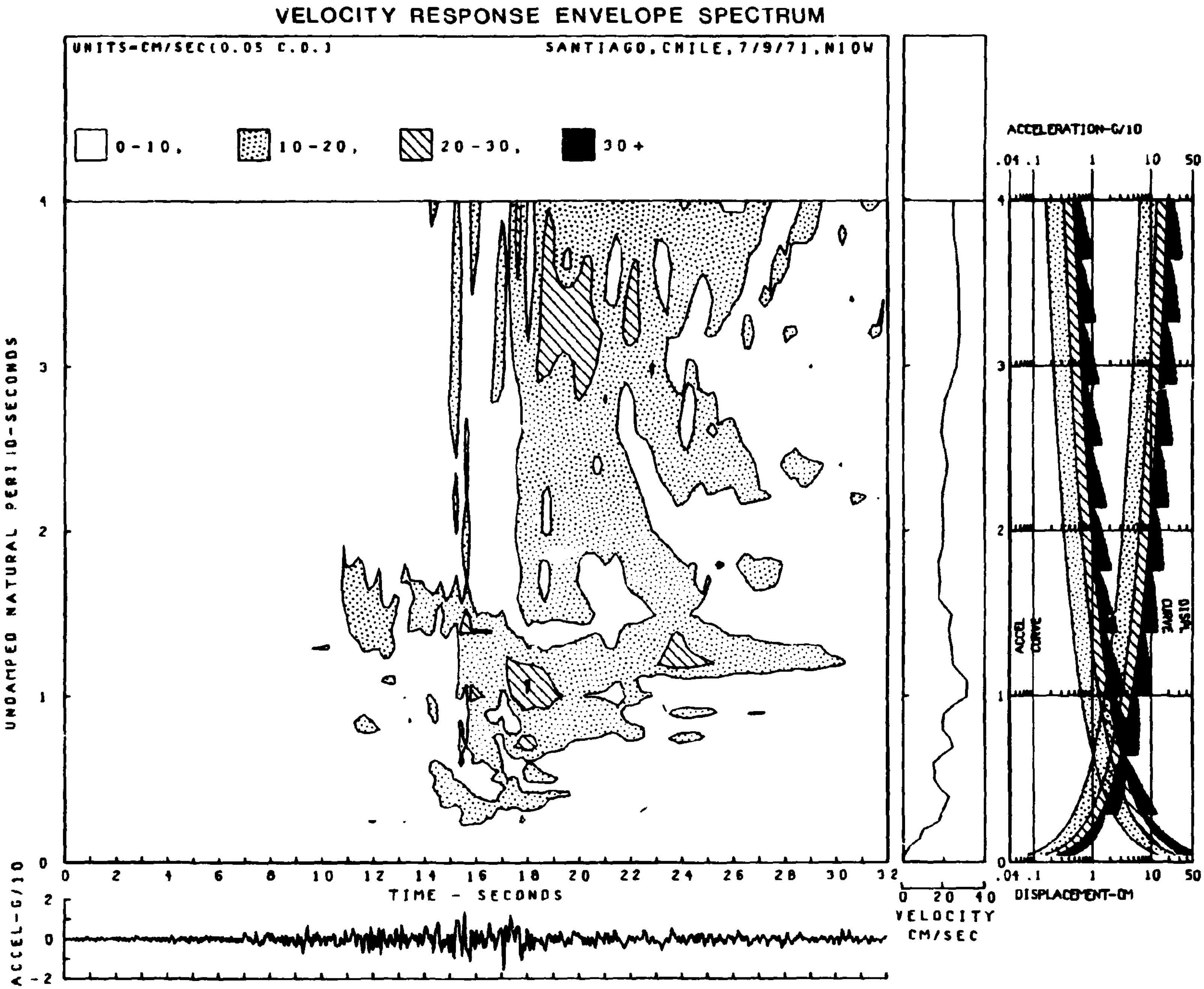
34.4	83	-25	-111	-63	43	80	51	20	-98	-237	-295	-282	-192	-106	-85	-127	-153	-68	40	110
34.8	148	110	46	14	-2	-24	-21	3	48	125	145	25	51	216	201	43	-91	-119	-36	9
35.2	-52	-82	-64	-16	45	82	103	127	150	202	148	41	33	63	34	-39	-105	-213	-213	-102
35.6	-30	-8	-46	-32	65	76	-131	-282	-236	-149	-108	-97	-96	-59	17	81	56	1	-7	-39
36.0	-142	-229	-211	-193	-176	-115	128	212	94	87	99	-17	-109	-105	-95	-112	-127	-88	-44	-48
36.4	-114	-118	-66	-18	13	26	40	84	117	97	176	275	307	152	-54	-62	-12	43	125	176
36.8	150	89	36	-29	-131	-195	-206	-157	-49	16	31	57	111	101	-29	-57	17	39	10	-55
37.2	-65	6	86	137	182	217	152	52	66	75	-35	-176	-270	-122	76	96	71	92	150	223
37.6	200	38	-52	-16	8	-24	-80	-143	-186	-210	-226	-169	-52	33	62	17	-94	-176	-129	-43
38.0	9	53	133	126	-51	-55	63	126	162	127	77	27	-56	-124	-164	-29	127	64	-26	-40
38.4	-20	-38	-75	-74	-25	23	61	58	40	86	25	-193	-272	-141	-12	65	154	317	299	11
38.8	-99	7	28	11	110	253	269	197	163	163	61	-77	-99	-94	-172	-289	-347	-325	-104	59
39.2	18	29	33	-21	-93	-133	-97	-25	29	64	117	194	258	215	102	41	38	30	-7	-66
39.6	-104	-90	-36	-38	-125	-188	-228	-290	-184	22	59	31	22	-23	-52	-23	-33	-118	-192	-195

SANTIAGO,CHILE,UNIVERSITY OF CHILE,7/9/71,N10W

SEC.																				
40.0	-94	39	100	81	77	155	169	83	16	-5	-18	-48	-64	-15	103	104	36	59	73	29
40.4	-69	-143	-75	58	78	19	15	25	-7	-23	10	31	-3	-15	-3	-2	9	2	-45	-117
40.8	-114	16	95	-22	-46	-65	-102	-156	-187	-108	-7	48	23	-82	-83	44	152	138	-9	-138
41.2	-206	-233	-161	-76	-32	-3	27	74	191	240	92	52	188	183	95	81	52	-11	-46	11
41.6	117	186	148	67	56	89	83	5	-69	-105	-42	64	110	98	-5	-104	-121	-98	-61	-25
42.0	24	36	-26	-75	-156	-240	-236	-124	-18	36	32	-16	-25	-31	-92	-119	-23	30	2	-0
42.4	41	55	-22	-84	-55	23	62	58	38	33	60	65	21	-37	-52	-3	82	148	155	137
42.8	87	-11	-51	-16	55	140	185	177	164	166	154	138	113	-27	-148	-85	1	-47	-109	-112
43.2	-73	2	57	68	36	-0	16	77	125	122	56	-18	-68	-118	-146	-120	-68	-47	-56	-82
43.6	-100	-103	-70	41	150	135	89	72	-4	-115	-149	-107	-60	32	150	199	164	107	44	-22
44.0	-62	-34	-6	-39	-45	15	83	139	186	205	180	89	-33	-134	-167	-132	-82	-82	-71	-9
44.4	-30	-107	-161	-146	-71	26	126	159	107	28	-4	66	72	-24	-62	-41	27	66	-36	-208
44.8	-288	-255	-121	-8	-16	-50	-67	-64	-29	16	47	78	121	188	240	246	177	61	21	41
45.2	64	96	87	26	-27	-60	-92	-125	-144	-135	-90	-35	-34	-67	-51	-13	-18	-4	54	90
45.6	96	84	55	38	27	12	1	30	41	21	-13	-77	-69	13	62	59	32	-3	-28	-44
46.0	-35	19	78	120	136	103	44	-7	-52	-48	23	82	78	43	12	-10	-22	-35	-52	-102
46.4	-145	-122	-70	-28	8	47	82	101	112	116	64	-23	-69	-93	-119	-126	-108	-56	-3	34
46.8	114	161	97	17	7	61	94	53	-6	-29	-24	-6	17	13	-34	-51	-17	6	-22	-67
47.2	-84	-46	12	-5	-94	-146	-90	-13	18	71	98	37	-25	-40	-18	13	29	48	85	94
47.6	64	31	-10	-52	-25	58	103	121	122	94	9	-78	-105	-72	28	55	7	-16	-35	-74
48.0	-133	-159	-146	-99	-14	55	41	-26	-34	-2	25	41	14	-54	-112	-107	-33	24	80	122
48.4	122	41	-76	-89	-52	-16	-21	-66	-38	35	0	-42	-28	3	23	-4	-28	-104	-184	-175
48.8	-124	-86	-41	-9	-62	-122	-89	-10	-25	-81	-77	-51	-71	-123	-134	-84	-16	31	60	76
49.2	87	98	110	118	122	105	53	-11	-36	-24	16	85	134	159	149	89	39	-8	-65	-102
49.6	-82	2	81	117	90	37	15	12	-3	-62	-58	-5	-5	19	64	51	-8	-69	-139	-200
50.0	-218																			


RELATIVE VELOCITY RESPONSE SPECTRUM
SANTIAGO,CHILE,UNIV OF CHILE,7/9/71,N10W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
0
20
40
60
80
100
120
UNDAMPED NATURAL PERIOD-SECONDS
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15

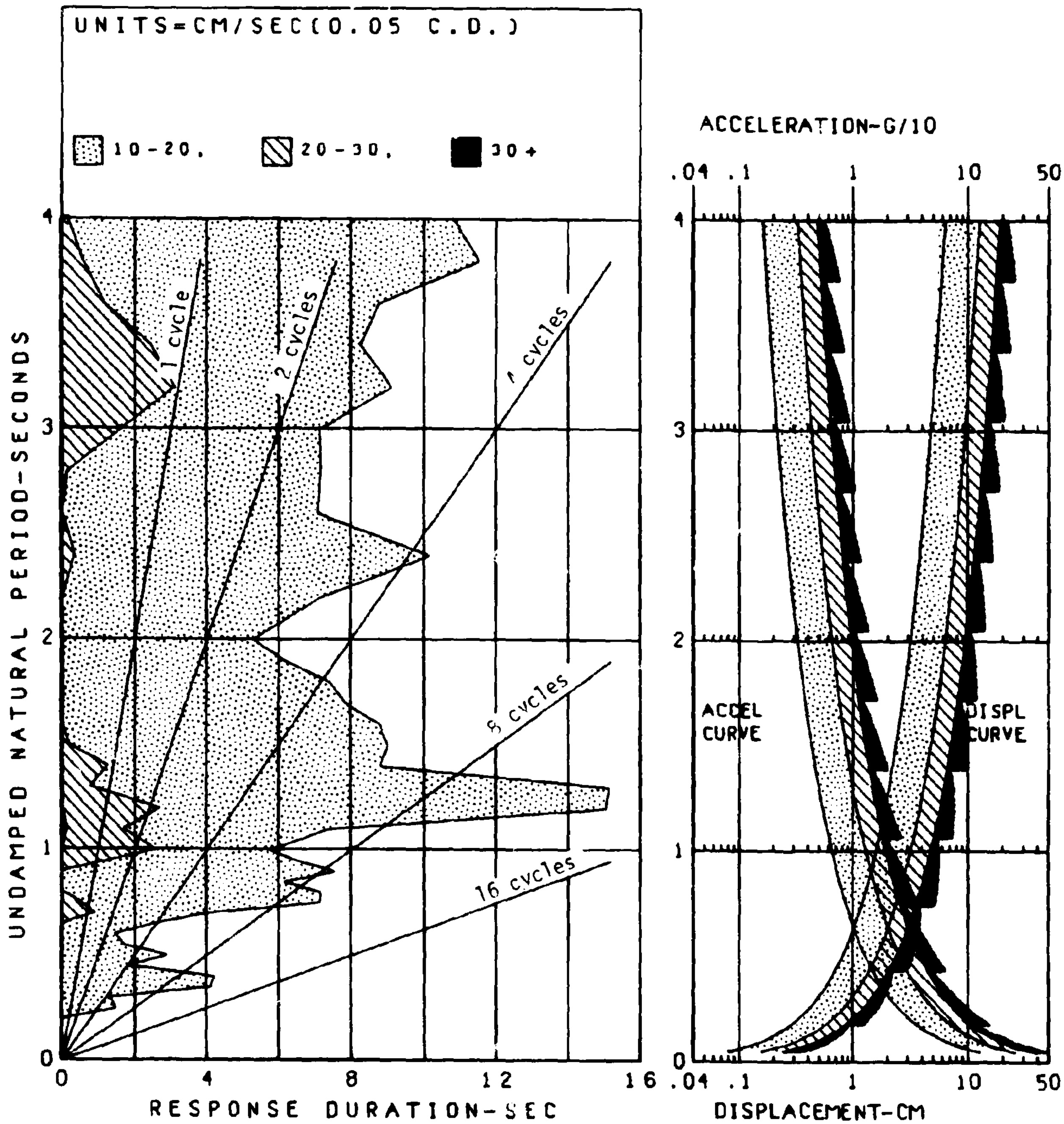

RESPONSE SPECTRA
SANTIAGO,CHILE,UNIV OF CHILE,7/9/71,N10W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.01
.1
.2
.4
1
2
4
10
20



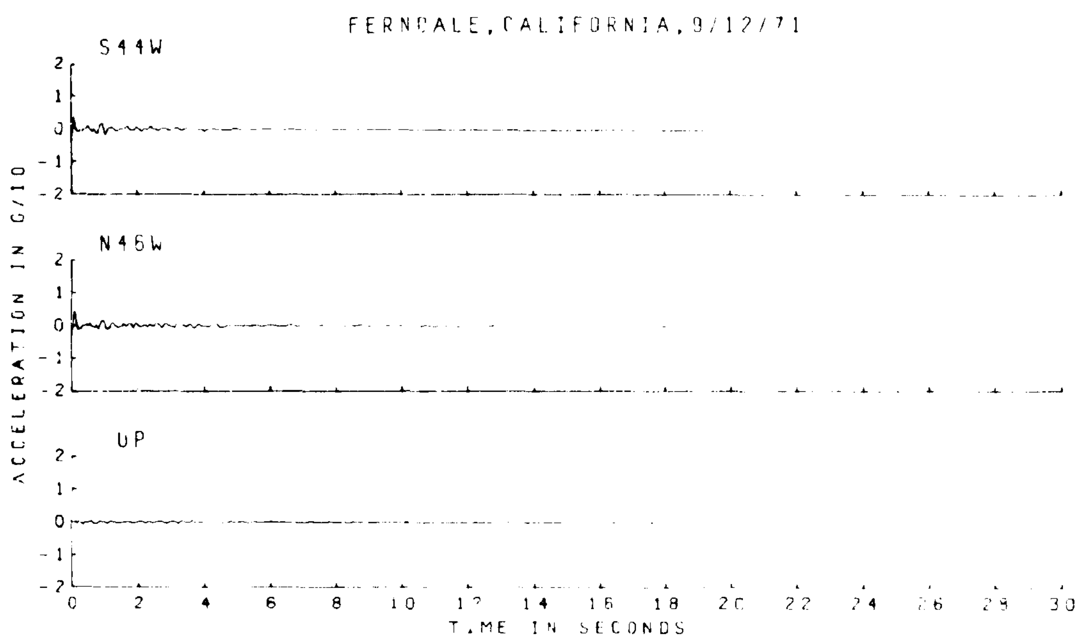
VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS-CM/SEC(0.05 C.D.)
SANTIAGO,CHILE,7/9/71,N10W
0-10.
10-20.
20-30.
30+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE

TIME DURATION SPECTRUM OF THE RESPONSE ENVELOPE

SANTIAGO, CHILE, 7/9/71, N10W



UNCORRECTED ACCELEROGRAM



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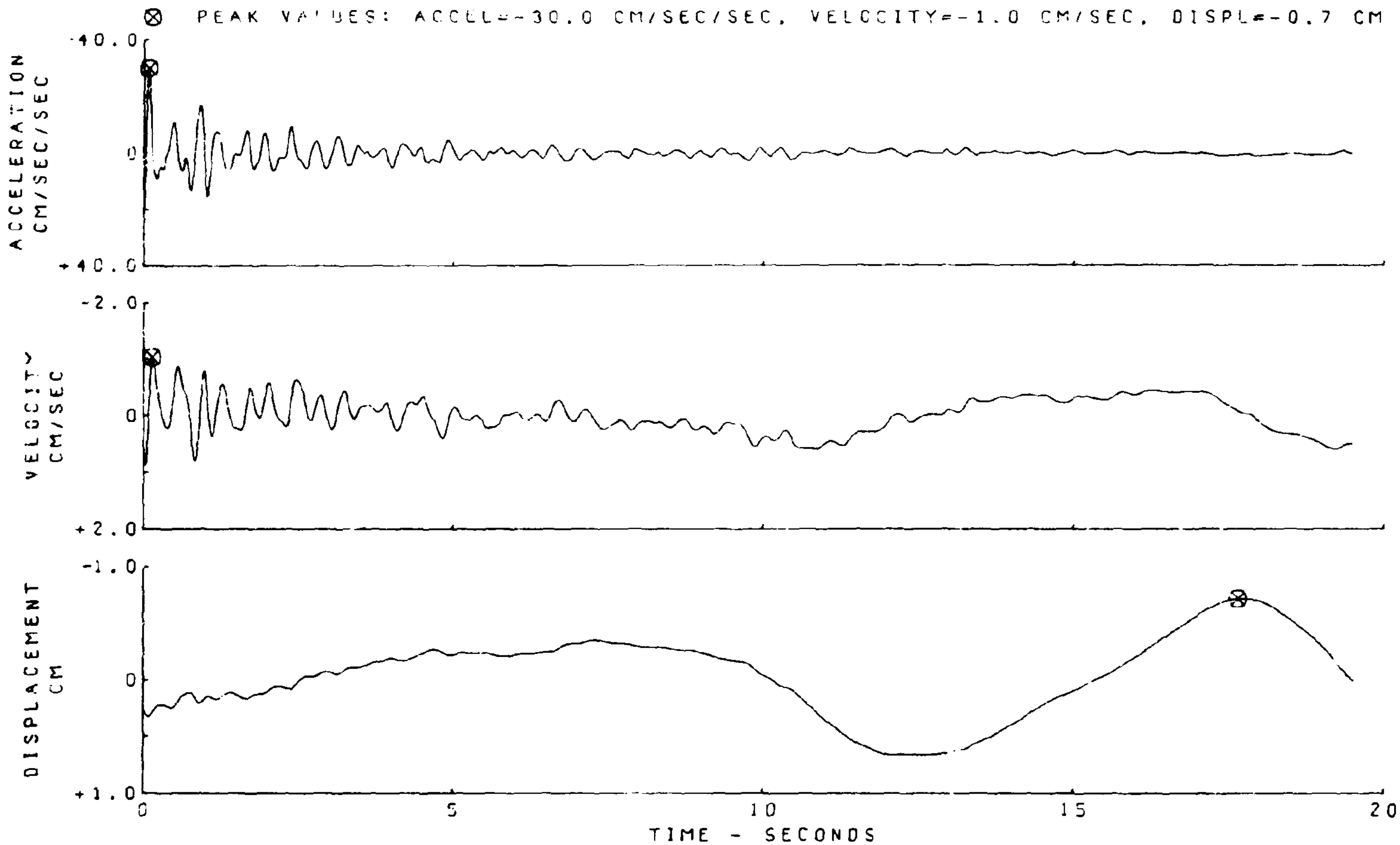
CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

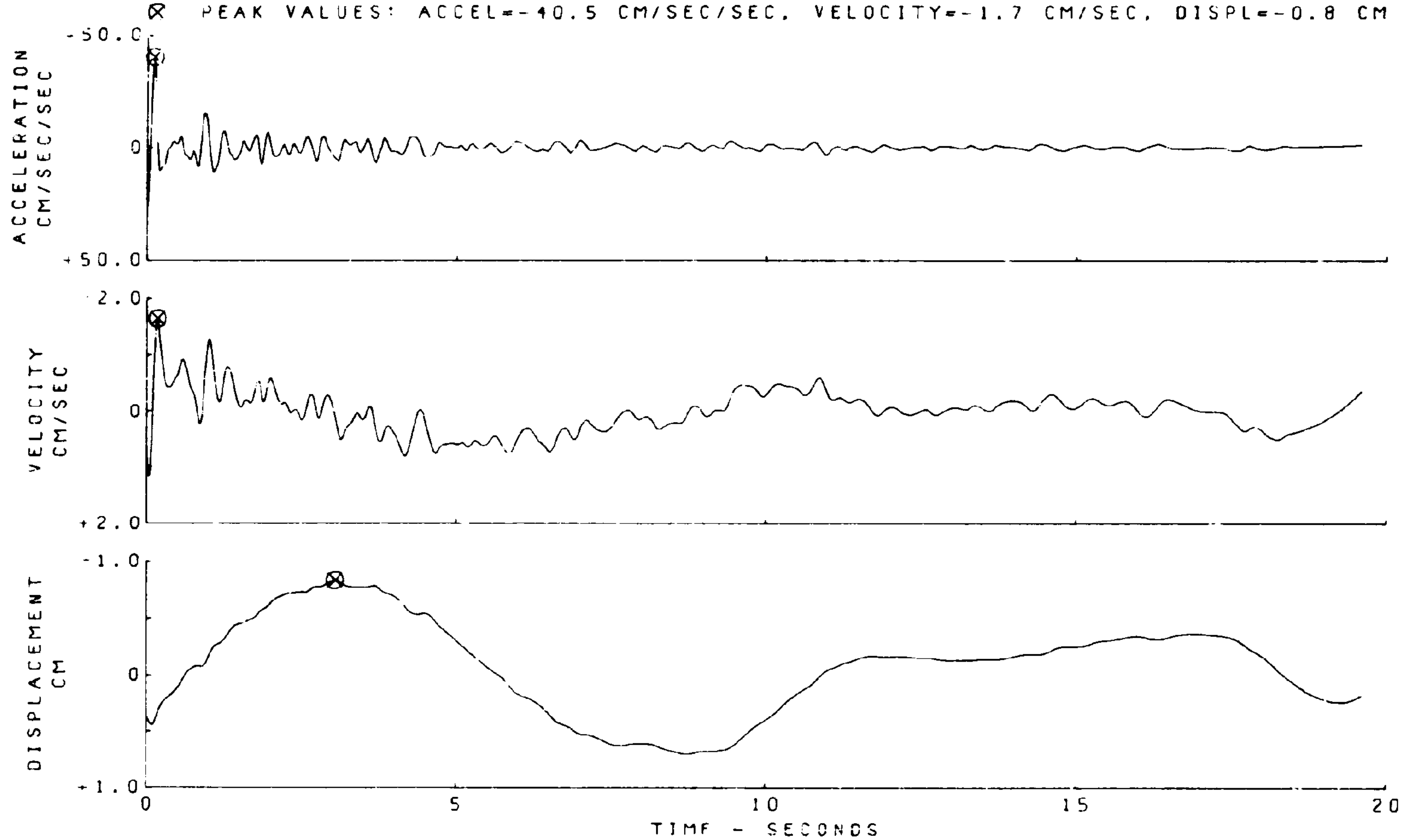
FERNDALE, CALIFORNIA EARTHQUAKE OF SEPTEMBER 12, 1971
CITY HALL, GROUND LEVEL PIER, COMP S44W



