SPECTRAL ANALYSIS OF THE JULY 8, 1971 EARTHQUAKE IN CENTRAL CHILE

by

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SYNOPSIS

A 7.5 magnitude earthquake affected Chile July 8, 1971 and, for the first time, simultaneous accelerograms were obtained.

The zero base line were determined using non-zero initial ground velocity. Intensity measures were calculated and compared with those obtained for the 1965 earthquake.

It was verified that Chilean earthquakes have usual characteristics with respect to the attenuation of maximum acceleration with epicentral distance.

Ground displacements, response spectra, Fourier Amplitude Spectra and correlograms were evaluated for the records considered. Acceleration Spectra for the Santiago components show large peaks for short periods, while for the other records they appear for 0.9 seconds.

INTRODUCTION

Throughout its history, Chile has been characterized by being a highly seismic country. However very few seismic instruments were installed in the country before 1968, and because of unfortunate circumstances, even these have not recorded the most important earthquakes of this century, i. e., the earthquakes of the 21st and 22nd of May, 1960.

In what follows, the principal characteristics, for the accelerograms obtained during the July 8, 1971 earthquake, recorded in Santiago (Chile) and in La Rioja (Argentine) are studied.

It must be pointed out that the instruments utilized were different. A Montana type accelerograph in Santiago, while an Akashi (Ishimoto) accelerograph in La Rioja, were triggered.

The general characteristics for the earthquake are given in Reference 1. The focus, determined using seven stations, had the coordinates 32°27'S and 71°34'W, 60 Km. deep, with 7.5 Magnitude (Berkeley) and 7.75 Magnitude (U.S.C.G.S.).

It is possible to affirm that the earthquake under study affected approximately the same zone as it did the March 28, 1965 earthquake.

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ANALYSIS OF ACCELEROGRAMS. GROUND DISPLACEMENTS.

The analysis of accelerograms usually requires digitizing the record; time scale, acceleration scale, and zero base line corrections for the acceleration of the ground (2).

The accelerograms used for this work were copies of the original records from the United States Coast and Geodetic Survey, and from C.O.N.C.A.R. (San Juan, Argentine). They were digitized using a Benson Lehner equipment, described in Ref. 2.

The zero base line correction for the ground acceleration used in this work is a modification of the method presented in Ref. 3, developed by the senior author (2), which admits the possibility of having non-zero corrected initial velocity.

Ground displacements were obtained integrating twice the corrected accelerogram and filtering out long period components. The maximum ground displacements obtained for this earthquake are smaller than 3.3 cm.

ARIAS' INTENSITY.

Arias' intensity (5), I_A, and the root mean square acceleration, both as a function of time, were computed for all the accelerograms considered.

In table I are compared the I_A values for different durations of the accelerograms for the 1971 and 1965 earthquakes. It is interesting to make this comparison since both earthquakes have similar characteristics regarding magnitude, focus location and affected zone.

MAXIMUM ACCELERATION.

The maximum accelerations recorded in Santiago and La Rioja for the 1971 earthquake were compared with the correspondent values for american, and specially with those belonging to the 1945, 1965 and 1967 Chilean earthquakes. A double logarithm graph was used, where the maximum acceleration is plotted in ordinates and the distance to the epicenter in abscissa (4).

It was found that the values obtained for all the Chilean earthquakes do not present characteristics significatively different with regard to the attenuation of maximum acceleration with epicentral distance, exclusion made of the 1966 and 1970 peruvian earthquakes.

RESPONSE SPECTRA.

After making the base-line correction, response spectra were determined exactly, assuming that the accelerogram varies linearly between peaks. Acceleration spectra are given in Fig. 1.

The Santiago acceleration spectra show large ordinates for small periods and the La Rioja correspondent spectra exhibit large values for longer periods.

FOURIER AMPLITUDE SPECTRUM.

Reviewing the results, it is observed that the Spectra obtained for the La Rioja accelerograms differ appreciably in shape with the remaining spectra. The La Rioja spectra show large ordinates for periods of the order of 2.5 sec. and small ordinates with few fluctuations for periods smaller than 1.0 sec.

The Fourier Amplitude Spectra for all the accelerograms were compared with the undamped velocity spectra. It was verified that in all the cases the Fourier amplitude spectrum is smaller than or equal to the undamped relative velocity spectrum.

CORRELOGRAMS

The correlograms give the correlation between the ground acceleration, $\ddot{x}$, recorded at time t and the ground acceleration recorded at time $t+\tau$.

The fact that the correlogram presents the shape of a damped curve means that the correlation between $\ddot{x}(t)$ and $\ddot{x}(t+\tau)$ becomes smaller when τ increases, although not monotonically, since correlograms present oscillations (2).

It is possible to conclude that the accelerograms recorded in Santiago have important random components. It does not happen the same with the accelerograms recorded in La Rioja. In fact, the correspondent correlograms show little damping and the maximum and minimum ordinates slowly diminish, i.e., the sinusoidal components are important.

BIBLIOGRAPHY

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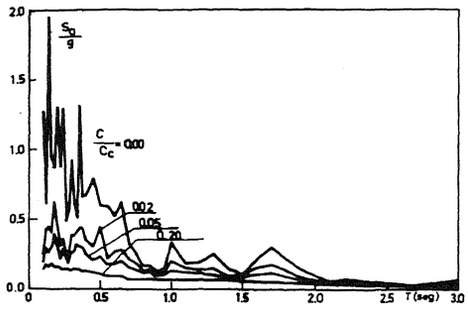
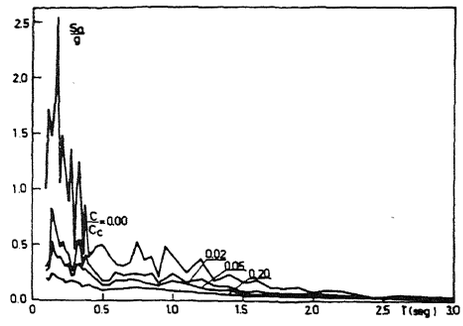
TABLE I. ARIAS' INTENSITY

$10^4 \frac{I_A}{g}$ (Sec.)

Place	Date	Comp.	t=5s.	10s.	20s.	40s.	80s.	160s.
Santiago	28-3-65	S80W	117	312	404	-	-	-
Santiago	28-3-65	N10W	73	215	287	-	-	-
Santiago	8-7-71	S80W	5	35	238	322	343	
Santiago	8-7-71	N10W	5	35	277	374	398	
La Rioja	8-7-71	NS	0.03	0.09	0.45	1.2	9.2	23.3
La Rioja	8-7-71	EW	0.03	0.09	0.39	1.1	9.9	25.5



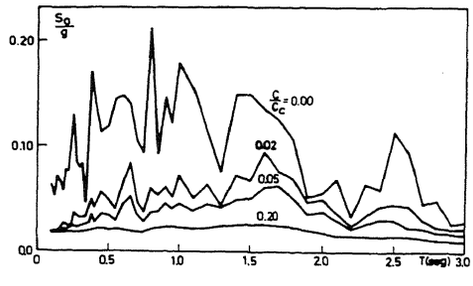
Santiago Comp. S80W



Santiago Comp. N10W

FIG.1 ACCELERATION SPECTRA. CHILEAN EARTHQUAKE 8 VII 1971

La Rioja Comp. EW



La Rioja Comp. NS