CARACAS EARTHQUAKE OF JULY 1967
GEOPHYSICAL FIELD MEASUREMENTS

by

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SYNOPSIS

The Caracas earthquake areas of intense damage and adjacent areas of little or no damage were locations selected for seismic refraction profiling and for velocity and overburden depth determinations. In-situ "P" and "S" wave velocity values were measured in arrays of boreholes (70 meters deep) at the intense damage areas of Los Palos Grandes in the Caracas Valley and Caraballeda at the seashore.

At both locations great thicknesses (over 200 meters) of low-velocity materials exist. Areas of little or no damage contain much less low-velocity material (0-70 meters). In the Los Palos Grandes area, where buildings collapsed, the depth to rock ("P" wave velocity = 4,000 m/sec) is approximately 200 meters; the valley fill material has "P" wave velocity values of 1,300 to 2,200 m/sec and "S" wave velocity values of 430 to 480 m/sec.

INTRODUCTION

The Caracas, Venezuela, earthquake of July 29, 1967, resulted in intense damage along parts of the seashore area, and in one part of the Caracas Valley, the Los Palos Grandes area where four (4) high-rise buildings collapsed[1]. This event, Magnitude 6.3, was located 50 kms northwest of Caracas in the Caribbean Sea.

In order to determine soil conditions and depths to rock throughout intense damage areas and adjacent areas of little or no damage, a geophysical field program took place consisting of seismic refraction profiling and in-situ velocity measurements. These routine exploration procedures were recently reviewed[2] for applications such as the measurements covered by this paper.

The refraction profiling was used primarily to determine depths to rock along selected sections of the Caracas Valley to evaluate an

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unpublished "depth-to-bedrock" contour map (which was based on only water well drilling a few core holes) and to determine average "P" wave velocity values of the valley fill materials and bedrock. Refraction studies were also made at several locations along the seashore (including the intense damage areas of Caraballeda) where no depths-to-bedrock maps existed and where only shallow borings had been drilled.

The in-situ "P" and "S" wave velocity measurements were made by the cross-hole method in arrays of boreholes drilled to depths of approximately 70 meters in the Los Palos Grandes area of the Valley and at Caraballeda on the seashore. Surface methods were used for "P" and "S" wave value determinations in numerous other locations throughout the Valley and seashore areas.

A dual objective was presented for these measurements: 1) to determine if a correlation exists between depth/velocity data and damage patterns; and 2) to provide input depth/velocity data for other studies related to the earthquake[3].

VELOCITY/DEPTH DATA

Caracas Valley

The alluvial fill materials[4] in the Valley have surprising uniform velocity values with no apparent "pockets" or "zones" of anomalously low (or high) values. However, a significant anomaly with regard to the depth to rock does exist in the Valley and coincides with the locale of intense damage (Los Palos Grandes). Comparative seismic survey sections across the Valley[5] are presented on Figure 2a and 2b; "P" and "S" wave velocity values[5] measured in-situ by the cross-hole method[5] are presented in Figure 1a.

Seashore Areas (Litoral)

Alluvial materials along the seashore areas have highly variable velocity values from one locations to another and also within the most intense damage area of Caraballeda. Lagoon deposits and alluvial fan conditions in the latter area apparently account for localized velocity differences there. A seismic survey composite section[5] across this area is presented on Figure 2c; in-situ velocity values are presented on Figure 1b.

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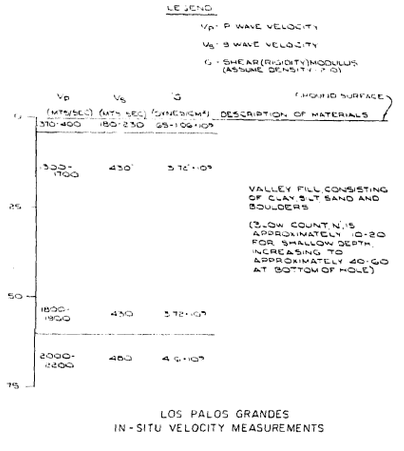
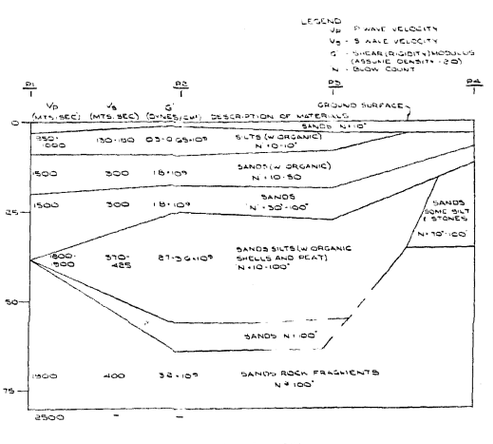