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

FERNDALE, CALIFORNIA EARTHQUAKE OF SEPTEMBER 12, 1971
CITY HALL, GROUND LEVEL PIER, COMP N46W

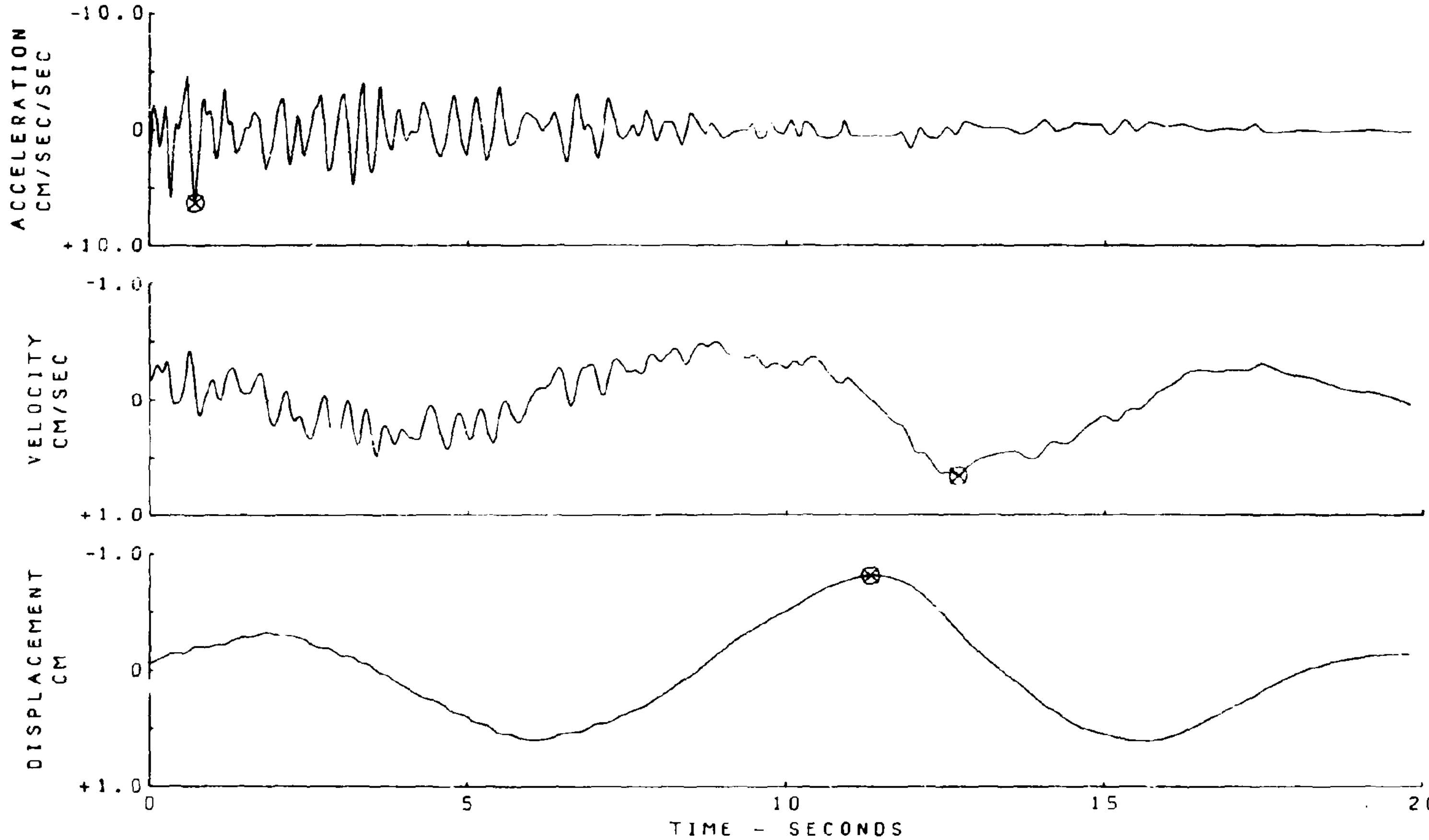
⊗ PEAK VALUES: ACCEL=-40.5 CM/SEC/SEC, VELOCITY=-1.7 CM/SEC, DISPL=-0.8 CM



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

FERNDALE, CALIFORNIA EARTHQUAKE OF SEPTEMBER 12, 1971
CITY HALL, GROUND LEVEL PIER, COMP UP

⊗ PEAK VALUES: ACCEL=6.3 CM/SEC/SEC, VELOCITY=0.6 CM/SEC, DISPL=-0.8 CM



CORRECTED ACCELERATION ORDINATES

FERNDALE,CALIF.,9/12/71,COMP S44W

INSTR PERIOD = .0660 SEC DAMPING = .570 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = -30.0 CM/SEC/SEC AT .08 SEC VELO = -1.0 CM/SEC AT .14 SEC DISP = -.7 CM AT 17.68 SEC
LENGTH OF RECORD = 19.50 SEC INITIAL VELO = .60595 CM/SEC INITIAL DISP = .27522 CM
976 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	213	61	-102	-277	-300	-222	-97	19	61	77	91	86	61	46	50	59	52	30	10	-2
.4	-19	-44	-73	-97	-112	-103	-77	-35	18	47	59	65	50	23	13	35	68	109	136	125
.8	87	30	-32	-92	-141	-170	-169	-145	-76	22	106	157	147	102	55	2	-47	-69	-74	-76
1.2	-73	-68	-48	-13	19	41	55	59	57	53	47	39	24	6	0	3	5	4	3	-7
1.6	-29	-53	-71	-81	-73	-53	-11	36	56	53	41	31	27	24	6	-30	-58	-72	-69	-55
2.0	-34	-5	27	49	62	61	49	37	26	16	12	13	15	16	12	-0	-26	-56	-85	-97
2.4	-79	-53	-27	-2	15	21	20	25	37	47	50	51	50	37	17	-2	-18	-30	-41	-45
2.8	-43	-34	-18	2	25	41	52	55	47	39	30	18	2	-14	-30	-47	-59	-59	-53	-46
3.2	-32	-10	13	32	42	41	39	37	30	18	5	-13	-29	-31	-24	-16	-8	-2	1	-1
3.6	-5	-3	3	9	12	14	15	11	6	1	-4	-9	-13	-18	-20	-15	-5	13	32	44
4.0	52	47	34	20	7	-6	-19	-30	-34	-33	-31	-28	-26	-21	-15	-9	-2	4	11	9
4.4	1	-9	-17	-22	-19	-9	5	23	32	33	31	27	22	19	21	24	27	29	32	30
4.8	17	1	-14	-26	-38	-47	-46	-39	-32	-23	-13	-2	7	15	23	25	21	15	10	5
5.2	2	-0	-2	-5	-9	-13	-13	-8	-3	2	7	12	16	20	23	21	15	8	-1	-6
5.6	-4	-0	1	-2	-6	-9	-13	-18	-22	-20	-14	-7	-1	1	0	-1	-4	-8	-9	-6
6.0	-2	2	8	13	14	[illegible]	14	11	7	1	-3	-8	-11	-11	-11	-10	-7	-2	2	6
6.4	10	14	18	16	7	-4	-13	-22	-30	-32	-28	-24	-20	-14	-8	-0	6	12	17	21
6.8	26	26	24	22	20	16	8	0	-8	-13	-15	-17	-19	-17	-14	-10	-5	0	5	10
7.2	14	18	22	22	20	18	16	13	10	7	3	0	-3	-6	-6	-7	-7	-7	-8	-8
7.6	-7	-7	-6	-6	-4	-1	5	9	11	14	16	18	15	6	-3	-11	-15	-13	-11	-10
8.0	-8	-6	-5	-3	-1	0	1	2	3	3	3	4	3	1	-3	-5	-1	5	10	11
8.4	9	8	6	5	2	-2	-5	-9	-10	-10	-10	-9	-8	-7	-5	-3	-0	5	10	15
8.8	19	18	14	9	5	1	-2	-5	-8	-9	-7	-3	1	4	6	9	11	13	13	9
9.2	4	-1	-6	-9	-12	-15	-16	-14	-12	-9	-5	-1	3	6	6	3	1	-0	-1	-2
9.6	-1	3	8	13	17	20	22	24	26	24	19	14	8	3	-3	-10	-18	-21	-18	-13
10.0	-8	-3	1	4	8	12	12	8	4	-1	-5	-10	-14	-19	-21	-17	-11	-5	1	7
10.4	13	20	24	23	20	18	15	12	8	4	0	-2	-2	-1	-1	-0	0	1	1	2
10.8	2	2	0	-2	-3	-5	-7	-8	-10	-10	-9	-7	-5	-3	-1	1	2	4	5	7
11.2	8	7	5	[illegible]	1	-2	-6	-10	-15	-18	-17	-15	-13	-11	-9	-6	-4	-2	-1	-0
11.6	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-1	-3	-4	-6	-7	-9	-10	-11	-12
12.0	-12	-13	-14	-14	-13	-11	-8	-5	-2	1	3	5	7	9	12	14	12	8	4	-0
12.4	-3	-5	-5	-6	-6	-7	-7	-7	-7	-6	-5	-4	-3	-2	-1	-0	0	0	0	0
12.8	0	0	0	0	0	-3	-8	-12	-11	-7	-2	2	4	5	6	6	5	1	-3	-8
13.2	-12	-15	-17	-19	-18	-14	-10	-5	-2	2	5	8	9	6	2	-1	-1	0	-0	-0
13.6	-1	-1	-1	-2	-4	-6	-8	-8	-6	-4	-1	0	1	1	2	2	2	2	2	1
14.0	-0	-2	-4	-6	-7	-6	-5	-4	-3	-1	-0	1	2	2	2	2	2	2	2	1
14.4	-0	-2	-3	-3	-2	-1	1	2	3	5	6	7	9	8	7	6	6	5	4	3
14.8	2	1	-0	-1	-2	-4	-5	-6	-8	-9	-9	-7	-6	-4	-3	-1	1	2	3	3
15.2	3	3	3	3	2	2	2	2	2	2	2	1	1	0	-0	-1	-1	-2	-3	-5
15.6	-7	-8	-9	-9	-8	-6	-5	-4	-3	-2	-0	2	3	5	6	5	3	2	-0	-2
16.0	-3	-4	-4	-4	-4	-4	-4	-3	-2	-2	-1	-1	-0	0	1	1	2	2	2	2
16.4	2	2	2	2	2	2	1	1	1	1	0	-0	-0	-1	-1	-2	-2	-2	-2	-2
16.8	-1	-1	-0	0	1	1	2	2	2	1	0	-0	-0	0	1	2	2	3	4	4
17.2	5	5	6	6	6	7	7	8	8	8	7	7	7	7	7	7	7	7	6	6
17.6	6	6	6	6	5	5	4	3	2	2	1	2	4	6	8	10	11	11	10	10
18.0	9	9	8	8	7	7	6	6	5	5	4	4	3	3	3	3	3	3	3	2
18.4	2	2	2	2	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4
18.8	3	4	4	4	4	5	5	5	5	6	6	6	6	6	6	5	5	4	3	2
19.2	1	-0	-2	-4	-5	-7	-8	-7	-6	-5	-4	-2	-1	0	1	7				

CORRECTED ACCELERATION ORDINATES

FERNDALE,CALIF.,9/12/71,COMP N46W

INSTR PERIOD = .0640 SEC DAMPING = .590 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.

PEAK VALS ACLN = -40.5 CM/SEC/SEC AT .10 SEC VELO = -1.7 CM/SEC AT .16 SEC DISP = -.8 CM AT 3.04 SEC

LENGTH OF RECORD = 19.60 SEC INITIAL VELO = .65981 CM/SEC INITIAL DISP = .36576 CM

981 INSTRUMENT AND BASFLINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

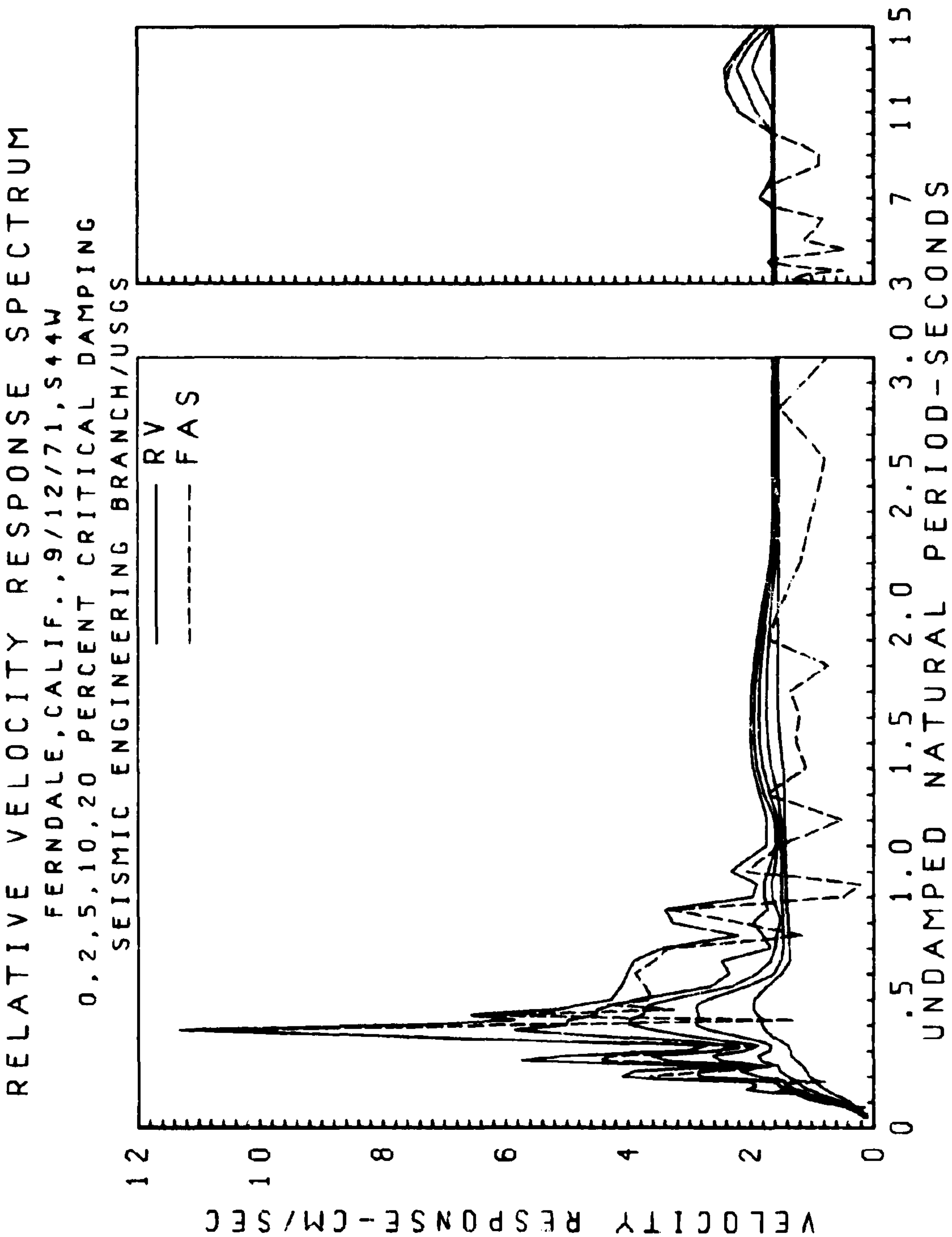
SEC.																				
0.	263	124	-8	-174	-343	-405	-321	-162	-2	96	113	90	84	85	76	47	18	4	1	-5
.4	-20	-27	-24	-16	-15	-29	-52	-53	-22	12	30	36	37	46	57	50	26	13	30	58
.8	86	83	35	-23	-80	-130	-155	-150	-128	-85	-24	39	84	111	107	86	80	58	14	-30
1.2	-61	-77	-74	-56	31	-2	23	31	36	52	57	52	46	37	26	15	-5	-29	-29	-13
1.6	0	10	16	7	-11	-29	-44	-58	-55	-30	14	57	77	59	16	-27	-63	-71	-48	-17
2.0	7	30	41	41	40	35	26	16	7	-4	-13	-6	12	26	34	25	4	-14	-17	-7
2.4	6	18	25	26	19	3	-14	-31	-49	-54	-43	-29	-13	5	24	48	65	55	26	-3
2.8	-32	-49	-53	-44	-25	-8	5	17	27	33	40	46	52	59	63	49	20	-8	-29	-36
3.2	-29	-21	-15	-10	-11	-16	-22	-26	-24	-11	7	19	23	16	4	-8	-22	-38	-36	-20
3.6	-1	22	47	62	69	62	41	21	6	-6	-31	-46	-38	-24	-9	6	17	18	18	18
4.0	18	18	21	26	30	33	29	20	8	-7	-23	-38	-47	-49	-50	-48	-45	-41	-36	-26
4.4	-15	0	21	38	45	45	46	45	41	37	33	28	18	4	-11	-21	-22	-16	-9	-5
4.8	-2	-1	-1	-2	-2	-1	1	3	3	3	3	2	-5	-10	-5	3	10	16	14	1
5.2	-11	-14	-16	-14	-7	-0	6	9	11	10	7	3	-0	-4	-8	-13	-18	-17	-13	-9
5.6	-4	-0	5	12	18	24	24	21	18	15	12	6	1	-5	-11	-17	-22	-26	-27	-25
6.0	-22	-20	-17	-15	-11	-7	-3	1	5	8	10	13	15	16	18	17	15	11	8	9
6.4	11	13	16	17	11	2	-7	-16	-23	-27	-29	-30	-27	-22	-17	-11	-6	-1	5	12
6.8	18	23	21	15	9	1	-9	-19	-29	-34	-30	-24	-19	-13	-6	3	11	13	12	12
7.2	12	11	10	9	7	5	4	2	0	-1	-3	-5	-7	-9	-11	-13	-16	-18	-19	-18
7.6	-16	-15	-13	-11	-9	-7	-5	-2	1	4	7	9	12	15	16	12	7	2	-4	-8
8.0	-9	-6	-2	1	4	7	11	13	16	18	20	18	11	4	-3	-8	-9	-8	-8	-7
8.4	-7	-6	-5	-4	-2	-1	0	2	3	4	1	-4	-9	-14	-19	-20	-21	-21	-19	-15
8.8	-10	-5	-0	4	7	10	13	16	17	14	9	5	1	-3	-6	-10	-13	-13	-9	-6
9.2	-2	1	3	3	4	3	-3	-12	-20	-26	-28	-29	-28	-24	-20	-16	-12	-9	-6	-3
9.6	-0	3	3	2	1	0	1	3	5	7	9	11	13	14	16	14	9	3	-2	-8
10.0	-13	-14	-14	-15	-15	-15	-13	-9	-6	-2	1	4	5	4	4	3	3	2	2	1
10.4	2	3	4	6	7	8	9	10	12	11	8	3	-2	-7	-11	-16	-20	-23	-24	-24
10.8	-19	-12	-4	4	11	18	23	29	33	31	24	16	9	3	-0	-3	-6	-7	-5	-1
11.2	3	6	8	10	11	7	2	-3	-4	-5	-5	-6	-6	-4	-2	1	3	5	7	9
11.6	11	13	15	17	18	18	14	10	6	2	-2	-5	-8	-11	-13	-13	-10	-8	-5	-3
12.0	-1	1	2	4	6	7	9	9	8	7	6	5	3	2	1	-0	-1	-2	-4	-5
12.4	-5	-4	-4	-4	-4	-6	-6	-4	-1	2	5	9	11	10	8	5	2	-1	-5	-7
12.8	-7	-7	-7	-6	-6	-6	-6	-5	-4	-3	-2	-1	1	2	3	3	3	3	3	3
13.2	2	-2	-5	-9	-11	-10	-6	-3	0	2	4	5	7	8	9	7	6	5	3	2
13.6	-1	-5	-8	-11	-12	-10	-9	-8	-7	-6	-5	-4	-3	-2	-2	-2	-2	-1	-1	-0
14.0	1	2	2	3	5	6	7	8	9	10	11	12	10	6	3	-1	-5	-8	-12	-16
14.4	-17	-16	-15	-14	-12	-11	-10	-8	-5	-2	0	3	5	8	9	10	11	12	13	14
14.8	13	11	9	7	5	2	0	-1	-3	-4	-5	-6	-7	-8	-10	-11	-11	-10	-8	-6
15.2	-4	-2	-0	2	3	4	5	6	7	8	8	6	5	4	3	2	0	-1	-2	-3
15.6	-4	-5	-5	-4	-4	-3	-3	-2	-2	-0	1	3	5	7	9	10	11	12	14	15
16.0	15	13	11	8	5	2	-1	-3	-5	-6	-8	-10	-11	-13	-14	-15	-16	-14	-12	-10
16.4	-8	-6	-4	-2	0	2	4	4	4	4	4	5	5	5	5	5	5	5	5	6
16.8	6	5	5	5	4	4	4	3	3	2	2	2	1	1	1	0	-0	-0	-0	0
17.2	0	0	0	1	1	1	1	1	2	3	5	6	8	10	11	13	13	13	13	13
17.6	13	13	13	11	7	3	-0	-4	-8	-10	-9	-6	-4	-1	2	4	6	7	8	9
18.0	9	10	10	9	8	8	7	6	5	4	3	1	-0	-2	-4	-6	-8	-8	-7	-6
18.4	-5	-5	-4	-3	-3	-3	-3	-3	-3	-3	-4	-4	-4	-4	-4	-4	-4	-5	-5	-5
18.8	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6	-6	-7	-7	-7	-7	-7	-7	-7	-8	-8
19.2	-8	-8	-8	-8	-8	-8	-9	-9	-9	-9	-10	-10	-10	-10	-11	-11	-11	-11	-11	-12
19.6	-12																			

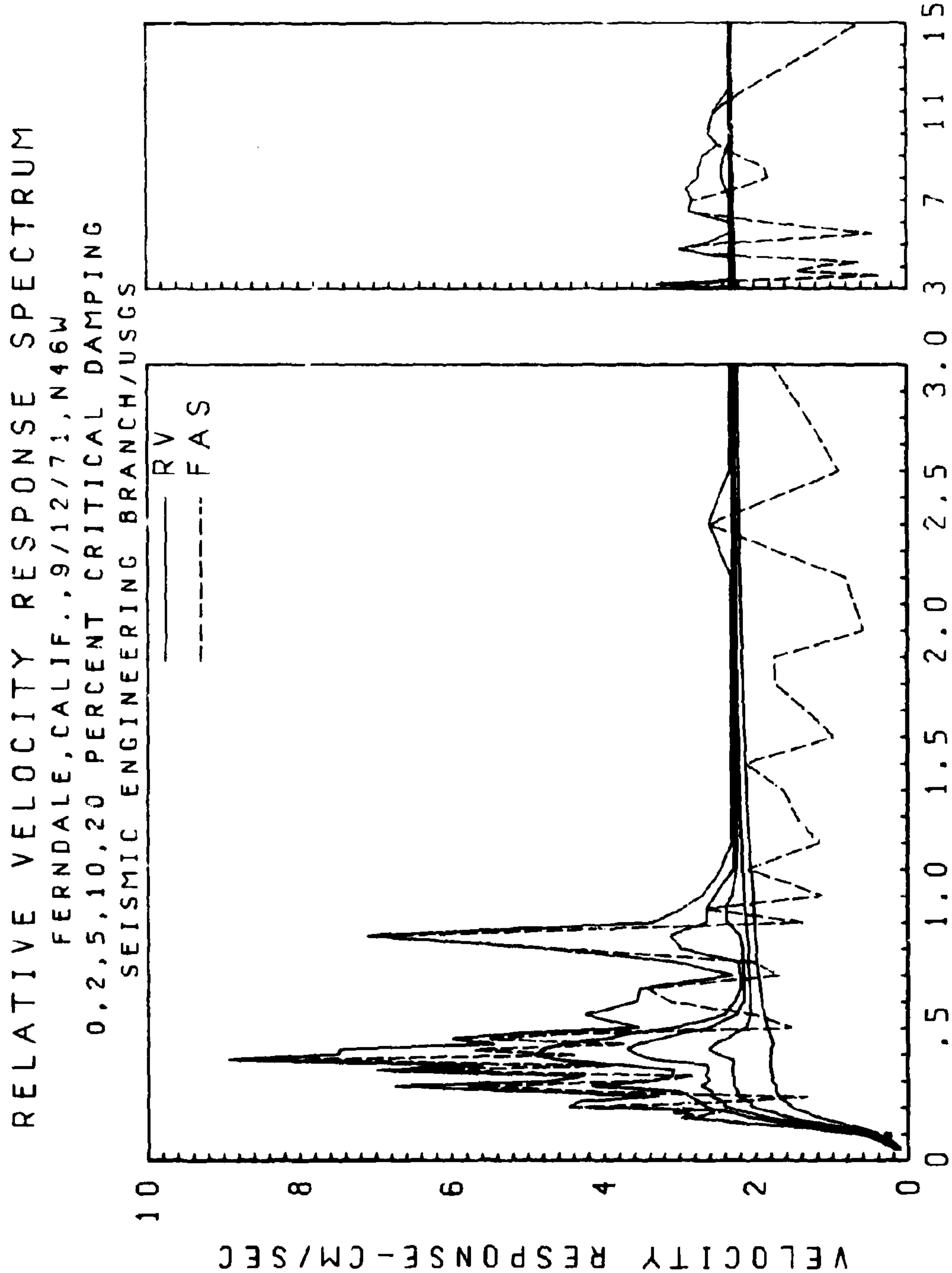
CORRECTED ACCELERATION ORDINATES

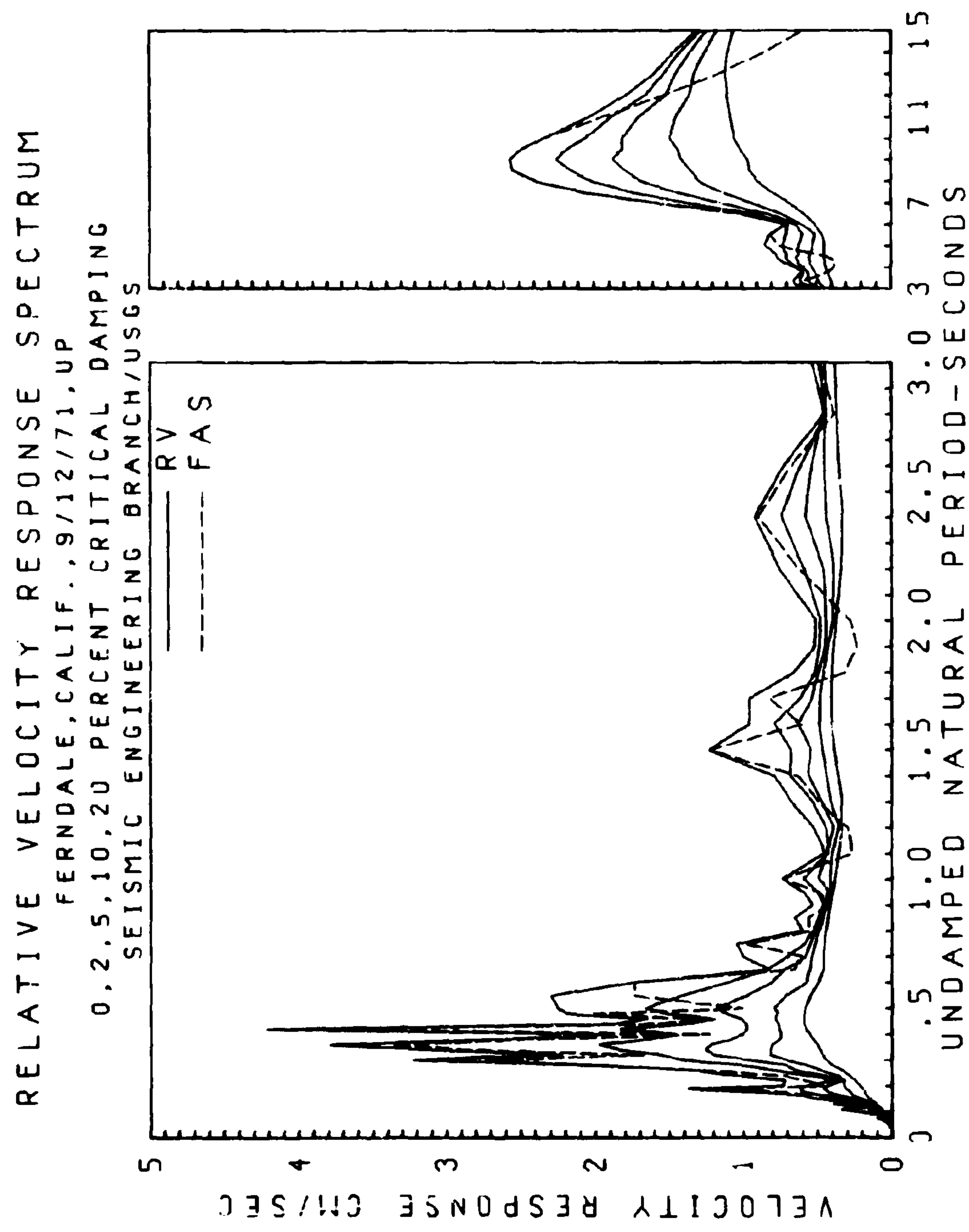
FERNDALE,CALIF.,9/12/71,COMP UP

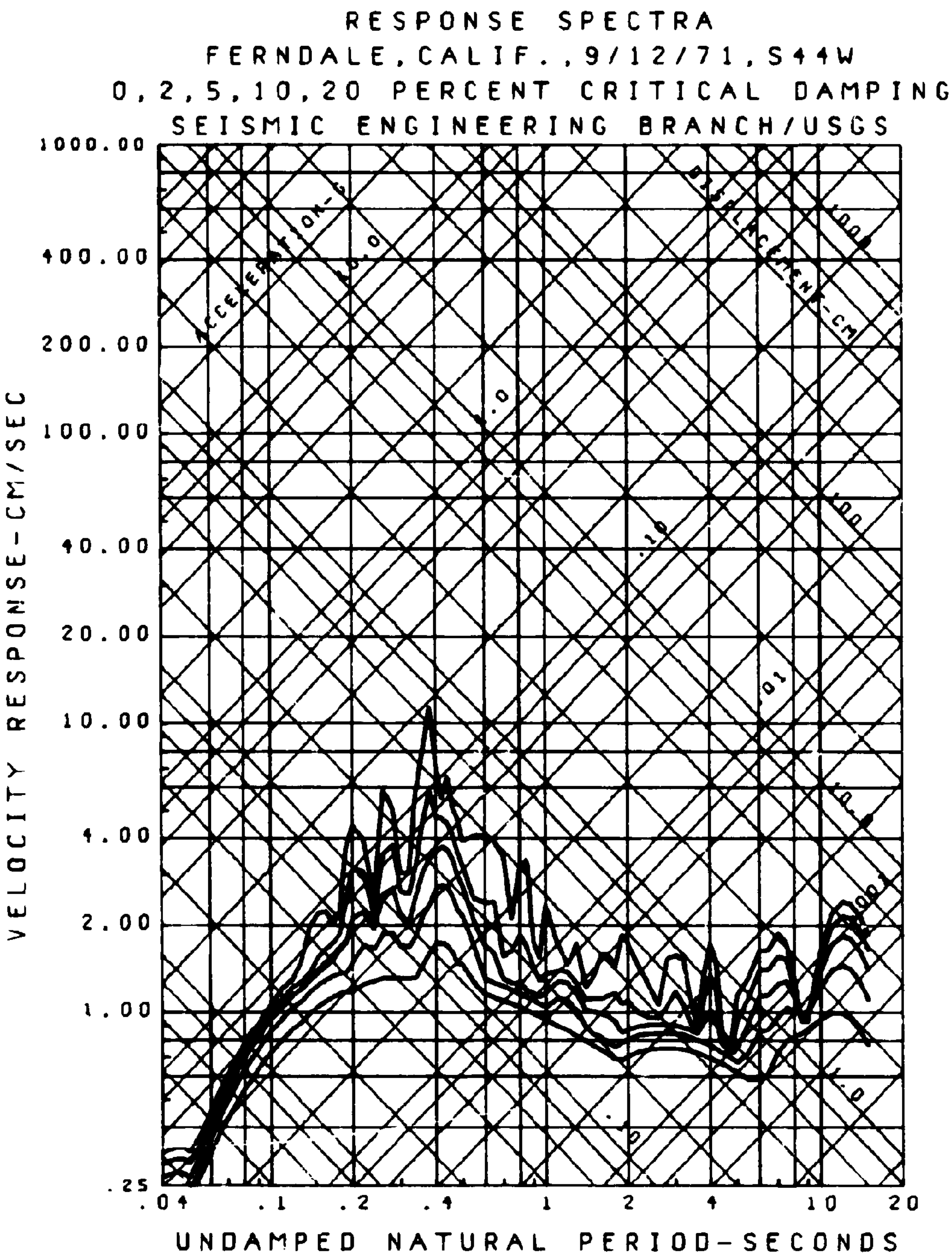
INSTR PERIOD = .0660 SEC DAMPING = .570 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 6.3 CM/SEC/SEC AT .70 SEC VELO = .6 CM/SEC AT 12.70 SEC DISP = -.8 CM AT 11.34 SEC
LENGTH OF RECORD = 19.80 SEC INITIAL VELO = -.18790 CM/SEC INITIAL DISP = -.06073 CM
991 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

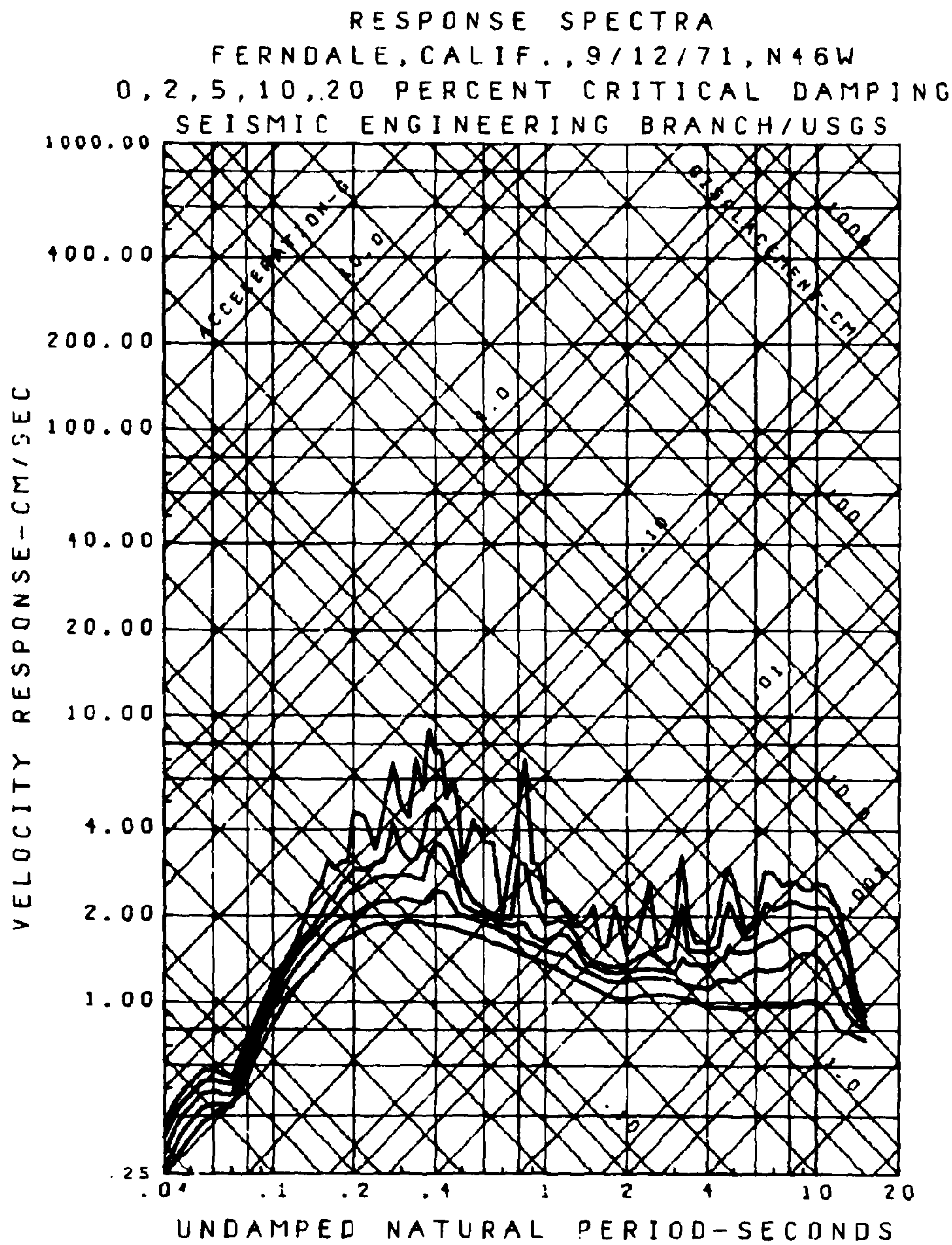
SEC.																				
0.	24	-6	-18	-22	-17	-8	5	15	11	2	-6	-14	-21	-10	14	41	59	48	24	3
.4	-5	-1	-0	-5	-12	-19	-26	-33	-41	-46	-35	-11	11	29	50	63	55	41	26	8
.8	-9	-23	-28	-21	-13	-13	-15	-17	-13	-3	9	20	26	22	12	3	-8	-23	-36	-32
1.2	-19	-7	-4	-7	-6	2	11	19	21	18	16	13	10	5	0	-2	-2	-1	-2	-5
1.6	-10	-14	-15	-14	-13	-10	-3	6	14	22	30	35	32	28	24	20	14	6	-2	-9
2.0	-16	-20	-23	-27	-27	-20	-9	3	14	25	31	27	19	12	2	-8	-12	-4	3	12
2.4	21	23	19	14	9	5	-1	-7	-13	-18	-19	-20	-22	-29	-31	-23	-12	-1	14	29
2.8	36	35	34	28	19	10	1	-7	-14	-20	-26	-31	-31	-27	-18	-8	2	16	32	46
3.2	48	35	18	2	-15	-28	-39	-40	-28	-13	1	15	28	35	38	36	29	20	5	-19
3.6	-37	-36	-24	-12	-4	2	7	11	14	17	17	12	3	-6	-13	-17	-18	-12	-3	4
4.0	8	10	9	6	3	1	1	2	2	3	2	-3	-11	-19	-25	-24	-21	-18	-15	-11
4.4	-6	-0	6	11	15	18	21	24	23	20	18	16	12	6	-2	-8	-16	-23	-29	-30
4.8	-24	-17	-9	-1	8	13	16	20	23	21	14	6	-2	-9	-17	-24	-29	-27	-19	-11
5.2	-2	6	14	21	26	27	22	18	13	7	-2	-12	-22	-31	-37	-34	-26	-16	-8	-1
5.6	4	10	14	14	13	12	11	10	7	3	-1	-6	-9	-11	-12	-13	-14	-14	-13	-12
6.0	-11	-10	-9	-8	-5	-3	-1	1	1	-0	-1	-3	-4	-5	-6	-8	-11	-15	-15	-11
6.4	-5	-0	5	10	15	20	26	29	27	20	10	-1	-11	-20	-28	-32	-29	-22	-15	-7
6.8	-0	-0	-2	-4	-5	-3	-1	3	8	13	19	25	26	20	13	7	-0	-8	-17	-26
7.2	-28	-24	-19	-15	-11	-6	-1	3	6	7	8	9	8	6	5	3	1	-1	-3	-4
7.6	-2	1	4	6	4	1	-2	-6	-11	-16	-17	-14	-11	-7	-3	1	6	10	10	6
8.0	3	-1	-4	-6	-6	-6	-6	-6	-6	-6	-6	-4	-1	2	5	8	11	14	13	9
8.4	4	-0	-5	-10	-14	-15	-13	-11	-9	-6	-4	-2	-1	1	2	3	4	2	-0	-3
8.8	-5	-5	-3	-2	-0	1	3	4	6	8	8	7	6	5	5	4	3	2	2	2
9.2	1	1	1	1	0	0	0	0	0	0	-1	-3	-4	-4	-2	1	4	7	8	7
9.6	7	7	6	4	1	-2	-5	-6	-4	-2	-1	1	2	3	3	3	4	4	3	0
10.0	-2	-5	-7	-8	-6	-3	-1	2	5	7	5	2	-2	-5	-7	-6	-5	-5	-4	-3
10.4	-1	0	2	4	5	6	6	6	7	7	7	7	7	7	7	6	6	6	5	4
10.8	4	3	2	-2	-6	-8	-5	-2	1	4	5	5	5	5	5	5	5	5	5	5
11.2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
11.6	5	5	5	5	5	4	3	3	2	2	2	3	6	8	10	13	15	17	16	13
12.0	10	7	4	1	-2	-2	-0	1	3	5	6	7	7	7	7	7	8	9	7	6
12.4	5	3	2	0	-1	-2	-2	-1	-0	1	2	3	4	3	2	-0	-2	-4	-5	-7
12.8	-7	-6	-6	-6	-5	-5	-4	-4	-4	-3	-3	-2	-2	-2	-1	-1	-1	-1	-1	-1
13.2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-1	-1	-0	0	1	1	2
13.6	2	3	4	4	4	4	3	3	2	2	1	1	0	-0	-1	-2	-3	-4	-5	-6
14.0	-7	-7	-8	-8	-7	-5	-4	-3	-1	-0	1	2	2	1	1	0	0	-0	-1	-1
14.4	-1	-2	-2	-3	-4	-5	-6	-6	-5	-5	-5	-5	-5	-5	-4	-4	-4	-4	-4	-4
14.8	-4	-4	-4	-4	-4	-4	-4	-4	-2	-1	1	2	3	5	5	4	3	1	0	-1
15.2	-2	-3	-4	-6	-7	-8	-7	-6	-5	-4	-3	-2	-1	0	1	1	-0	-1	-2	-3
15.6	-3	-4	-5	-6	-6	-6	-6	-5	-5	-5	-5	-4	-4	-4	-3	-3	-3	-3	-3	-3
16.0	-3	-3	-3	-4	-4	-4	-4	-4	-4	-4	-5	-5	-4	-4	-3	-3	-2	-2	-2	-1
16.4	-1	-1	-0	-0	-0	0	0	0	1	1	1	1	1	1	0	0	0	-0	-0	-0
16.8	-1	-1	-1	-1	-1	-1	-1	-0	-0	-0	-0	-0	0	0	0	0	1	1	1	1
17.2	0	-1	-1	-2	-3	-3	-4	-5	-4	-3	-2	-2	-1	0	1	2	3	3	3	3
17.6	3	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1
18.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
18.4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
18.8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1
19.2	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
19.6	2	2	2	2	2	2	3	3	3	3	3									

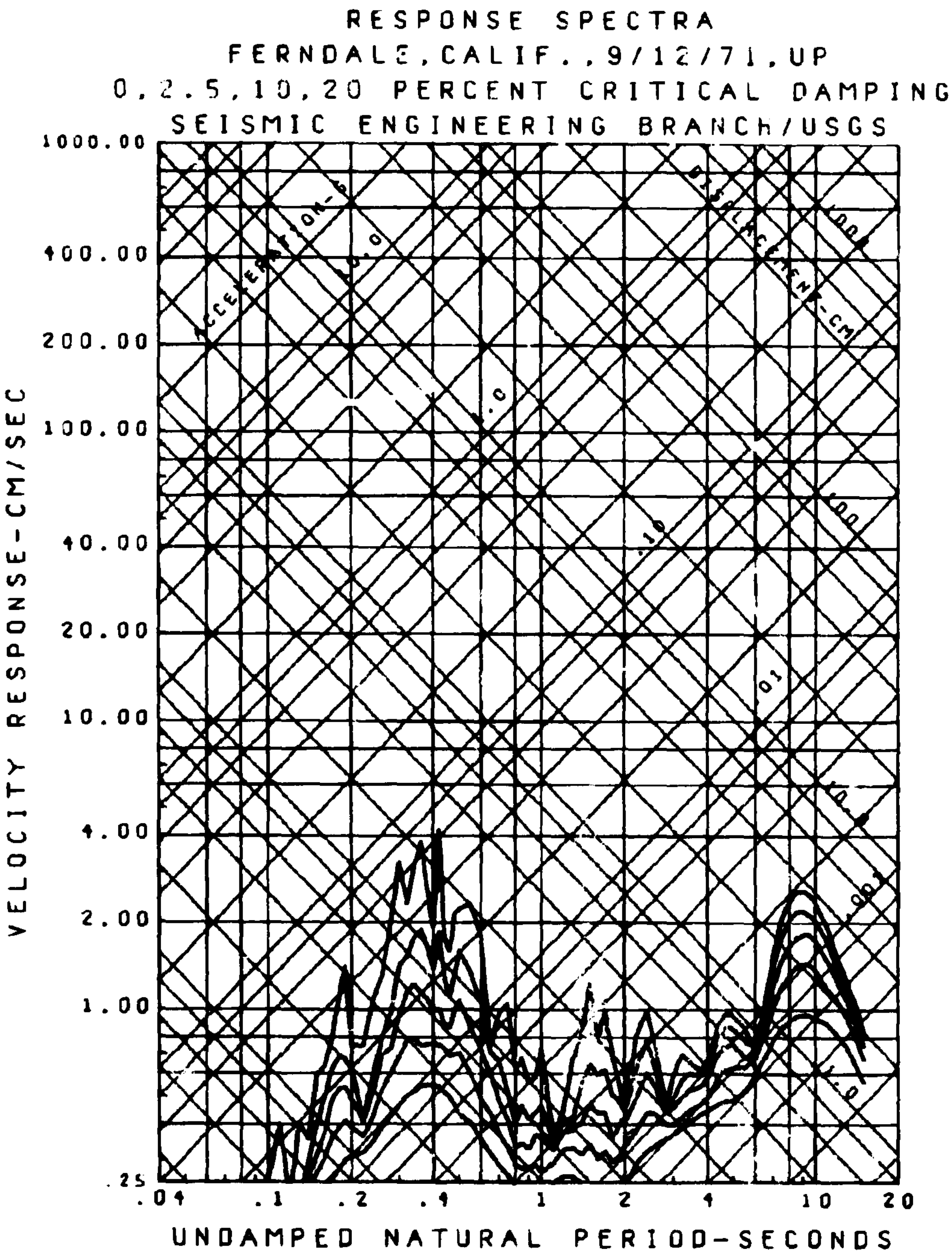

RELATIVE VELOCITY RESPONSE SPECTRUM
FERNDALE,CALIF.,9/12/71,S44W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
0
2
4
6
8
10
12
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15