LOS PALOS GRANDES
IN-SITU VELOCITY MEASUREMENTS

Figure 1a



CARABALLEDA
IN-SITU VELOCITY MEASUREMENTS

Figure 1b

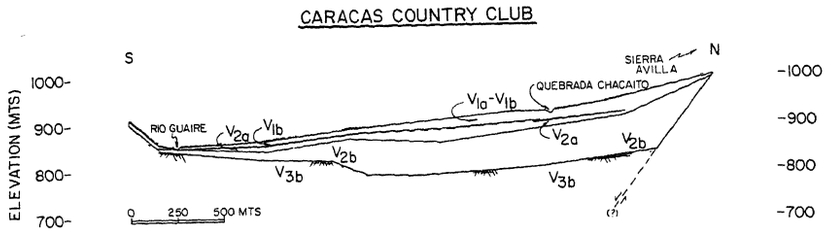


Figure 2a

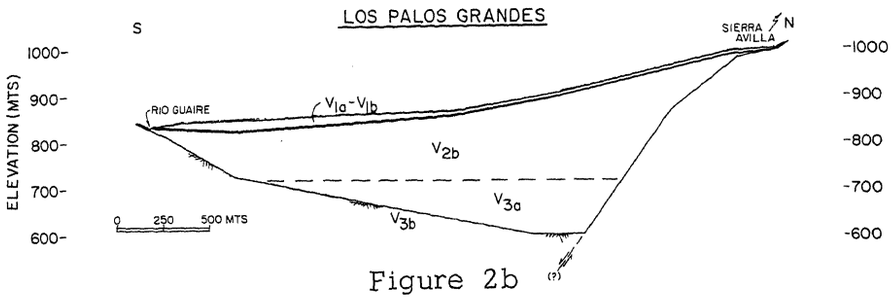


Figure 2b

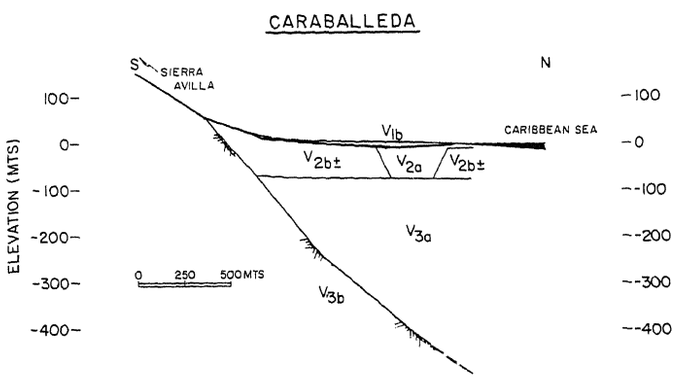


Figure 2c

CARACAS - SEISMIC VELOCITY VALUES

SYMBOL	VELOCITY ("P" WAVE) (MTS / SEC.)	IDENTIFICATION
V_{1a}	400 - to 500±	SOILS, PROBABLY LOOSE
V_{1b}	900±	SOILS
V_{2a}	1500±	SOILS, SATURATED
V_{2b}	1700 - to 1850±	SOILS, COMPACTED VALLEY FILL; ALSO LAYERS OF SOFT AND/OR WEATHERED ROCK.
V_{3a}	2400±	SEDIMENTARY ROCK AND/ OR CEMENTED SOILS.
V_{3b}	4000±	ROCK, GNEISS OR MASSIVE SCHIST.

Figure 2