RELATIVE VELOCITY RESPONSE SPECTRUM
FERNDALE,CALIF.,9/12/71,N46W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
UNDAMPED NATURAL PERIOD-SECONDS
VELOCITY RESPONSE-CM/SEC
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
0
2
4
6
8
10

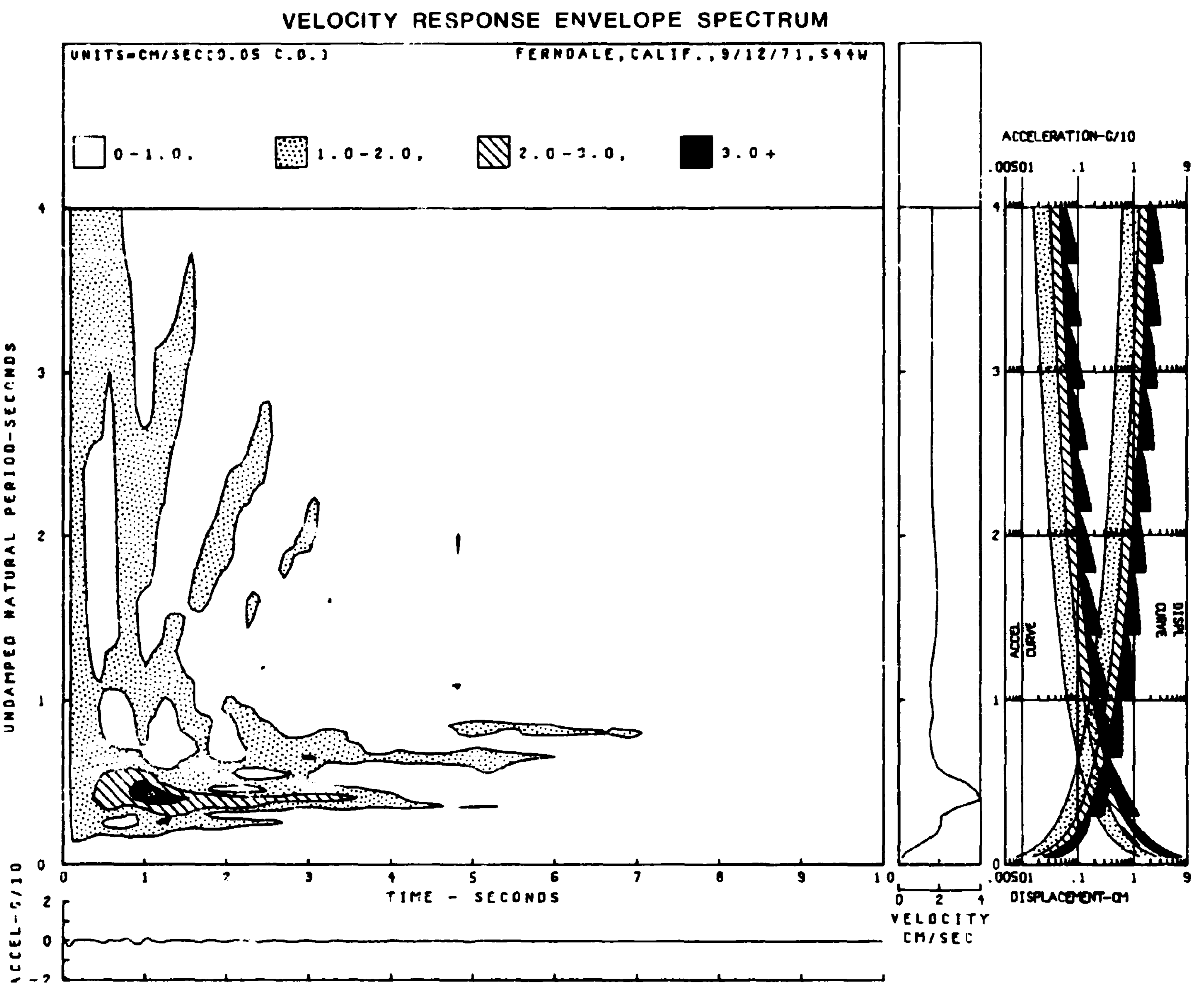

RELATIVE VELOCITY RESPONSE SPECTRUM
FERNDALE,CALIF.,9/12/71,UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE CM/SEC
0
1
2
3
4
5
UNDAMPED NATURAL PERIOD-SECONDS
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15


RESPONSE SPECTRA
FERNDALE, CALIF., 9/12/71, S44W
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20


RESPONSE SPECTRA
FERNDALE,CALIF.,9/12/71,N46W
0,2,5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
ACCELERATION-G
DISPLACEMENT-CM
.04
.1
.2
.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS

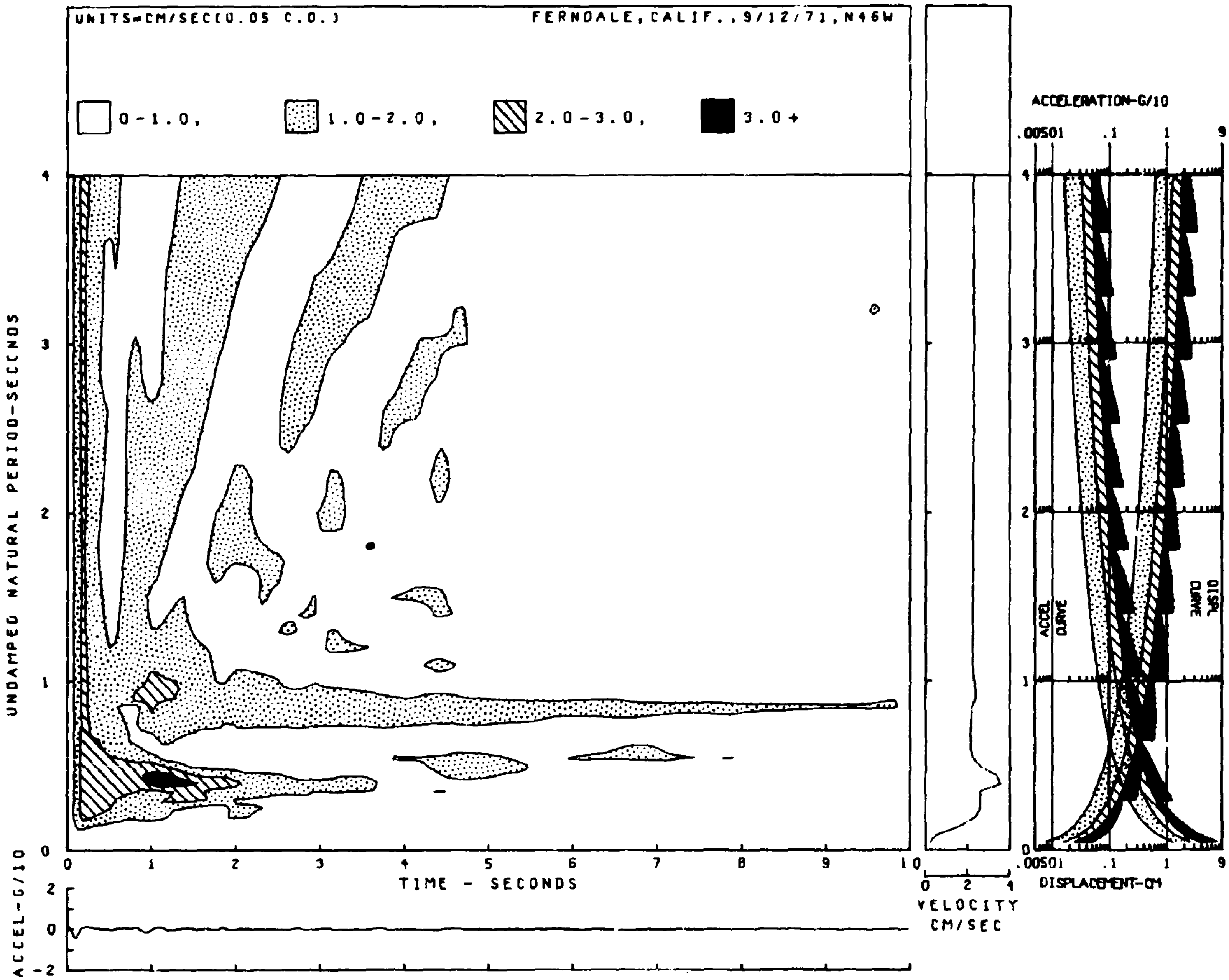


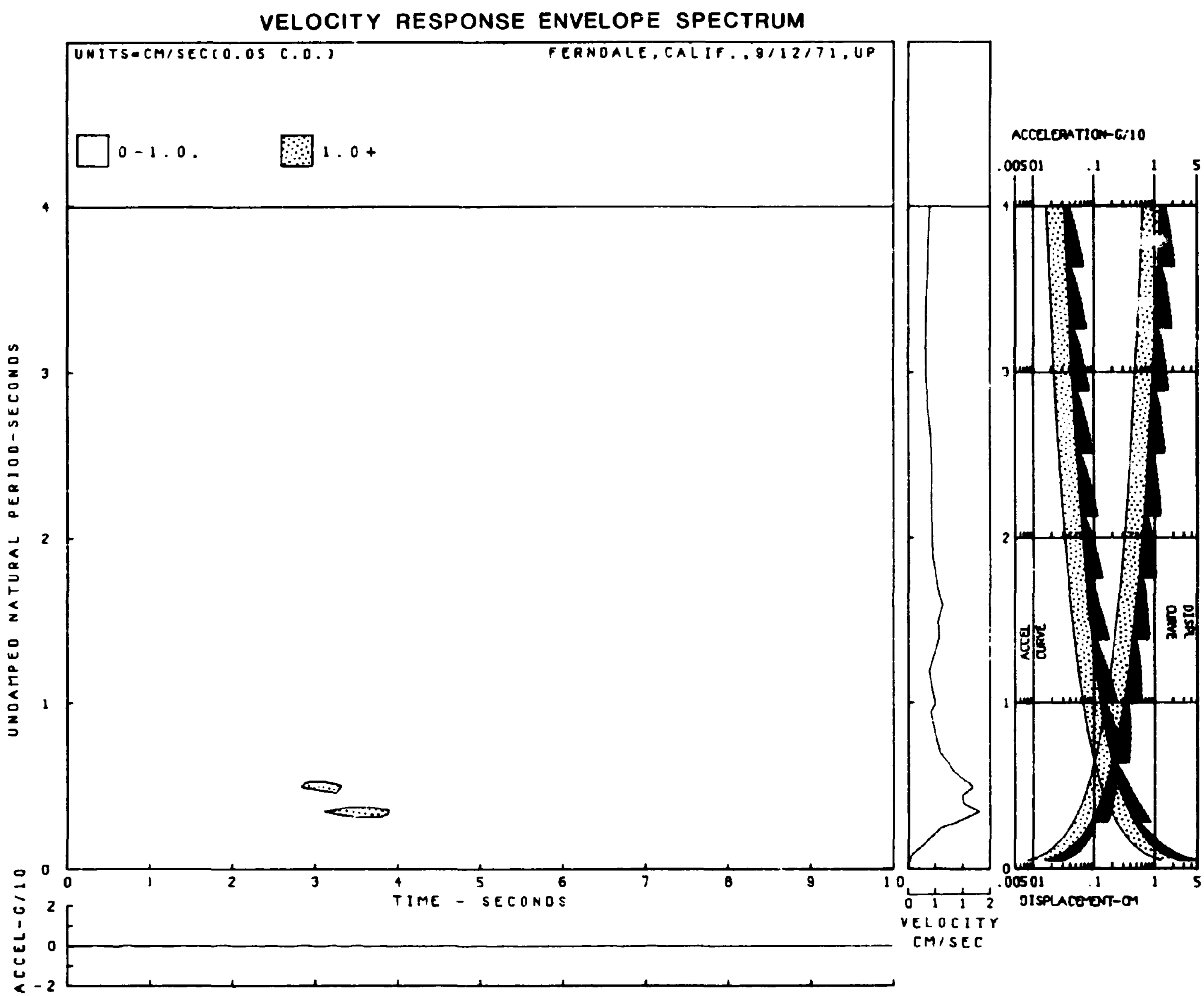
RESPONSE SPECTRA
FERNDALE,CALIF.,9/12/71,UP
0,2.5,10,20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
DISPLACEMENT-CM



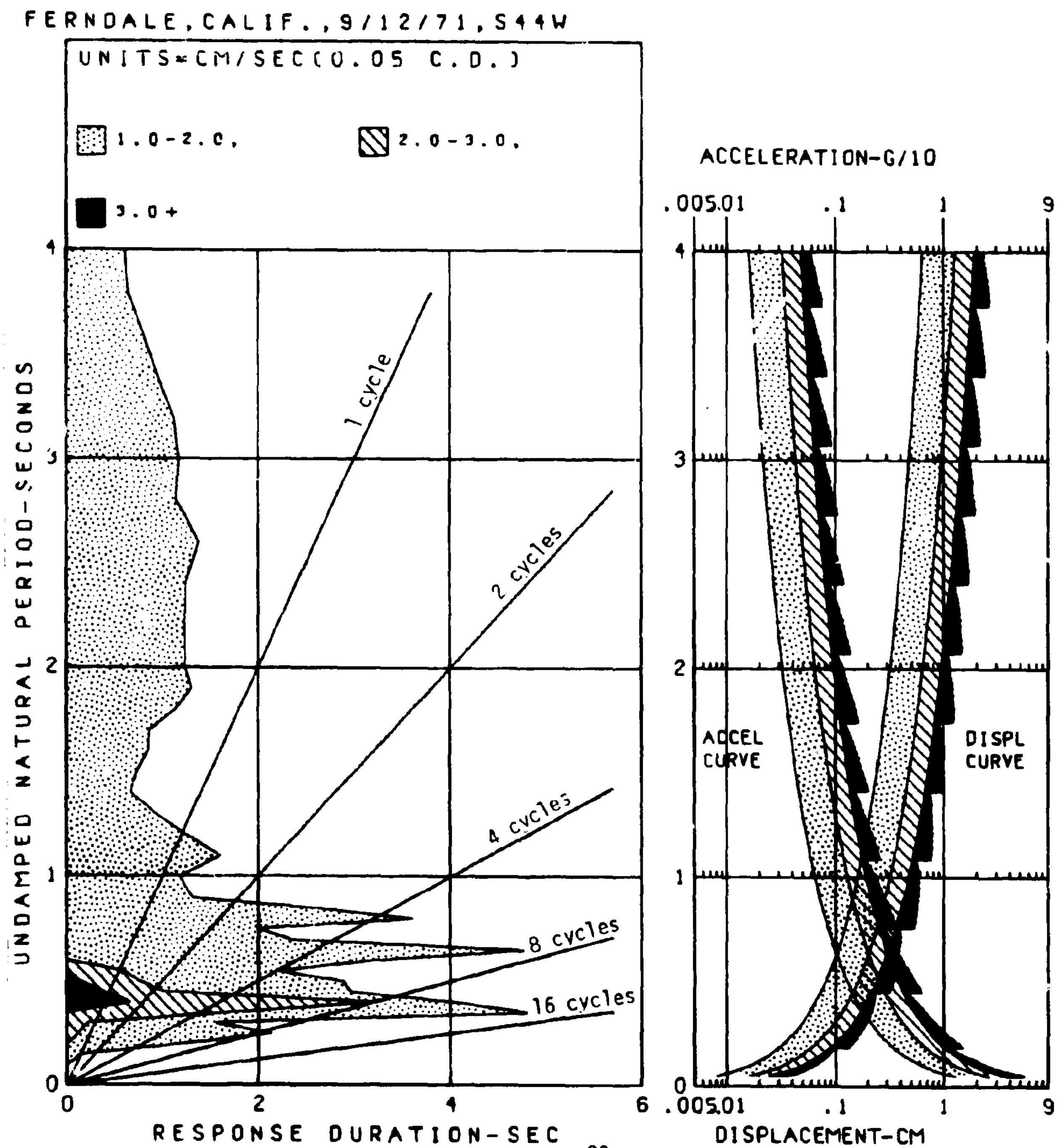
VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
FERNDALE, CALIF., 9/12/71, S44W
0-1.0,
1.0-2.0,
2.0-3.0,
3.0+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE

VELOCITY RESPONSE ENVELOPE SPECTRUM

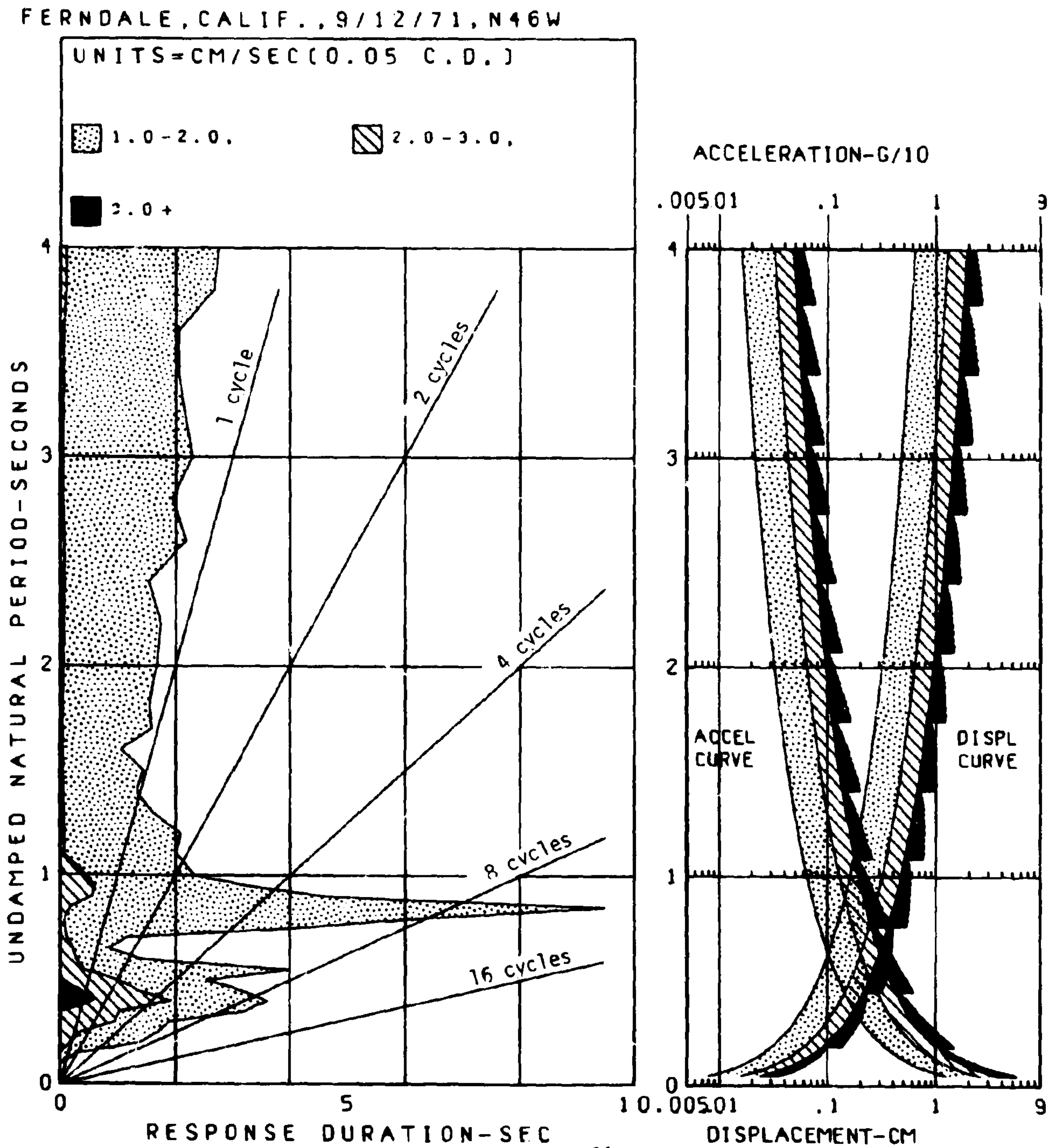



VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
FERNDALE,CALIF.,9/12/71,UP
0-1.0.
1.0+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE

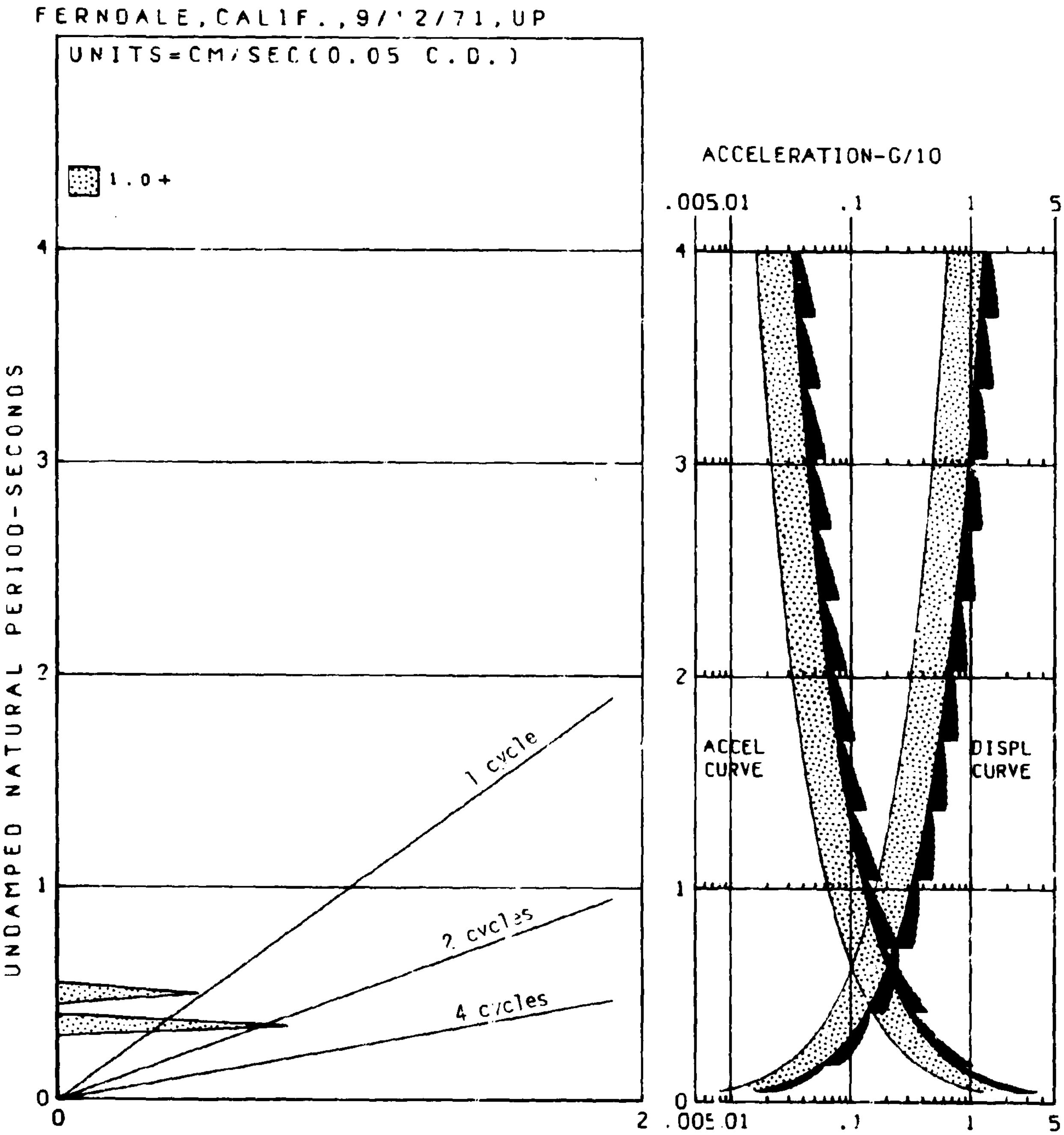
TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



TIME DURATION SPECTRUM OF THE RESPONSE ENVELOPE



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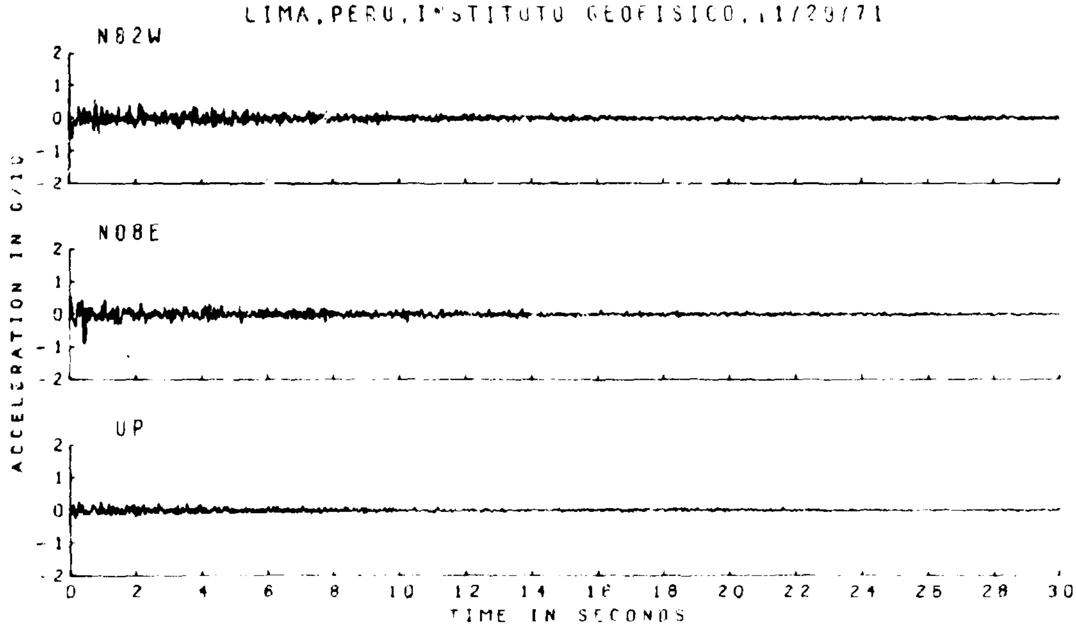
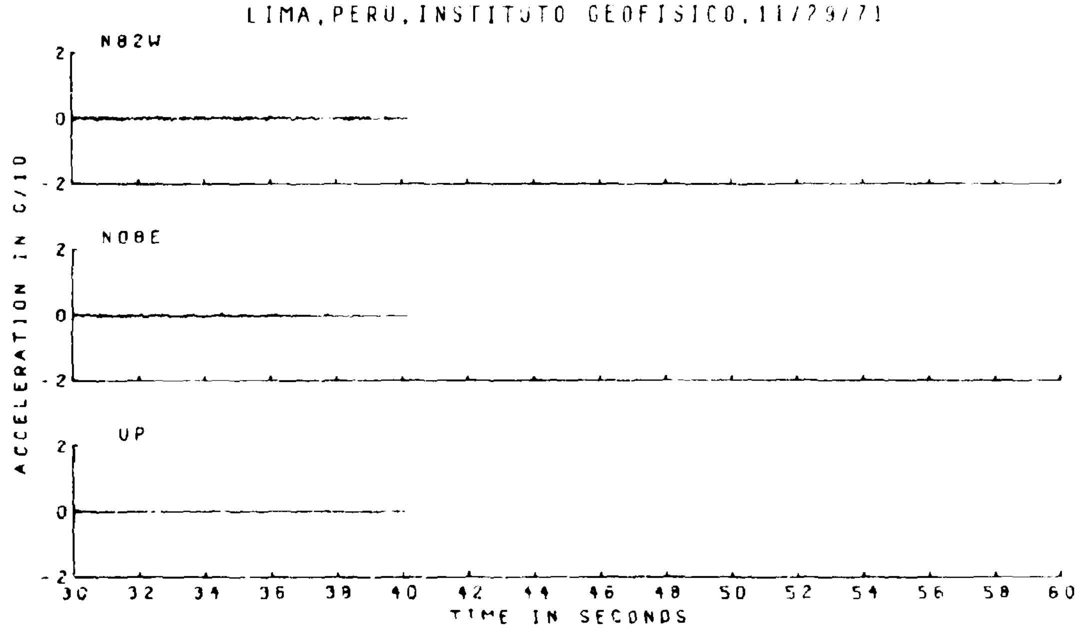
UNCORRECTED ACCELEROGRAM

LIMA, PERU, INSTITUTO GEOFISICO, 11/29/71



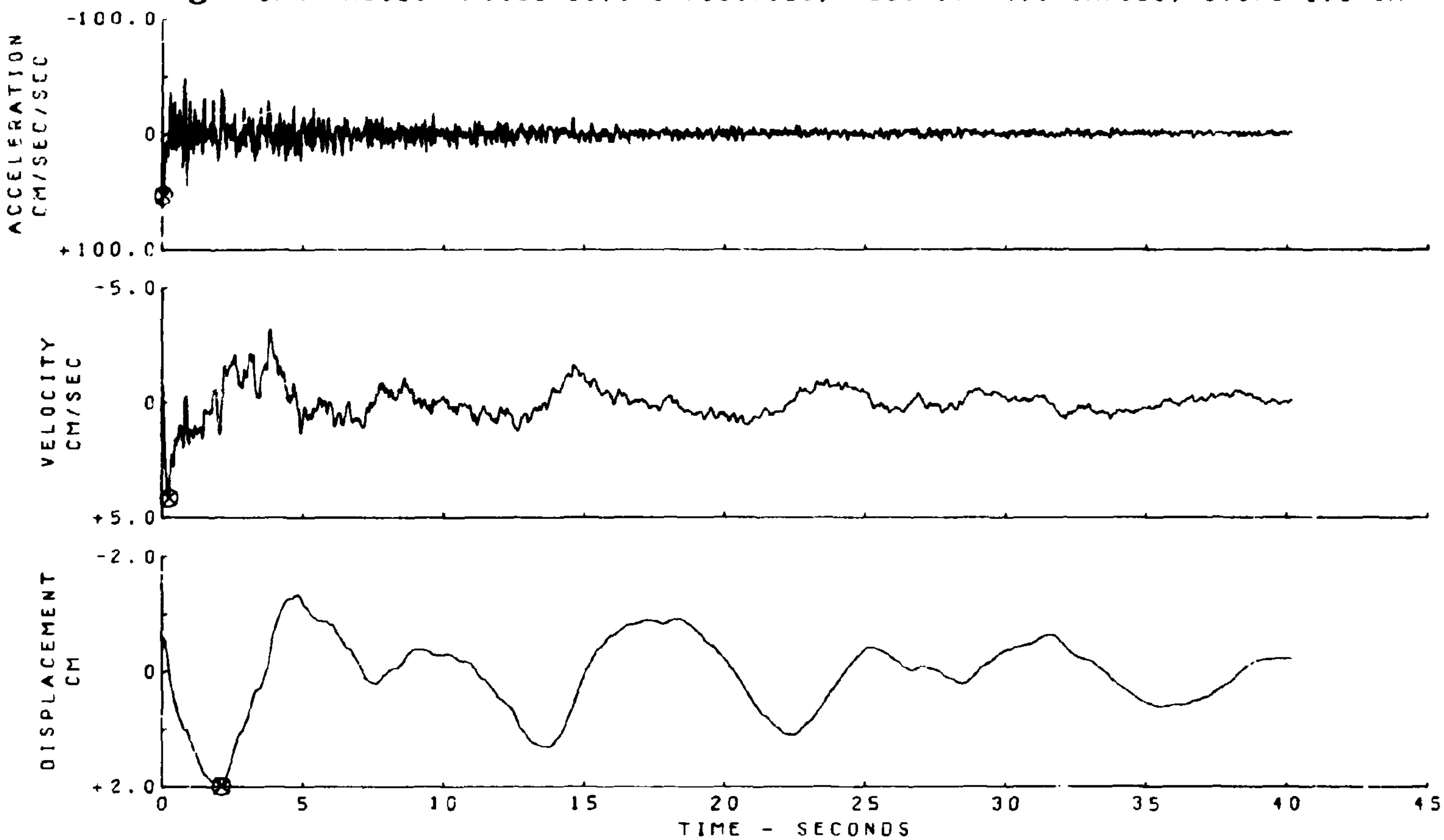
LIMA, PERU, INSTITUTO GEOFISICO, 11/29/71



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

LIMA, PERU EARTHQUAKE OF NOVEMBER 29, 1971
INSTITUTO GEOFISICO DEL PERU, COMP N82W

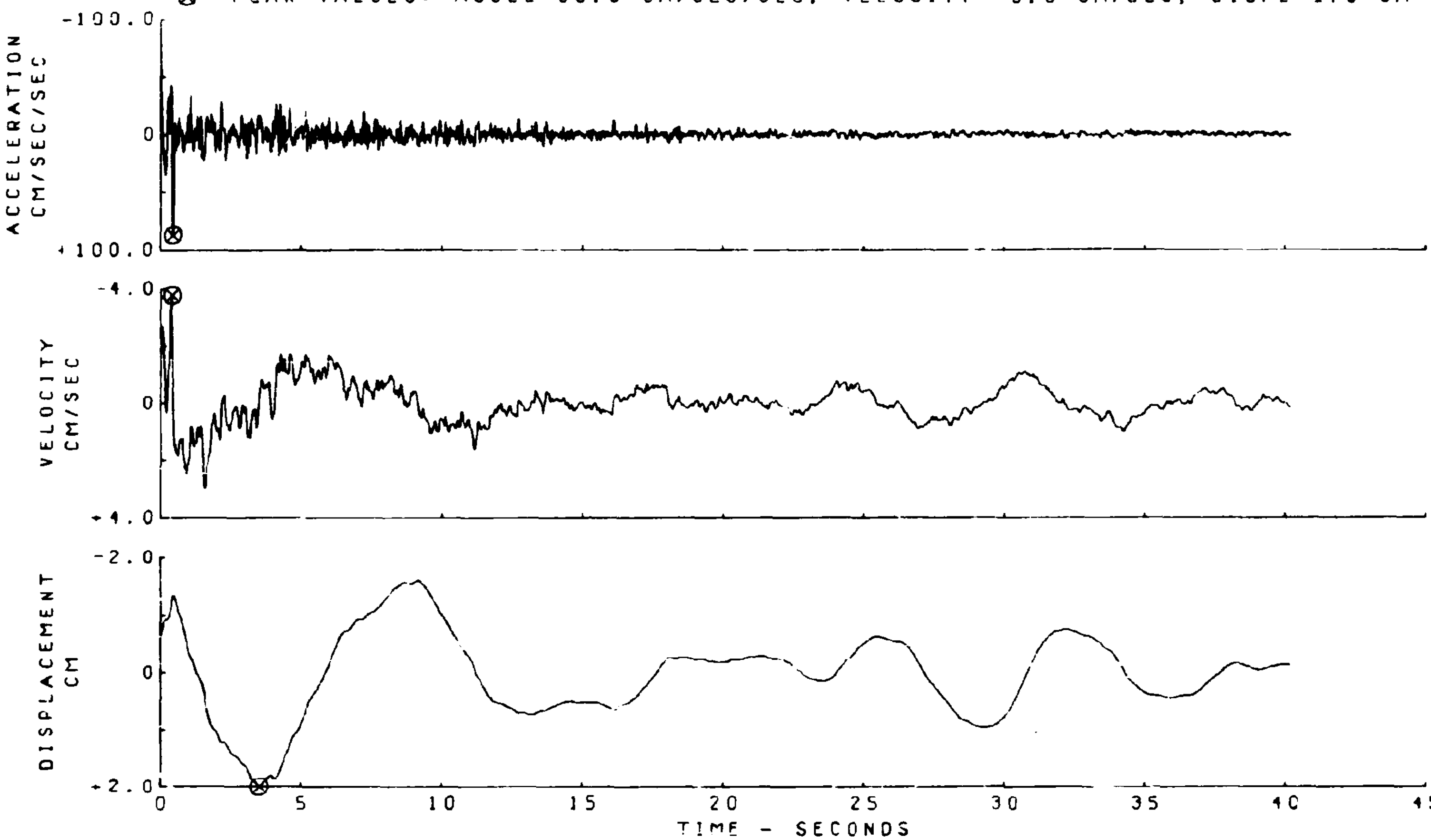
⊗ PEAK VALUES: ACCEL=53.6 CM/SEC/SEC, VELOCITY=4.1 CM/SEC, DISPL=2.0 CM



CORRECTED ACCELERATION. VELOCITY. DISPLACEMENT

LIMA, PERU EARTHQUAKE OF NOVEMBER 29, 1971
INSTITUTO GEOFISICO DEL PERU,COMP N08E

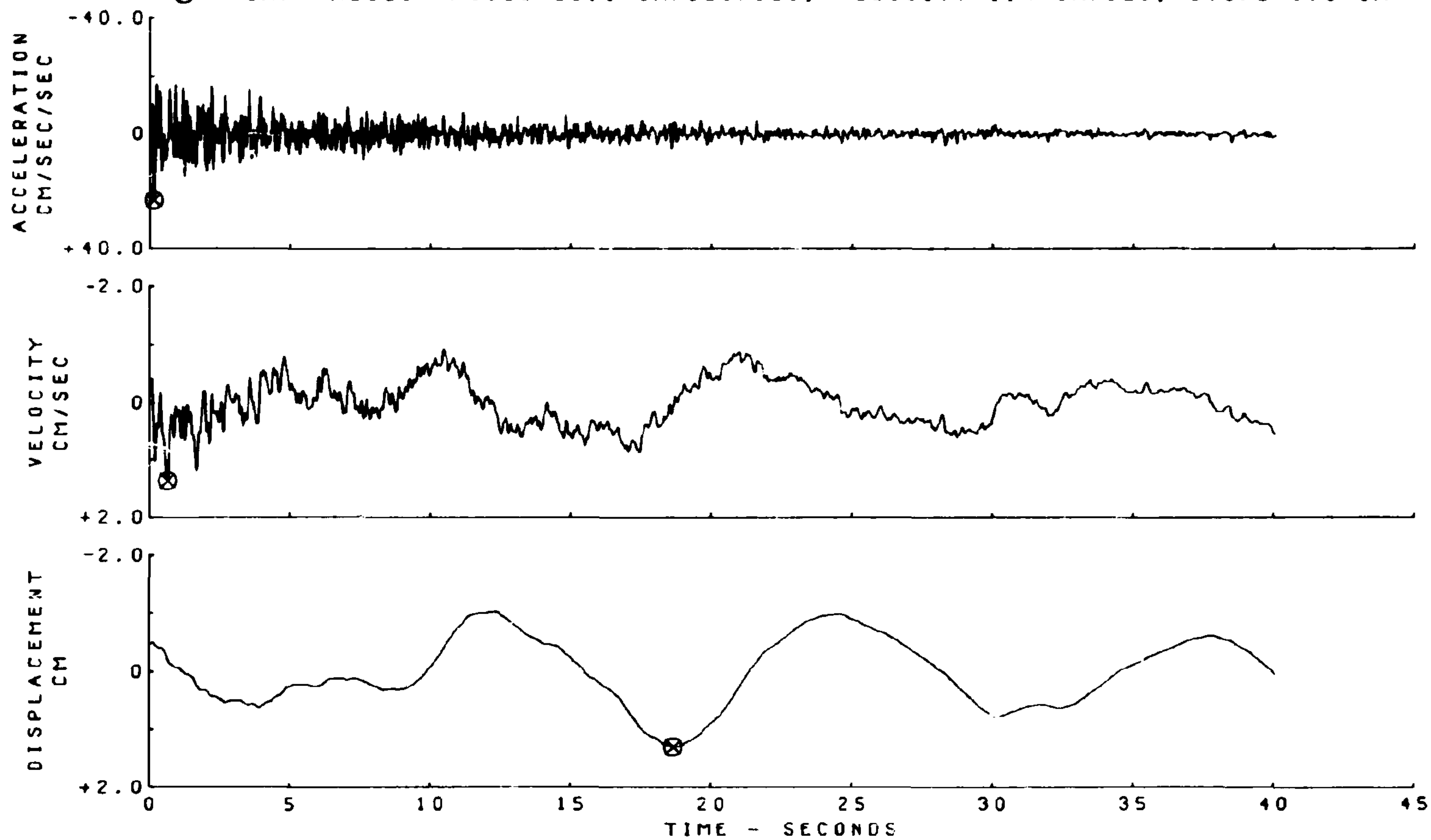
⊗ PEAK VALUES: ACCEL=86.6 CM/SEC/SEC, VELOCITY=-3.8 CM/SEC, DISPL=2.0 CM



CORRECTED ACCELERATION, VELOCITY, DISPLACEMENT

LIMA, PERU EARTHQUAKE OF NOVEMBER 29, 1971
INSTITUTO GEOFISICO DEL PERU, COMP UP

⊗ PEAK VALUES: ACCEL=23.1 CM/SEC/SEC, VELOCITY=1.4 CM/SEC, DISPL=1.3 CM



CORRECTED ACCELERATION ORDINATES

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,N82W

INSTR PERIOD = .0650 SEC DAMPING = .610 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 53.6 CM/SEC/SEC AT .04 SEC VELO = 4.1 CM/SEC AT .24 SEC DISP = 2.0 CM AT 2.12 SEC
LENGTH OF RECORD = 40.18 SEC INITIAL VELO = -.85514 CM/SEC INITIAL DISP = -.57201 CM
2010 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	-144	280	536	518	367	236	89	62	140	208	96	39	-6	-287	-367	-251	-33	121	135	100
.4	-51	-276	-279	-52	151	-2	-159	-29	111	-41	-214	-127	8	54	18	79	302	158	-406	-493
.8	-230	-92	-30	227	459	274	91	89	-114	-290	-16	131	-27	-79	31	175	13	-220	-135	84
1.2	70	21	98	-16	-127	8	59	-48	-83	13	114	177	8	-270	-318	-117	34	69	42	-6
1.6	-47	-24	40	7	26	36	-95	-97	106	41	-291	-300	12	44	-53	63	83	83	234	264
2.0	175	75	49	48	-174	-403	-197	-108	-334	-299	-16	-27	32	195	89	-84	-100	-7	-22	-74
2.4	-53	22	57	-52	-87	7	68	-25	-186	-50	210	99	-10	95	45	31	156	135	-52	-44
2.8	24	29	94	-47	-234	-166	-26	103	111	18	-45	-58	-92	-146	-169	-8	10	-81	73	157
3.2	-8	-158	11	243	230	80	180	181	4	9	-84	23	130	-103	-235	-152	-74	-12	-44	-62
3.6	-26	6	-82	-57	43	125	78	-237	-295	-139	17	-151	-207	81	95	52	172	177	53	-15
4.0	78	43	-91	23	84	132	199	-22	-191	-41	103	59	25	80	70	-117	-119	171	247	2
4.4	-75	153	186	34	-65	-92	3	134	69	-82	-67	19	-59	-252	-69	190	128	12	-16	63
4.8	172	79	-40	95	171	241	173	-98	-92	-24	-155	-147	-84	-71	10	100	64	75	68	-1
5.2	-77	-101	110	86	-136	-60	146	21	-234	-91	103	69	-23	-37	-11	21	-26	-146	-136	16
5.6	42	-38	2	161	104	-131	-95	35	24	-17	-8	105	171	67	-70	-142	-107	-14	8	5
6.0	39	74	0	47	182	155	68	-31	-65	-30	-68	-57	-33	-70	20	48	-49	76	196	12
6.4	-65	72	5	-153	-78	18	-39	-121	-102	-19	23	-31	-51	57	148	150	65	32	42	-1
6.8	-65	-23	9	-33	-16	62	42	-61	-51	40	36	4	70	58	4	34	-7	-25	23	-55
7.2	-74	-31	-140	-152	-23	125	29	-35	20	-108	-132	14	112	13	-91	-28	-12	28	25	-83
7.6	-138	-40	54	-3	-87	-95	-56	5	134	-23	-162	30	75	9	92	81	-42	-57	-56	-24
8.0	64	95	66	27	-55	-60	-57	-46	81	127	26	-29	20	2	13	46	-45	-45	-32	-107
8.4	-70	44	66	9	-32	-54	-78	-52	-31	-60	-65	100	140	-11	-54	-10	49	70	15	12
8.8	72	3	-68	-53	-11	86	85	103	98	-24	-98	47	55	-57	-17	14	-36	-55	46	120
9.2	87	13	-86	-83	35	9	-128	27	165	17	-8	55	9	-13	-68	-54	68	114	70	-4
9.6	-132	-183	-51	79	90	-0	-29	-47	-29	22	-1	-24	-19	36	9	-51	-15	-6	-44	-15
10.0	49	52	2	15	41	-27	-70	-24	53	113	83	-10	-27	-24	15	10	6	68	35	-62
10.4	-96	11	134	84	-35	-74	-66	-66	-44	[illegible]	22	1	22	38	-30	-36	9	-12	-19	[illegible]
10.8	41	-2	21	18	2	-5	-60	-16	99	76	28	46	33	74	-74	-118	9	119	95	15
11.2	21	-54	-114	-44	-42	-31	13	-42	-74	-35	-15	4	-2	39	106	39	-29	7	42	-8
11.6	-13	4	-27	27	97	41	-23	-13	26	34	-28	-41	23	77	48	-67	-113	-26	-45	-92
12.0	-59	-26	53	81	12	24	-6	-86	3	120	54	-97	-99	-27	20	62	50	16	-13	39
12.4	6	-44	55	109	70	22	5	51	[illegible]	-29	46	62	-44	-6	-17	-55	-38	[illegible]	-83	4
12.8	-1	-15	-47	-27	33	-6	-21	4	29	99	79	-13	-64	-21	45	-9	-77	[illegible]	-36	-49
13.2	-38	0	-32	-24	63	45	-14	-8	12	-30	-66	-22	35	68	-69	-94	-35	[illegible]	2	-21
13.6	-10	54	83	48	-6	-49	-66	-54	-44	-61	-57	-42	-48	-35	-9	-26	[illegible]	[illegible]	69	-54
14.0	-64	22	48	11	5	13	-27	-53	-38	-8	-12	-40	-58	-24	5	-31	-52	-17	-2	-19
14.4	-27	-20	10	45	27	-17	-3	32	-31	-140	-132	1	48	-5	6	38	[illegible]	20	10	42
14.8	92	23	-20	-9	-28	-24	-27	-10	51	[illegible]	2	72	71	2	5	20	-4	-11	-15	34
15.2	92	15	-98	-74	18	-3	-43	[illegible]	28	[illegible]	5	51	71	47	21	-9	15	69	53	-11
15.6	-6	-5	-48	14	26	-46	-3	26	-27	-50	-16	21	16	-9	37	77	21	-12	7	28
16.0	57	75	27	-0	-4	-67	-91	-53	-18	-25	-54	-41	13	59	47	39	3	-12	-14	-48
16.4	-5	43	18	-7	16	41	10	-1	53	95	20	-40	-16	7	-10	-23	-5	-18	17	29
16.8	-40	-35	9	-8	9	49	17	-23	-46	-34	17	31	-9	-39	4	65	28	-35	-10	24
17.2	7	10	33	20	38	56	[illegible]	-47	-7	26	-0	-32	-16	12	-3	-12	18	14	-20	5
17.6	19	25	51	13	-30	-30	[illegible]	-22	-18	-27	-45	-36	-12	8	17	-21	-57	-23	15	-0
18.0	-27	-17	21	9	1	45	[illegible]	35	-16	-31	-12	26	20	-20	-41	4	64	68	33	-13
18.4	-27	21	36	-8	-11	7	[illegible]	56	28	-28	0	[illegible]	-49	-29	22	34	11	-21	3	14
18.8	6	45	29	-16	-1	16	-9	-0	20	-18	-55	-13	50	1	-45	-6	20	-17	-13	36
19.2	48	50	42	10	-9	-11	-26	-43	-40	6	12	-30	-28	-31	-48	-33	-3	45	69	59
19.6	22	9	46	40	-14	-30	7	16	-49	-68	-16	4	-13	-1	31	34	-22	-40	25	29

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,N82W

SEC.																				
20.0	23	39	-10	-38	1	39	67	31	-19	-7	-40	-68	-6	30	1	-52	-41	45	76	37
20.4	33	60	-6	-63	-33	-24	-16	12	-4	-45	-15	38	74	43	17	25	2	-8	15	7
20.8	-15	10	6	-35	-30	-16	-8	9	19	-23	-59	-22	-7	-23	13	22	-7	-6	1	-0
21.2	2	-5	6	-13	-48	-21	7	-25	-45	-9	-8	-28	-15	13	29	16	-6	11	40	48
21.6	39	-6	-40	-12	18	16	-2	-35	-28	0	-12	-23	22	29	-15	-26	9	5	-24	-17
22.0	7	28	10	-21	-2	-6	-49	-61	-22	1	-26	-9	30	-2	-37	-21	-10	-10	-10	4
22.4	10	-23	-10	14	-0	-31	-72	-69	-28	12	33	-20	-74	-44	9	44	38	-1	1	11
22.8	-17	-36	-24	3	30	36	12	-5	-1	29	34	-5	-26	-19	11	10	-40	-19	1	-43
23.2	-42	-46	-45	-14	6	28	27	1	15	4	-35	-14	13	17	19	18	3	-29	-51	-42
23.6	-10	-4	-6	43	64	41	20	2	-9	-18	-13	13	2	-25	-11	7	-4	-3	13	-0
24.0	-30	-30	-1	16	22	31	43	36	-3	-22	-7	-13	-43	-36	-12	-19	-4	47	63	14
24.4	-20	10	10	0	14	-12	-14	23	24	-21	-31	7	29	16	-13	-6	21	25	0	2
24.8	29	13	-15	-36	-44	-8	38	52	26	-11	-9	12	18	9	20	44	31	1	16	39
25.2	23	24	42	50	38	-9	-25	-12	-11	-11	-12	-14	-8	20	31	-1	-37	-53	-23	35
25.6	27	2	38	52	8	-16	-15	-15	-13	13	51	63	35	-12	-30	-23	-5	3	-22	-23
26.0	7	-9	-40	-3	27	-14	-11	52	40	-22	-32	0	22	24	22	22	18	0	-23	-32
26.4	-30	-24	-11	-6	-13	-25	-30	-19	14	4	-35	-41	-20	13	7	-41	-21	21	5	-28
26.8	-50	-45	-1	5	-25	-2	47	52	12	17	17	3	36	40	10	22	51	34	-6	-1
27.2	19	-11	-45	-53	-45	1	34	36	30	4	-29	-28	2	5	19	26	-17	-44	-4	33
27.6	20	-13	0	39	57	68	25	-27	-14	5	-24	-42	-24	7	29	2	-34	-24	-12	-31
28.0	-30	-19	-13	11	37	30	32	11	8	35	9	-1	15	-33	-57	-33	-46	-48	-16	20
28.4	46	41	-8	-24	-7	-20	-36	-38	-31	-23	-21	-22	-22	-22	-22	-21	-1	27	27	-4
28.8	-34	-7	12	-21	-34	-9	16	19	4	-7	-8	-16	-6	20	8	10	22	-10	-5	31
29.2	42	37	-3	-27	3	20	-3	-10	11	-1	-17	-2	11	7	-12	-34	-38	-13	-4	-7
29.6	20	27	-1	-4	14	16	-10	-2	25	14	-6	13	31	-4	-8	17	-7	-20	10	35
30.0	25	-9	-2	46	29	-21	-19	-3	7	-6	-29	-13	1	-20	-22	-1	27	41	31	5
30.4	-10	11	10	-11	5	18	-10	-25	-13	8	-4	-26	-24	2	34	25	-12	-23	17	39
30.8	-4	-32	2	32	-7	-27	10	-3	-32	-36	-30	11	17	-16	-7	6	-7	5	23	16
31.2	-10	-26	-3	23	18	-4	-31	-18	23	33	6	13	25	15	36	26	-6	9	15	-1
31.6	-12	-16	7	28	13	7	28	41	37	26	2	-9	3	16	25	32	31	15	-12	-16
32.0	10	13	-1	9	31	29	-1	-32	-43	-25	-17	-26	-20	12	32	8	-22	-18	-5	-11
32.4	-12	5	5	-14	-22	-11	3	-18	-45	-49	-9	13	28	1	-0	-8	-23	-3	33	41
32.8	-1	-34	-26	5	17	-4	-36	-39	-4	30	49	49	30	4	-1	19	20	-2	-5	11
33.2	21	6	-12	-18	4	2	-28	-7	21	-2	-24	-1	2	-8	7	28	22	-8	-9	4
33.6	-2	3	19	29	37	40	23	-26	-56	-41	-14	14	15	-8	-12	6	4	-24	-39	-27
34.0	-2	8	-4	-9	9	27	26	3	-12	2	13	-11	-34	-14	13	11	-3	-10	4	18
34.4	16	6	-5	-10	-6	8	20	21	6	-21	-33	-15	7	14	6	-12	-23	-25	-5	16
34.8	-0	-17	2	-9	-35	-21	15	24	-4	-9	6	-3	9	5	-38	-30	11	30	26	18
35.2	2	-5	2	-14	-31	-29	-8	24	23	-10	-27	-11	13	14	-5	-6	-14	-40	-43	-24
35.6	-3	5	2	-7	-11	-2	8	4	-8	1	5	-18	-24	12	34	16	5	26	25	-5
36.0	-17	-6	8	10	6	1	9	25	25	-0	-18	-20	-22	-22	-20	-8	5	6	-3	-17
36.4	-20	-8	-8	-22	-8	12	5	-12	-24	-25	-18	-6	20	41	44	32	13	7	8	1
36.8	-27	-25	6	1	-21	-15	-5	-12	-14	5	23	23	7	-4	4	11	1	-11	-6	-0
37.2	-17	-34	-31	-25	-22	-13	6	21	22	21	21	20	7	-9	-12	-11	-11	-11	-11	-10
37.6	-8	-4	-2	-10	-16	-4	13	16	11	6	-1	-8	-12	-12	-0	20	29	24	8	-10
38.0	-17	-16	-16	-14	-14	-14	-14	-15	-16	-16	-15	-3	21	34	8	-25	-17	10	28	9
38.4	-2	23	2	-25	4	23	12	23	7	-17	-17	-12	-2	8	-1	-13	9	30	29	20
38.8	8	-8	-15	10	29	1	-10	10	26	-5	-26	-1	16	14	13	11	13	13	13	13
39.2	13	12	10	1	-16	-25	-18	-2	8	8	-0	-12	-23	-30	-15	19	19	-10	-11	16
39.6	27	9	-8	-0	15	24	21	2	-13	-15	-13	-7	4	15	-3	-25	-17	3	4	-2
40.0	13	19	8	-4	-14	-17	-16	-13	-4	1										

CORRECTED ACCELERATION ORDINATES

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,N08E

INSTR PERIOD = .0660 SEC DAMPING = .560 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACLN = 86.6 CM/SEC/SEC AT .44 SEC VELO = -3.8 CM/SEC AT .40 SEC DISP = 2.0 CM AT 3.52 SEC
LENGTH OF RECORD = 40.18 SEC INITIAL VELO = -.99706 CM/SEC INITIAL DISP = -.60305 CM
2010 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	-562	-429	-181	81	141	152	216	279	360	287	85	-93	-288	-341	-123	-2	-179	-372	-440	-377
.4	201	771	866	745	229	-114	68	140	-56	-22	98	-0	-154	-97	-14	-16	5	-43	19	161
.8	160	60	39	80	42	-31	69	68	-163	-177	58	75	-192	-350	-126	11	22	101	157	93
1.2	-13	-62	-36	46	-53	-166	-83	16	133	65	-66	-169	-10	211	176	124	185	235	170	24
1.6	-75	-130	-162	-41	-27	-59	-66	-15	-47	-152	-183	-125	-30	-4	-77	-118	32	165	91	23
2.0	39	14	-45	-5	146	114	-95	-295	-278	-64	-33	-35	-46	-43	121	238	131	42	51	2
2.4	-40	42	78	-20	-53	-72	-26	-2	-98	-99	-2	8	-46	-40	17	1	26	110	126	81
2.8	33	24	-77	-178	-123	-48	-21	54	93	7	-95	-28	123	223	214	-12	-117	25	108	38
3.2	-80	-150	-115	-91	-78	-8	-8	-42	30	151	180	36	-155	-174	-51	-76	-173	-137	-99	-59
3.6	59	86	31	12	18	11	-60	-75	70	42	-40	-34	-48	25	109	134	162	154	109	-32
4.0	-121	33	22	-149	-223	-278	-196	-26	-54	38	193	-83	-277	-56	104	108	137	-10	-171	-94
4.4	95	164	72	-42	-4	-5	20	50	-131	-235	-44	49	1	44	97	108	86	93	92	-6
4.8	-76	-4[illegible]	6	38	19	-49	-69	-38	-70	-73	-83	-38	36	62	28	34	-43	-203	-58	158
5.2	30	-84	-4	53	18	41	131	32	-64	-23	46	70	78	78	32	-58	-88	-28	-35	-69
5.6	9	50	48	28	38	25	-99	-114	1	52	-64	-60	89	136	24	-80	-12	-23	-150	-156
6.0	-8	66	6	-8	37	-2	26	85	16	-13	67	-8	-123	-21	71	38	-19	-12	38	39
6.4	6	34	53	40	73	123	69	-34	-4	91	98	-29	-70	-50	-73	-44	65	11	-130	-118
6.8	14	9	-68	59	108	-8	-7	74	23	-12	49	55	63	77	-16	-49	90	93	-27	-137
7.2	-202	-123	67	88	-69	-113	25	145	33	-81	17	63	13	-8	2	15	16	66	84	-44
7.6	-140	-57	34	-33	-132	-33	150	113	-60	-73	-19	-37	-43	25	118	54	-71	-78	36	19
8.0	-40	0	9	-26	4	-1	-50	-61	-32	10	36	15	16	30	55	75	46	48	27	-46
8.4	-55	3	74	82	-27	-124	-105	10	88	59	32	61	103	54	-22	-68	-25	54	78	-10
8.8	-64	15	23	-38	-75	-97	-41	52	9	-49	-26	8	18	-9	-8	66	105	46	66	119
9.2	45	-20	30	48	-77	-124	-25	63	89	48	-3	-1	26	39	23	-5	2	58	80	49
9.6	12	-8	-30	-58	-29	-7	-41	-74	17	112	66	6	-5	25	-23	-127	-104	5	17	-0
10.0	15	-6	25	86	27	-113	-103	54	121	54	-51	53	93	-32	-67	-44	-25	17	16	-30
10.4	12	11	-10	54	42	-29	-62	-76	-30	55	101	38	-80	-133	-103	-35	38	103	78	17
10.8	21	48	18	-38	-33	-24	-60	-28	55	80	38	9	8	37	63	74	111	90	-13	-62
11.2	-78	-79	-62	-111	-123	35	77	20	32	12	-31	-25	17	13	-45	-44	44	66	-2	-21
11.6	10	11	-15	0	-20	-83	-115	-34	34	9	-18	-2	-18	-82	-35	38	48	14	-51	-57
12.0	-36	-1	35	-2	-63	-28	78	80	20	-28	-27	16	19	22	41	31	-13	-59	-64	-25
12.4	-22	-13	57	64	13	17	19	-7	-24	9	24	20	32	-30	-128	-140	-44	45	10	-13
12.8	46	49	-10	2	14	-5	33	52	5	-29	6	22	-13	-10	-12	-33	17	-6	-79	-60
13.2	3	24	5	24	-20	-114	-109	18	69	12	20	27	-9	26	60	7	-19	40	114	73
13.6	-22	-70	-71	-38	-60	-121	-43	32	23	16	-24	2	89	80	-17	-47	-16	25	36	2
14.0	-17	-18	-17	-14	-5	8	20	28	21	-9	-32	-17	49	19	-67	-29	1	5	42	61
14.4	30	6	-27	-31	19	45	41	20	-22	-48	-27	27	47	35	24	-14	-23	6	-22	-23
14.8	8	-28	-37	-4	-10	-17	9	-2	-14	17	11	5	35	34	4	3	12	-6	-31	-27
15.2	15	36	-15	-35	23	62	15	-40	-45	-19	-12	-18	-6	21	57	52	7	-17	-18	-3
15.6	37	60	18	-27	-31	-31	-17	25	40	3	-27	-3	21	-3	-21	11	25	-2	-11	8
16.0	26	24	7	-66	-126	-115	-31	4	7	-21	-33	1	21	17	11	34	47	6	-22	-2
16.4	1	-20	-27	-21	7	34	17	-22	-3	10	-13	-22	-24	-28	-10	13	-5	-18	25	44
16.8	-6	-19	-12	-59	-99	-37	46	43	-2	-15	-1	29	14	-28	-13	30	35	3	-2	11
17.2	18	6	-63	-104	-27	76	67	-15	-19	6	-17	-21	-11	-13	-16	11	54	5	-52	-13
17.6	6	-17	7	27	13	3	3	6	-9	-24	-17	-4	9	27	-8	-24	29	28	-23	-4
18.0	36	68	69	84	52	-3	-16	19	45	28	3	-29	-51	-21	3	-25	-57	-7	40	-14
18.4	-81	-11	83	56	-13	14	38	-12	-12	25	18	-5	5	14	3	6	14	-2	-31	-15
18.8	16	1	-29	-23	9	28	6	-33	-24	-15	-26	-8	-10	-20	14	55	56	14	5	1
19.2	-30	-23	-4	-2	-1	17	46	46	36	15	4	-11	-44	-50	-28	-8	2	-13	-35	-19
19.6	11	22	24	37	46	23	-16	-14	-6	-20	-32	-56	-47	-20	-23	-1	54	48	-4	3

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,NOBE

SEC.																				
20.0	27	6	-17	-13	-14	-16	-21	5	-9	-20	-29	-40	-5	22	31	46	52	31	0	0
20.4	13	-1	-4	23	16	-51	-67	-9	21	3	-15	1	17	13	-0	-31	-51	-21	1	-5
20.8	9	15	0	8	29	29	18	8	-6	-10	6	15	14	8	-3	-21	-36	-37	-3	21
21.2	-3	1	34	41	11	-11	5	1	-5	30	33	-2	-9	10	20	7	-16	-19	9	38
21.6	31	-22	-52	-35	-12	-13	-17	3	11	3	10	-20	-48	-8	26	22	18	32	19	-7
22.0	-1	-3	6	17	-0	-12	-2	12	18	17	7	-6	-0	3	-6	5	21	16	13	34
22.4	34	6	-5	5	-20	-47	-30	7	18	3	7	19	-2	-31	-34	-1	26	29	15	14
22.8	21	12	-16	-39	-39	-6	4	-14	3	20	-2	-26	-31	-30	-26	-10	5	8	8	2
23.2	-4	6	13	-1	-19	-12	11	2	-19	-24	-19	4	18	-7	-26	-26	-18	3	18	2
23.6	-23	-23	-15	-11	-10	15	21	-14	-30	-10	8	-4	-30	-42	-36	-22	-19	-24	-24	-22
24.0	-16	2	23	34	39	28	-5	-20	-16	-10	-8	-13	-16	-6	-6	-14	1	32	46	42
24.4	30	16	10	-10	-32	-39	-38	-24	21	43	31	-8	-21	-5	-26	-43	-15	5	4	5
24.8	5	29	9	47	18	3	5	5	3	-14	-21	-5	7	7	-2	-15	-6	6	-5	-11
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26.0	17	15	-4	-22	-21	-18	-20	-20	-18	-20	6	20	19	29	14	-0	16	19	17	23
26.4	22	20	18	7	-0	2	4	26	43	26	-1	0	20	24	9	10	10	2	1	1
26.8	9	20	28	33	22	-6	-10	7	-2	-21	-10	0	1	9	8	-6	-18	-15	-5	2
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31.2	22	21	24	17	7	10	0	2	9	-13	-12	9	4	19	39	13	-7	-7	2	24
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40.0	-6	2	13	16	13	10	11	10	10	10										

CORRECTED ACCELERATION ORDINATES

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,UP

INSTR PERIOD = .0650 SEC DAMPING = .560 ACCELEROGRAM IS BAND PASS FILTERED BETWEEN 0.07 AND 25 CYC/SEC.
PEAK VALS ACCLN = 23.1 CM/SEC/SEC AT .14 SEC VELO = 1.4 CM/SEC AT .64 SEC DISP = 1.3 CM AT 18.68 SEC
LENGTH OF RECORD = 40.06 SEC INITIAL VELO = -.61335 CM/SEC INITIAL DISP = -.45331 CM
2004 INSTRUMENT AND BASELINE CORRECTED DATA IN MM/SEC/SEC AT EQUALLY-SPACED INTERVALS OF 0.02 SEC.

SEC.																				
0.	92	122	79	-22	-109	-59	98	231	230	162	66	-51	-176	-141	-7	49	-3	-117	-153	-60
.4	82	135	120	56	-2	37	63	72	95	71	31	22	28	-40	-146	-159	-117	-89	-51	19
.8	22	19	55	89	32	-121	-174	-8	83	38	-36	-42	-11	20	85	88	60	11	-133	-160
1.2	9	130	152	36	-109	-119	-91	-29	50	101	48	-66	-53	-2	14	69	104	21	-13	36
1.6	32	55	119	105	-22	-101	-77	-90	-89	15	23	-57	-76	-81	-106	-6	-26	-74	77	106
2.0	91	128	-2	-93	17	103	76	3	-53	-117	-169	-123	47	125	37	-31	-1	26	-20	-18
2.4	33	25	27	37	-15	-51	-55	-73	-8	95	102	75	3	-134	-106	-59	-59	-25	-25	-6
2.8	-10	26	75	31	9	-5	9	31	-15	-20	21	9	-47	-34	-1	13	30	8	-40	13
3.2	103	89	-67	-59	55	88	53	-5	-55	-62	13	46	12	-17	-8	-20	-123	-158	-55	20
3.6	39	64	88	19	-17	27	45	12	22	82	11	-24	14	17	-57	-118	-132	-128	-37	45
4.0	32	-44	-54	34	37	-35	15	53	10	13	21	13	38	35	-2	-10	-3	0	-53	-97
4.4	-63	-26	25	62	9	-47	-2	42	50	61	33	13	-16	-75	-51	-31	-67	-29	-9	-49
4.8	-4	41	35	44	17	-20	40	73	16	21	38	-20	-45	-12	13	24	27	6	-17	10
5.2	55	56	5	-17	-27	-48	8	73	27	-26	-38	-45	-28	8	13	33	6	-21	28	49
5.6	45	8	-16	18	5	-15	5	-7	-17	12	-6	-51	-39	10	19	-21	16	33	-27	-59
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6.4	38	4	55	55	-14	-19	13	16	-11	-55	-13	58	32	1	14	9	-39	-31	-24	1
6.8	55	35	4	47	66	-11	-40	-7	13	33	-1	-97	-96	-47	-28	2	-8	-23	41	47
7.2	28	6	-7	7	12	71	61	-10	-14	-13	4	12	19	35	1	-36	-64	-40	55	93
7.6	39	-9	-13	7	-27	-84	-62	18	64	36	-3	17	53	16	-40	-51	-40	12	38	13
8.0	-0	-1	-21	-34	6	12	25	48	21	-13	-44	-33	-16	-6	18	10	-50	-84	-40	6
8.4	-24	-17	34	22	6	20	31	34	32	-16	-55	-35	-18	24	62	8	-8	60	37	3
8.8	-24	-61	-63	-72	-43	56	77	-18	-48	37	50	-16	-27	-22	-35	-33	1	29	30	3
9.2	-41	-42	-29	-24	30	31	9	27	-3	-51	-28	6	12	14	5	-19	-45	-73	-15	51
9.6	19	16	25	-31	-55	-19	28	56	-14	-65	-18	16	1	-27	-16	31	56	42	11	-22
10.0	-26	-15	-21	-27	-6	9	-6	-24	-33	-3	40	37	3	-10	-5	-0	5	8	-8	-7
10.4	-4	-51	-65	-28	10	42	18	-5	12	21	44	49	21	-6	-23	-30	-13	3	-15	-13
10.8	-3	-20	-7	28	43	21	-10	1	14	-4	28	59	13	-27	-0	11	-40	-79	-29	15
11.2	22	38	24	24	32	1	-32	6	39	25	27	41	34	11	-11	-31	-28	22	59	43
11.6	14	-3	-29	-41	-7	19	17	14	-1	5	19	18	27	10	-8	-14	-42	-46	-5	21
12.0	6	-13	-25	3	47	28	-3	-10	-21	-12	32	25	-20	-13	26	33	22	16	11	12
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12.8	12	-29	-37	-24	2	29	29	11	0	0	-5	4	17	-12	-64	-20	38	8	-2	29
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14.0	-17	-29	-34	-24	-16	-23	-35	-24	-12	9	32	39	23	-6	-7	14	26	12	-16	-28
14.4	-21	-4	14	22	22	23	19	8	10	25	29	17	1	-4	1	11	21	23	7	-44
14.8	-69	-40	-9	-2	20	55	51	3	-18	1	18	17	8	8	-6	-36	-37	-5	17	6
15.2	-23	-38	-10	14	14	20	35	16	-6	4	8	-1	22	37	23	9	-8	-38	-39	12
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16.0	-29	-29	-20	6	31	4	-9	13	22	2	-13	-14	-13	5	-10	-27	-3	14	30	37
16.4	-1	-12	11	11	18	23	2	-11	-18	-10	3	-5	-16	-21	-7	30	43	24	15	22
16.8	14	5	8	10	2	4	27	5	-34	-14	15	16	38	14	-33	-29	-3	-13	-37	-15
17.2	8	6	12	2	1	19	25	20	6	-7	6	25	6	-26	-41	-48	-43	-12	7	-14
17.6	-38	-28	-8	-6	-1	-4	-1	15	18	-2	-15	-9	-15	-25	-25	-19	-12	-10	-10	-4
18.0	8	28	40	30	20	15	4	-12	-6	8	3	-10	-13	0	-4	-29	-34	5	25	7
18.4	-14	-16	-7	-10	-24	-36	-36	6	53	44	-9	-41	-22	-18	-43	-37	5	30	22	3
18.8	-13	-22	-20	-13	-10	-9	2	11	-4	-27	-37	-20	1	6	5	15	21	8	1	3
19.2	4	5	7	-1	-20	-28	-12	1	-0	-3	-16	-13	19	23	6	0	7	10	-20	-49
19.6	-45	-19	-8	-16	-17	-17	-13	9	16	3	-3	26	42	25	0	-22	-28	-15	17	30

LIMA,PERU,INSTITUTO GEOFISICO,11/29/71,UP

SEC.																				
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21.2	-5	-23	-28	-2	10	8	4	-3	-3	4	15	21	21	21	21	21	22	18	-16	-48
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22.0	26	21	4	-10	-13	-10	4	11	2	1	5	-5	-12	-2	11	11	1	-13	-24	-8
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37.2	13	11	3	-5	-4	-1	-0	-1	-2	-3	-3	-3	-5	-7	-6	-4	-1	2	3	3
37.6	3	3	3	3	6	18	24	13	1	-1	5	12	14	10	5	3	3	4	10	11
38.0	2	-1	-0	-0	-0	-0	-0	-0	-0	-1	-2	-6	-9	-9	-8	-7	-5	-3	-1	-0
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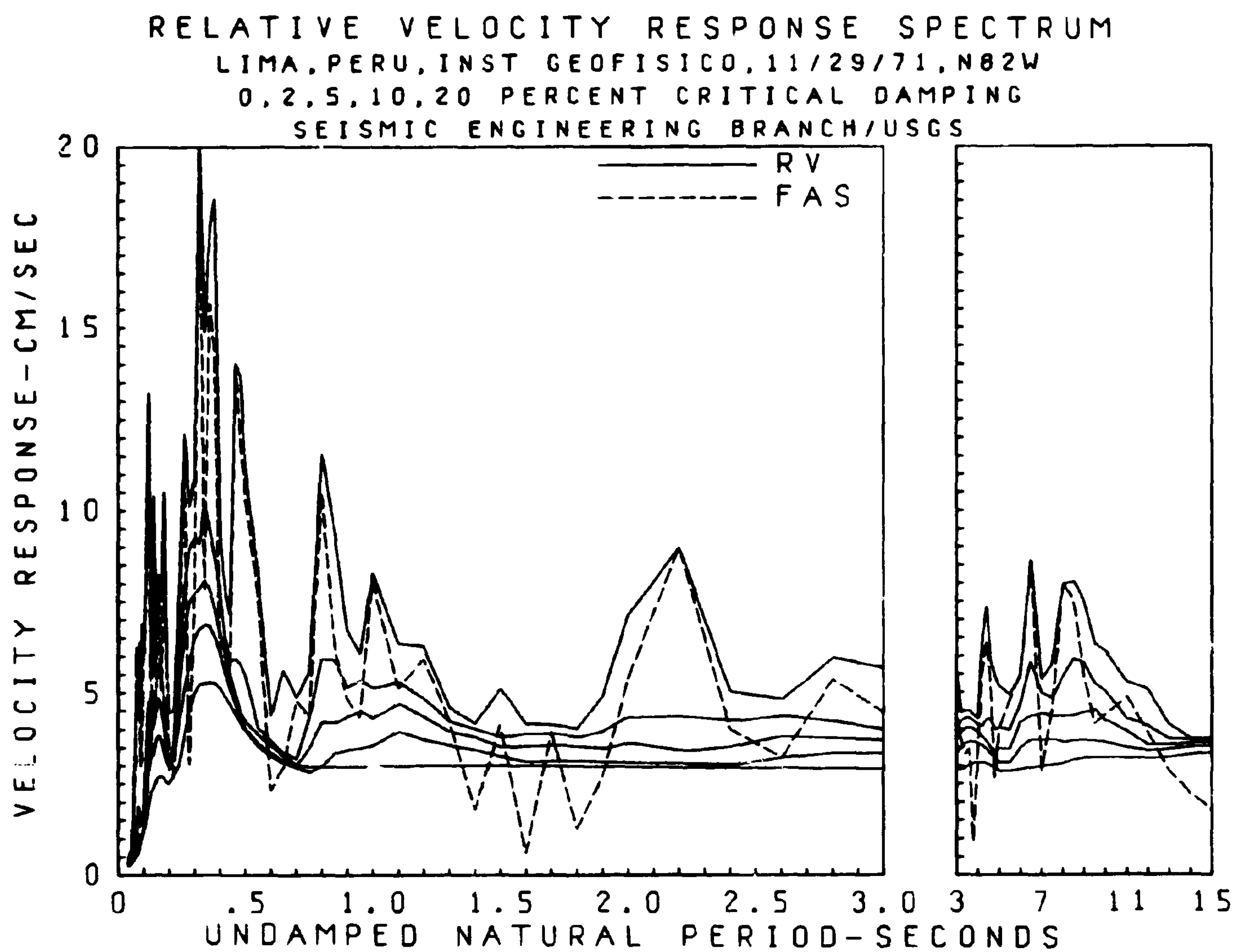
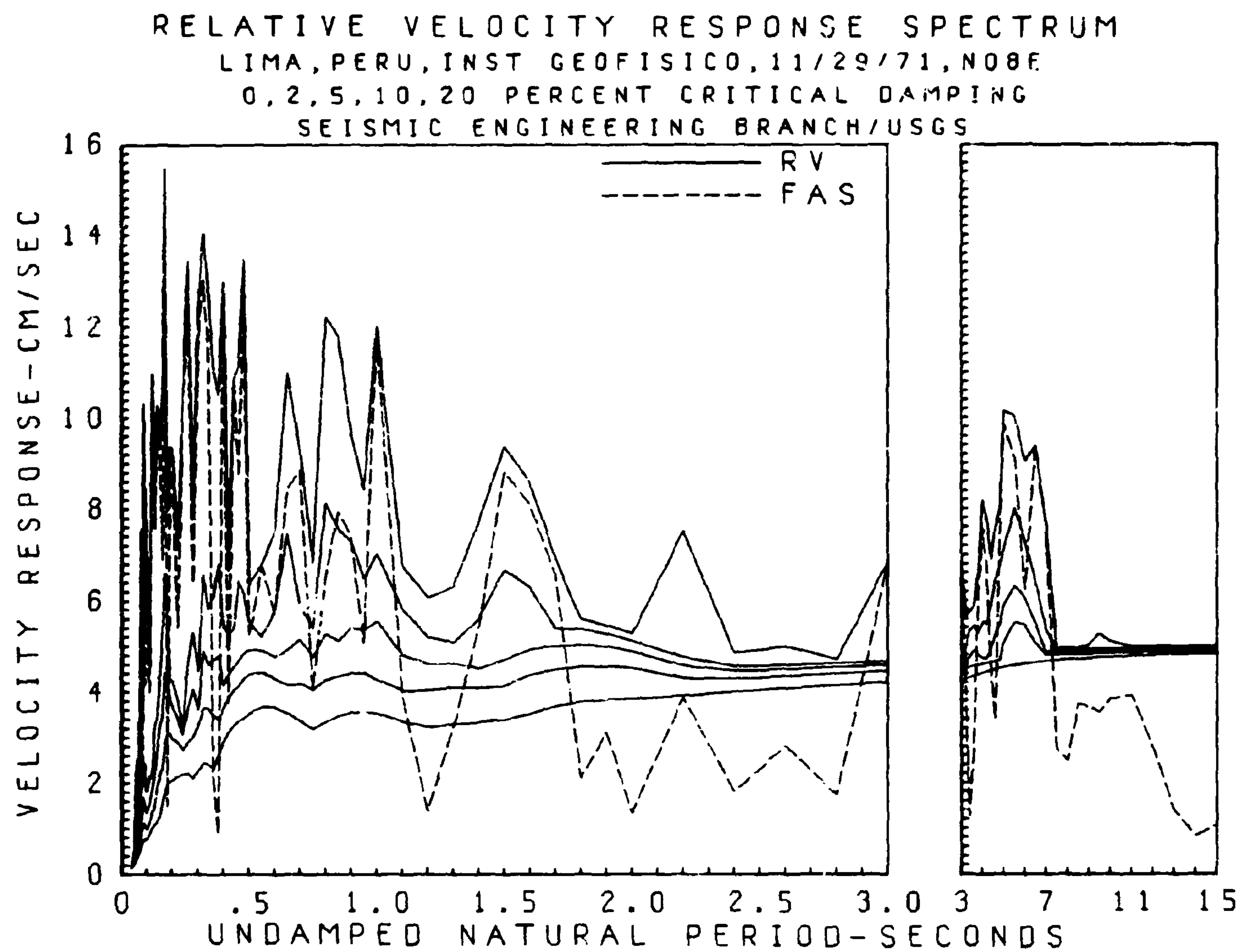
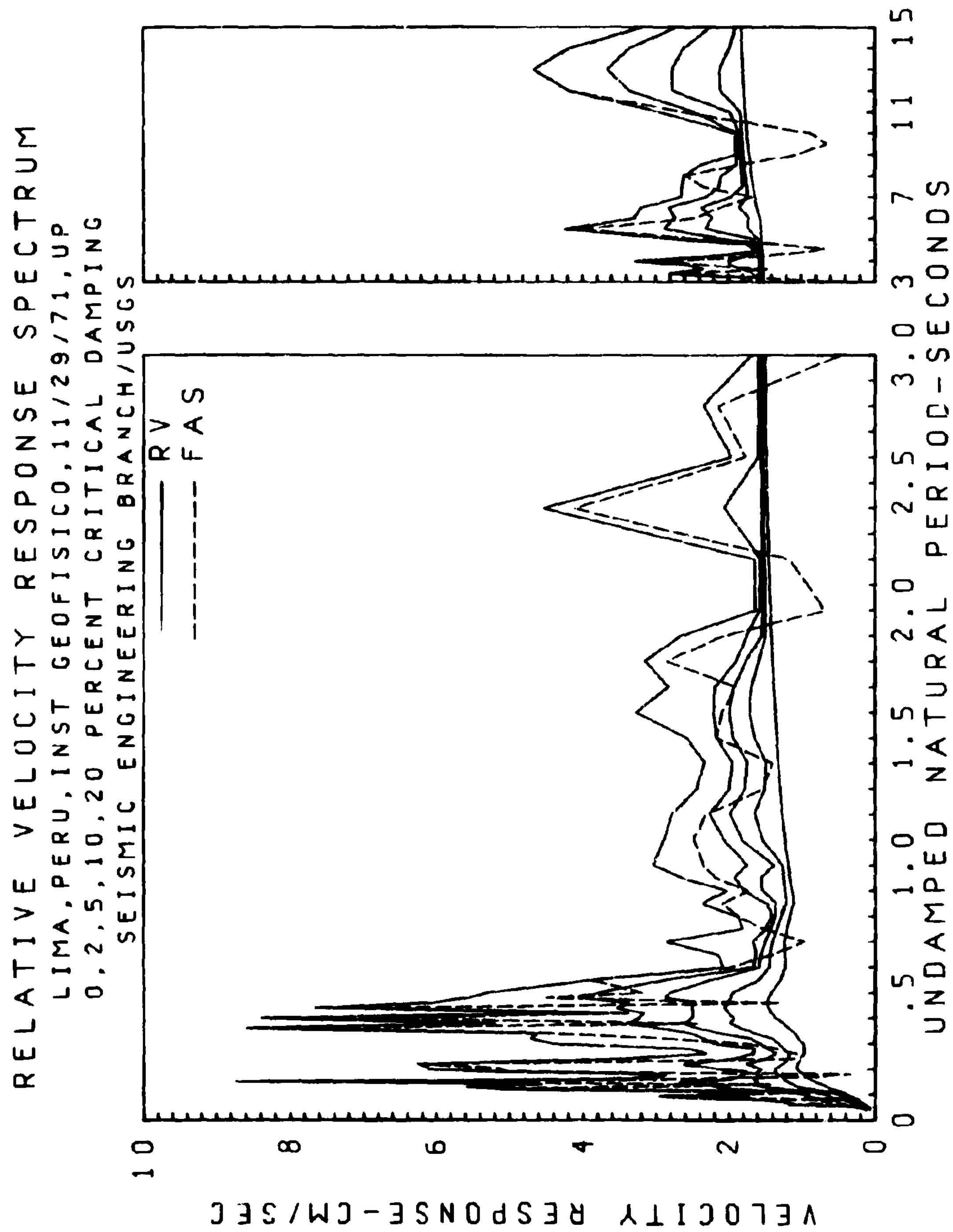
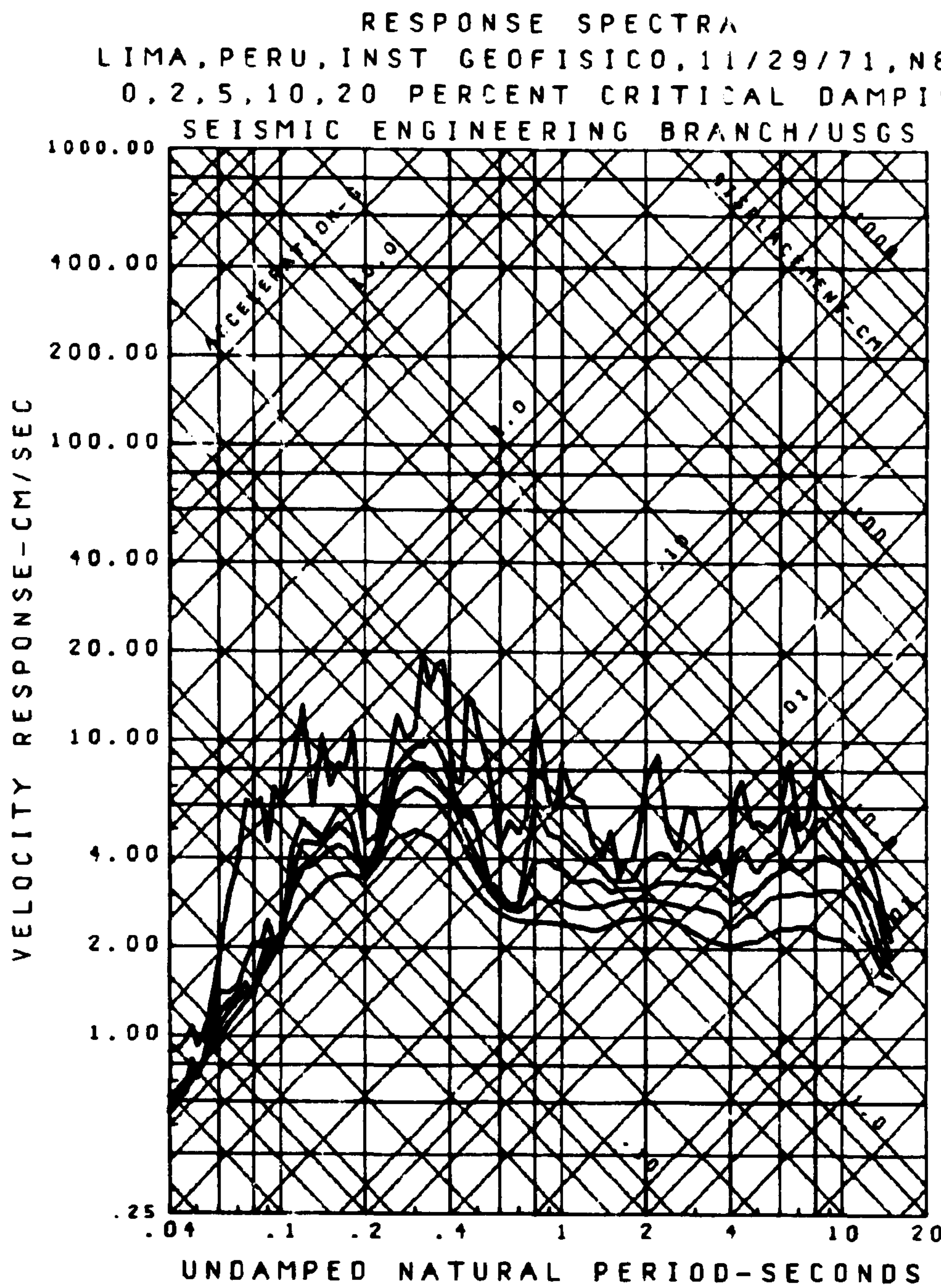

RELATIVE VELOCITY RESPONSE SPECTRUM
LIMA, PERU, INST GEOFISICO, 11/29/71, N82W
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
0
5
10
15
20
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15


RELATIVE VELOCITY RESPONSE SPECTRUM
LIMA, PERU, INST GEOFISICO, 11/29/71, N08E
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
16
14
12
10
8
6
4
2
0
0
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15
UNDAMPED NATURAL PERIOD-SECONDS

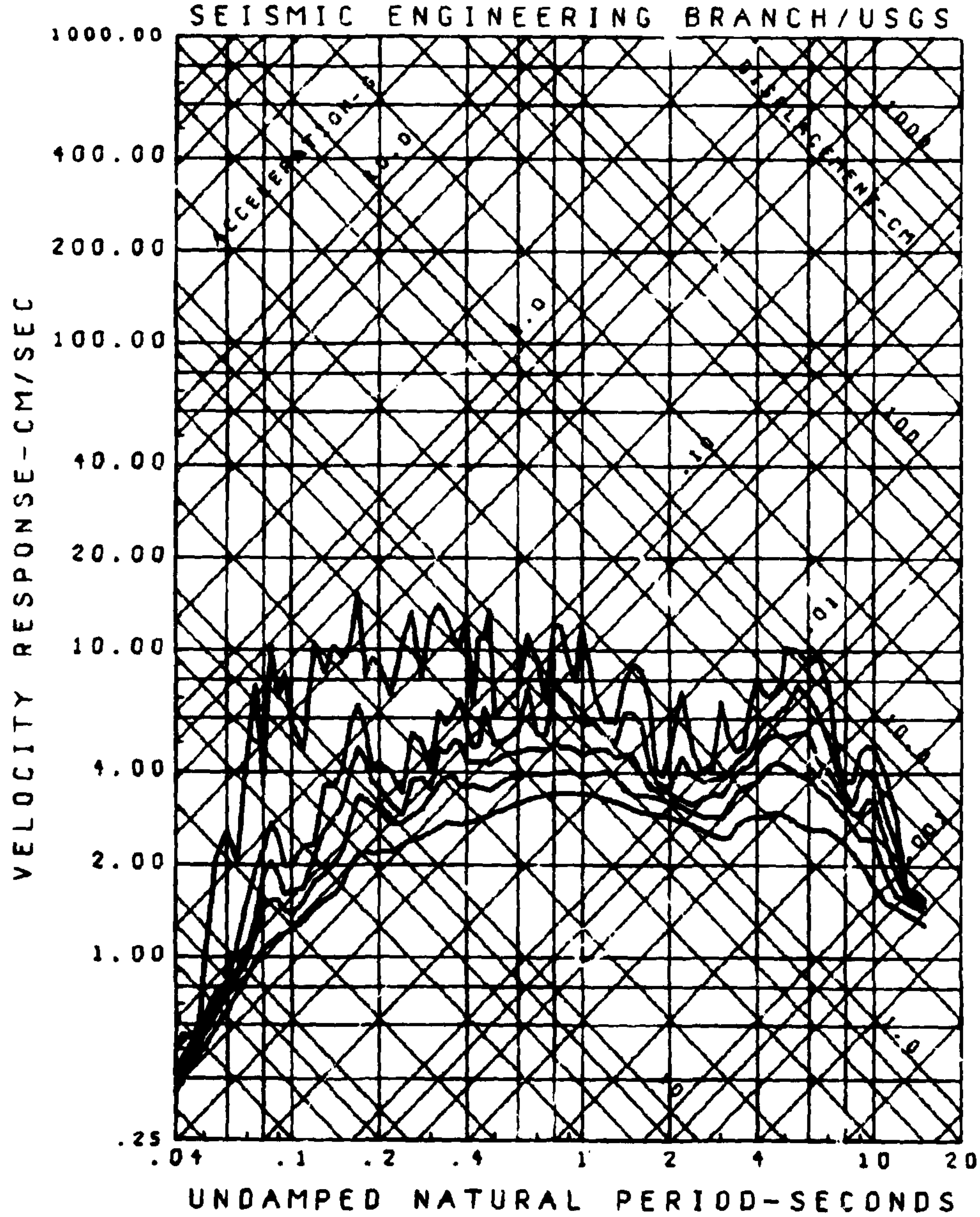


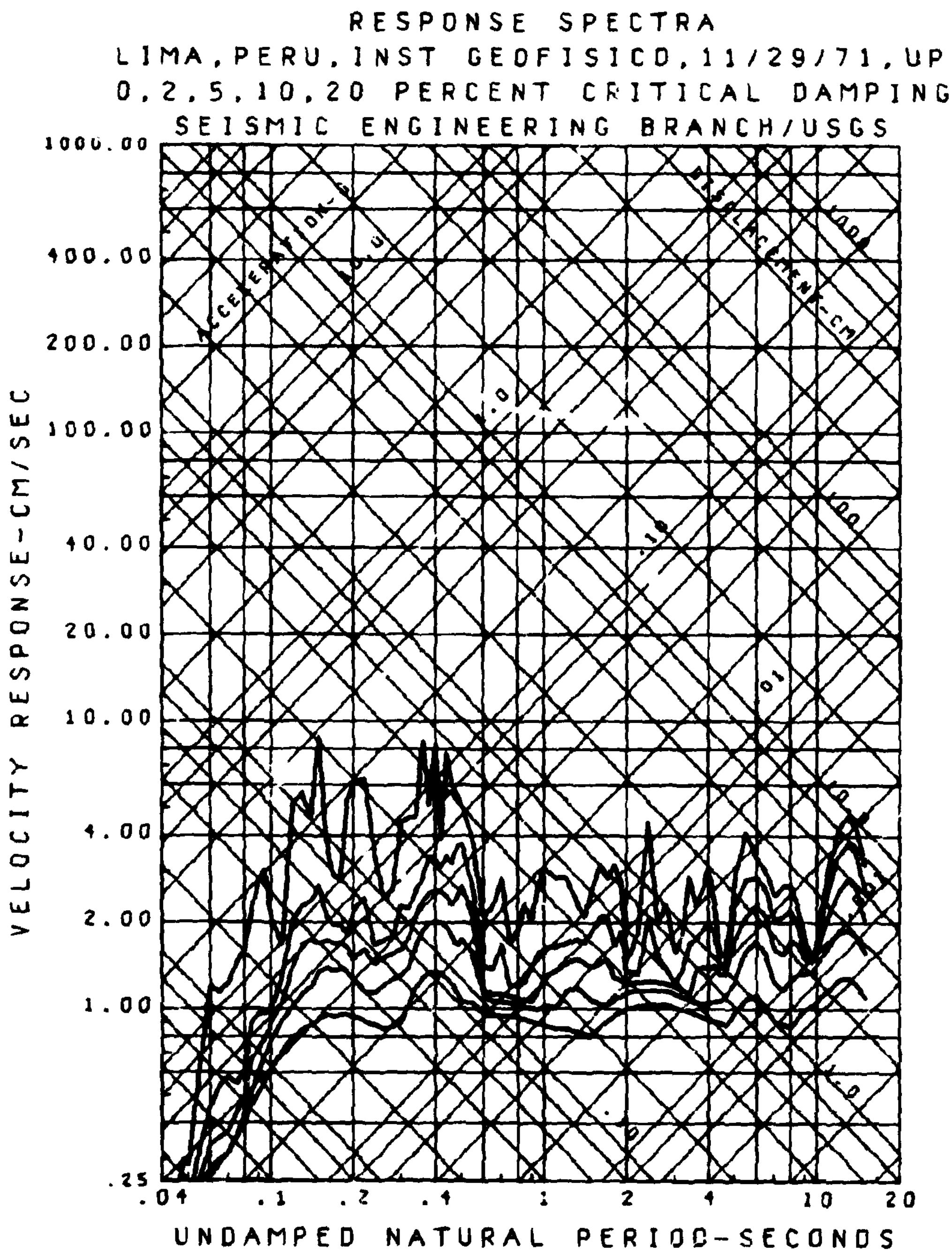
RELATIVE VELOCITY RESPONSE SPECTRUM
LIMA, PERU, INST GEOFISICO, 11/29/71, UP
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
RV
FAS
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
0
2
4
6
8
10
.5
1.0
1.5
2.0
2.5
3.0
3
7
11
15

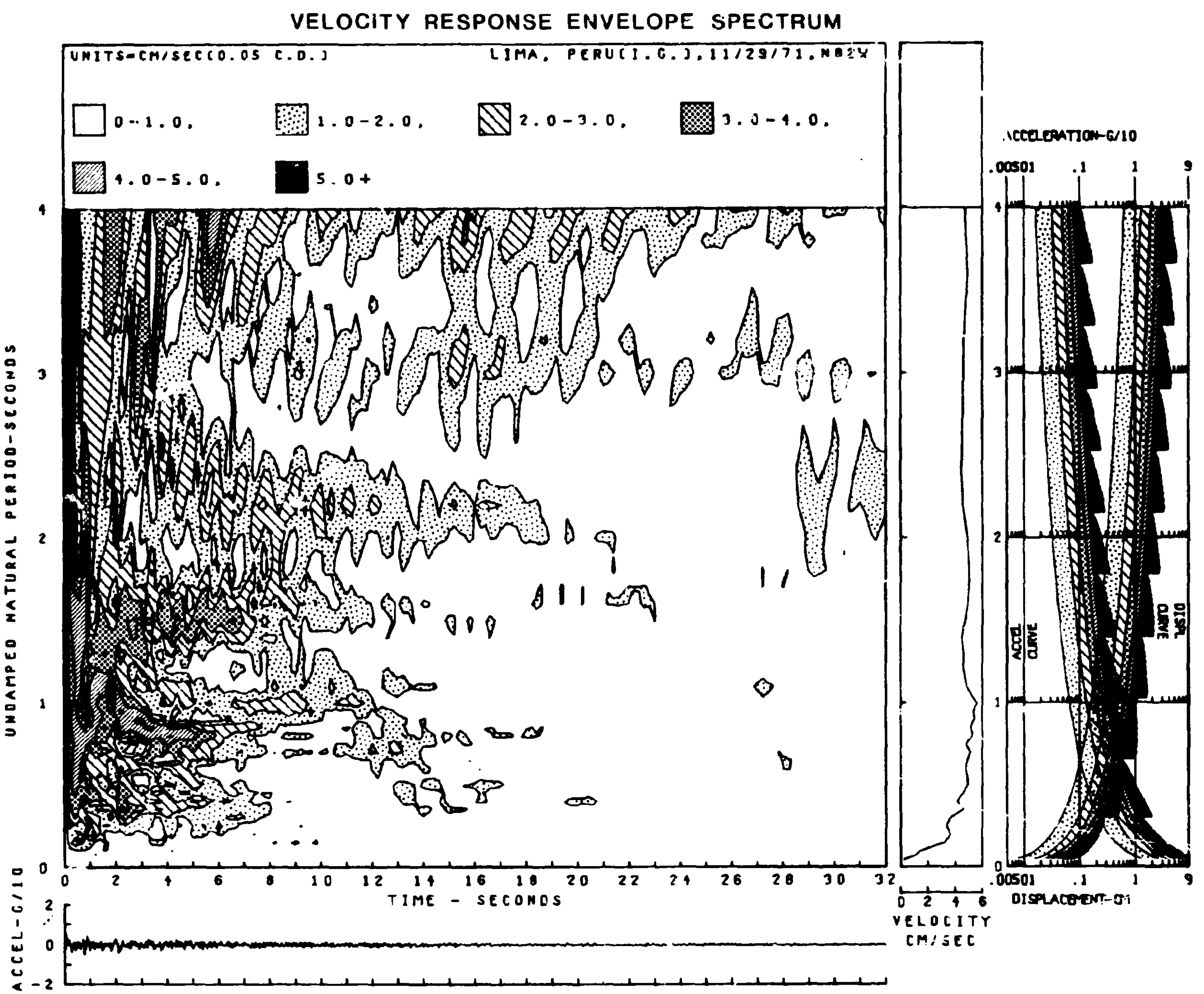


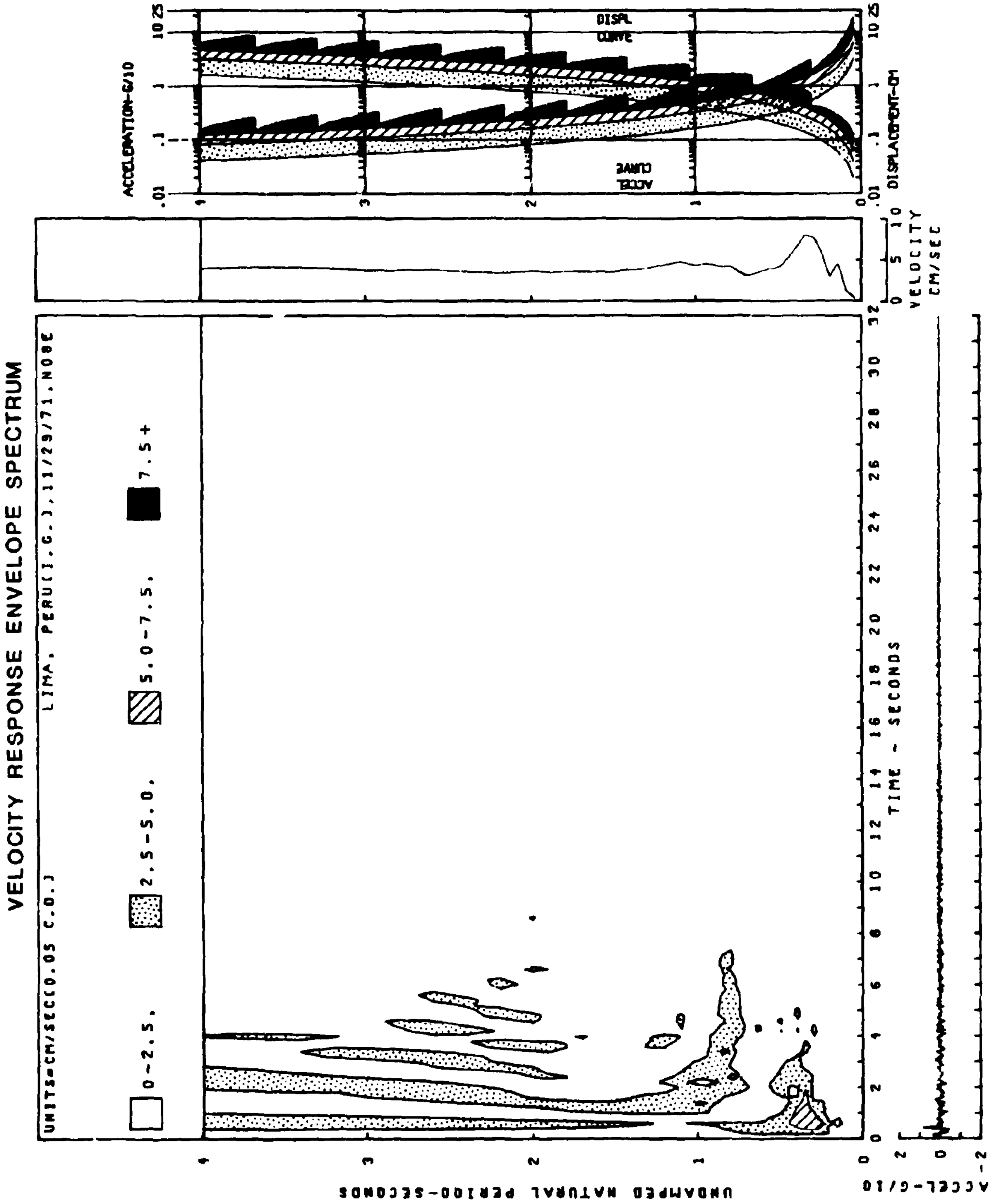
RESPONSE SPECTRA
LIMA, PERU, INST GEOFISICO, 11/29/71, N82W
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS

RESPONSE SPECTRA
LIMA, PERU, INST GEOFISICO, 11/29/71, N08E
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS

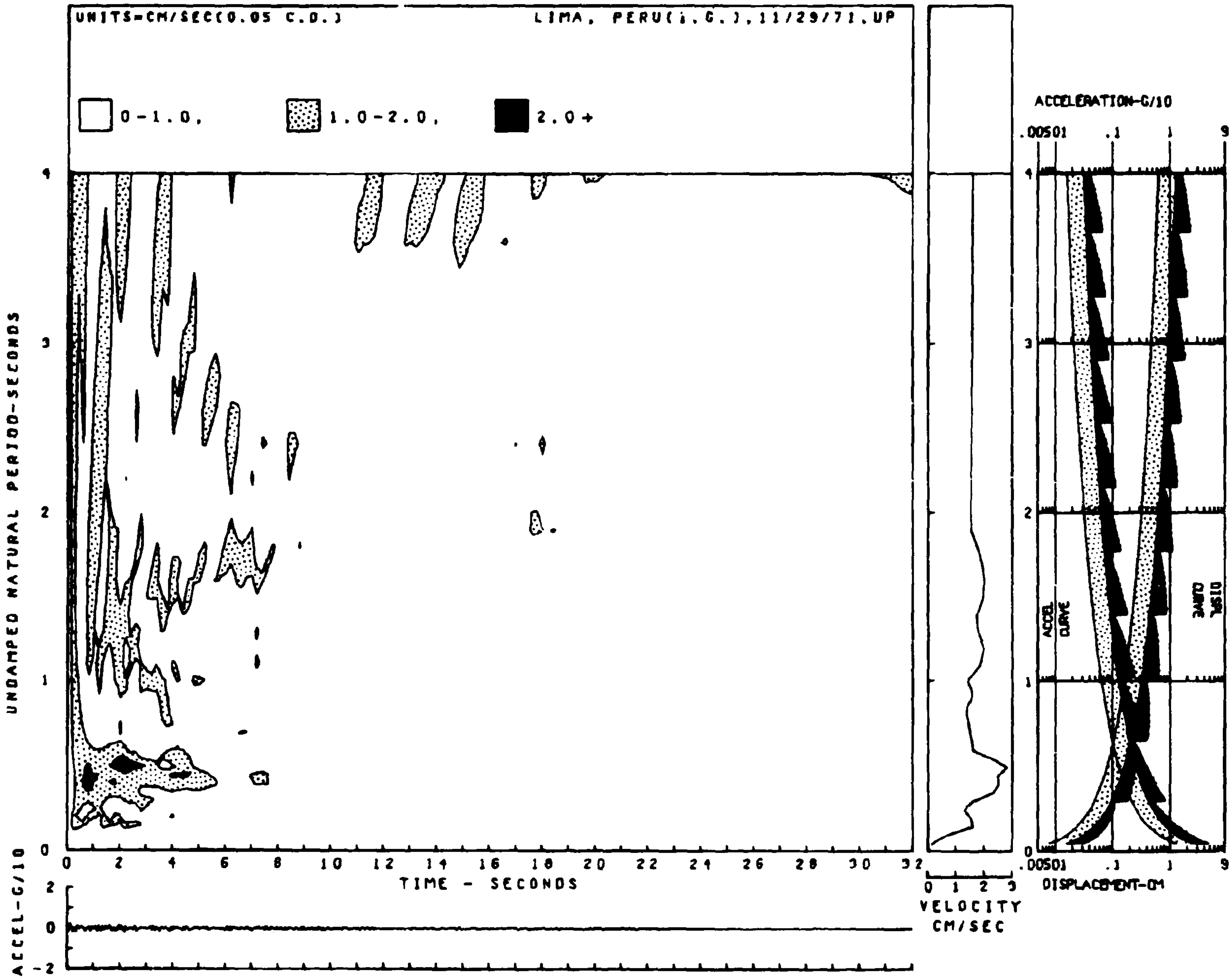



RESPONSE SPECTRA
LIMA, PERU, INST GEOFISICO, 11/29/71, UP
0, 2, 5, 10, 20 PERCENT CRITICAL DAMPING
SEISMIC ENGINEERING BRANCH/USGS
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
.25
.04
.1
.2
.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM

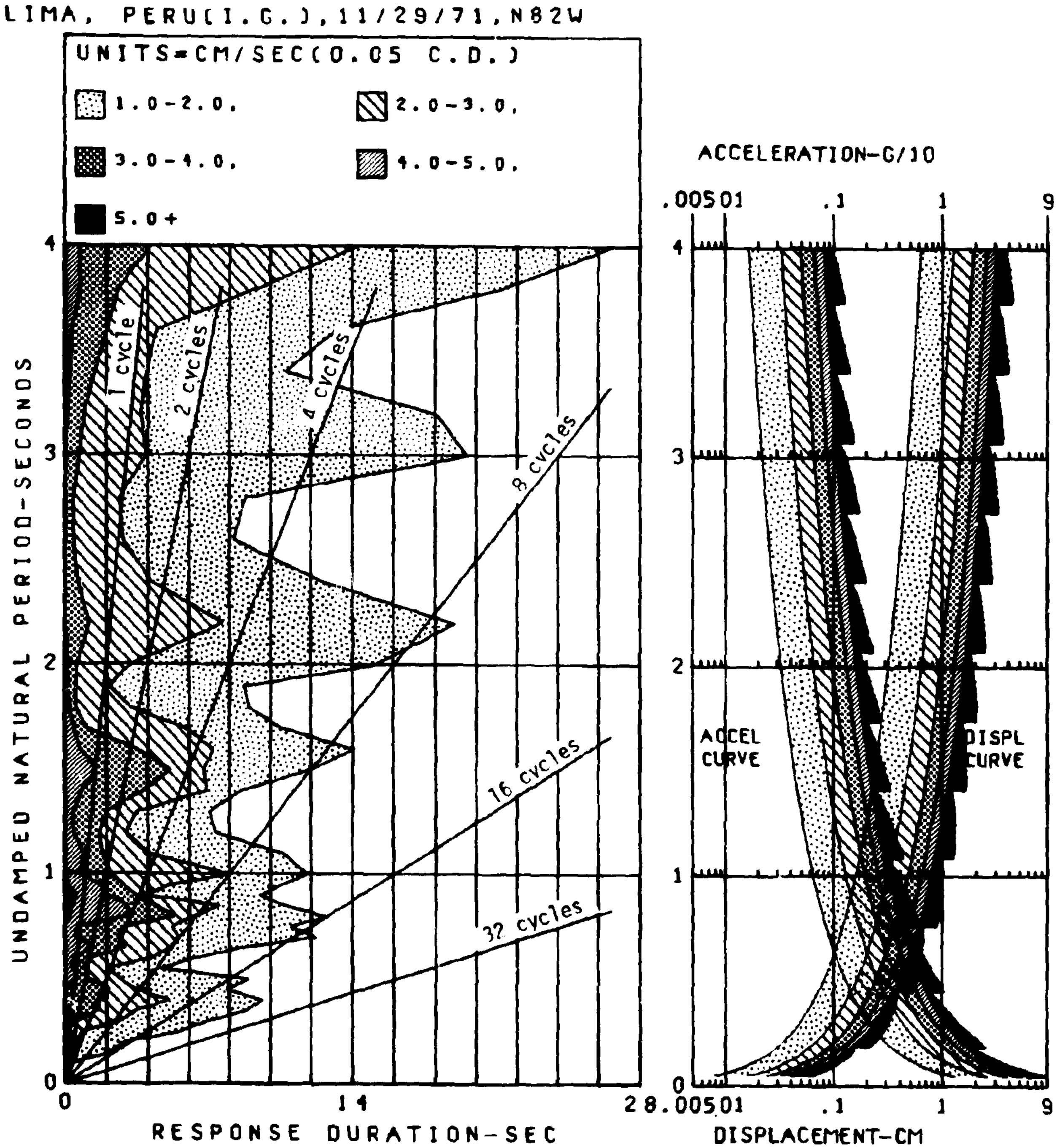

VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
LIMA, PERU(I.G.),11/29/71,N82W
0-1.0,
1.0-2.0,
2.0-3.0,
3.0-4.0,
4.0-5.0,
5.0+
UNDAMPED NATURAL PERIOD-SECONDS
TIME - SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
ACCEL CURVE
DISPL CURVE


VELOCITY RESPONSE ENVELOPE SPECTRUM
UNITS=CM/SEC(0.05 C.D.)
LIMA, PERU(T.G.),11/29/71,N08E
0-2.5,
2.5-5.0,
5.0-7.5,
7.5+
TIME - SECONDS
UNDAMPED NATURAL PERIOD-SECONDS
ACCEL-G/10
VELOCITY CM/SEC
ACCELERATION-G/10
DISPLACEMENT-CM
DISPL CURVE
ACCEL CURVE

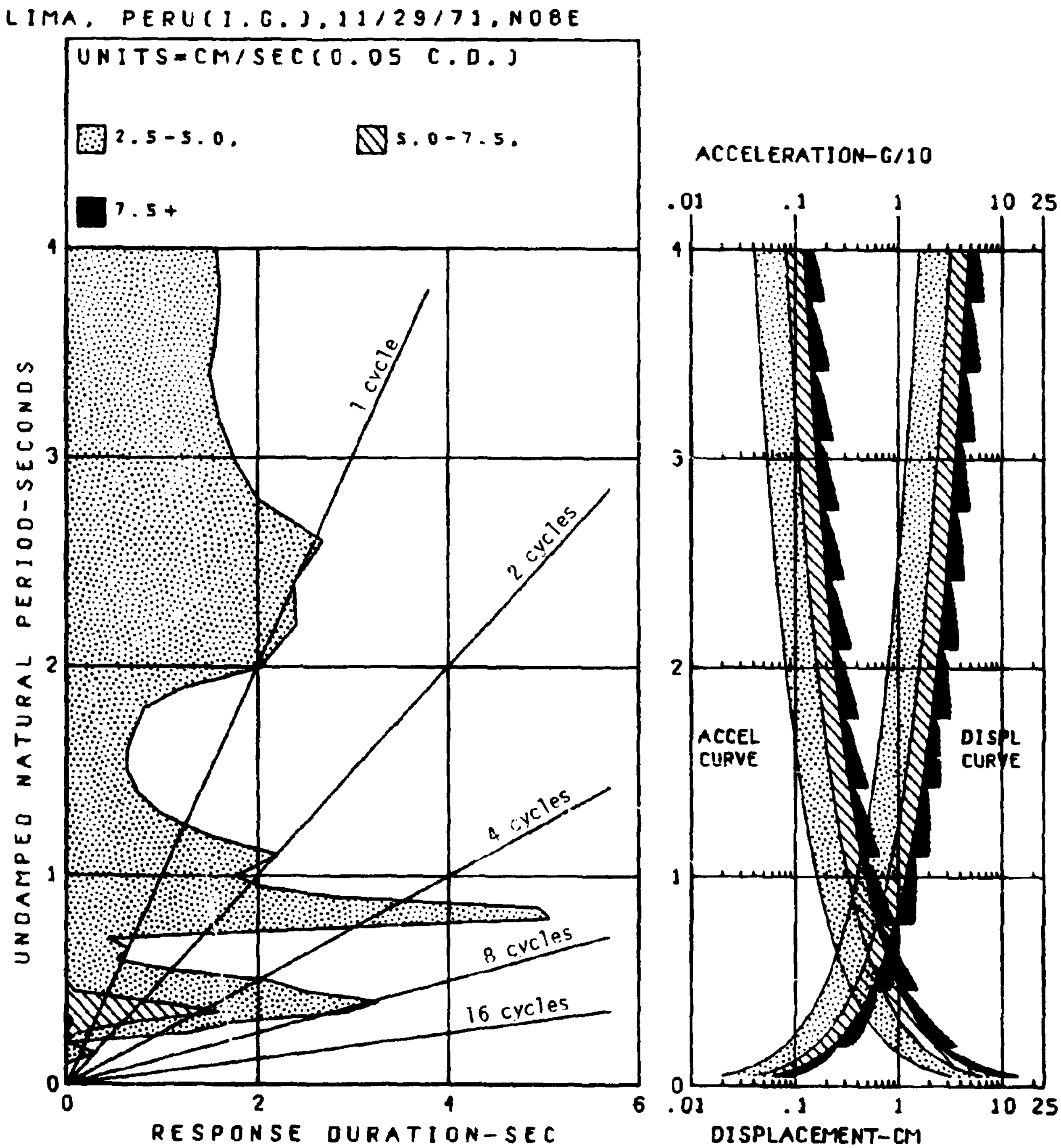
VELOCITY RESPONSE ENVELOPE SPECTRUM



TIME DURATION SPECTRUM OF THE RESPONSE ENVELOPE



TIME DURATION SPECTRUM
OF THE RESPONSE ENVELOPE



TIME DURATION SPECTRUM OF THE RESPONSE ENVELOPE

LIMA, PERU(I.G.),11/29/71,UP