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MEDICAL DISTRICT EARTHQUAKE PLANNING SCENARIO IN CARACAS, VENEZUELA

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ABSTRACT

The primary concern addressed in these planning scenarios is related to the assessment of health care facilities earthquake vulnerability in the"Medical District" of Caracas. This "Medical District" is constituted by 'La Candelaria' 'San Bernardino' and 'San José' districts in the Libertador Municipality. At the present, the Municipal System for Attention and Mitigation of Emergencies (SMMAE) of this Libertador Municipality is starting to develop scenarios for the whole Municipality, in order to quantify the seismic risk for the formulation of strategies and countermeasures for reducing it. This municipality is the most important and the largest of Caracas The SMMAE gathers public and private institutions related with the different levels of municipal services: municipal and district authorities, the Fundación Venezolana de Investigaciones Sismológicas (FUNVISIS), the Firemen Department, Civil Defense Department, the electricity, gas and water supply companies, the main oil enterprises, the National Housing Institute, etc. The planning earthquake scenarios described in this paper constitutes a pilot project on the development of a method for estimating probabilistic building damage patterns in the whole municipality as a result of two probable earthquakes.

Priorities were allocated to the health care facilities since it has been stated by the emergency response planners, that this type of building should not only remain undamaged when an earthquake occurs, but it must remain functional, in order to render all essential services required by a post earthquake situation. The specific characteristic of health care facilities, creates a critical situation, since in them, the particular medical functions are combined with those of a hotel, office building, laboratory, storage and others. Besides, they are heavily occupied (they house a variety of population such as patients, medical and administrative personnel, visitors and others) throughout the year, for the 24 hours a day.

The main objective in developing these "microscopic" earthquake scenarios in the "Medical District" of the Libertador Municipality, is to visualize the probable effects that a possible earthquake might produce in a zone of the city that presents:
1. The greatest concentration of private and public health care facilities, not only in Caracas, but in the entire country; with a significant variety of building types, structural systems, configurations, heights, and services rendered, ranging from very complex

structures designed specifically for health care, to residential or commercial spaces remodeled for medical services. The complexity of the services rendered by the different institutions, also vary from simple emergency care or ambulatory treatment (out-patient service) to sophisticated treatment in nuclear medicine, intensive care units, etc. In inventorying the area, a total of 110 entities was identified as providing health care services in the zone. The exact location of each entity was identified on an official urban information map scale 1:1000.

2. A wide range of alluvial soils which go from 0 to 120 meters in depth, identified in the "Map of Depth to Bedrock in the Caracas Valley," scale 1:20.000 developed in 1969, after the moderate 6.3 Richter magnitude earthquake, on July 29, 1967. This is the strongest earthquake that Caracas residents have experienced in the last 90 years. Extensive structural and non-structural damage was recognized in the area. Several authors suggested, at that time, and corroborated afterwards, the correlation between the concentration of structural damage and the depths, the dynamic soil characteristics and the behavior of underlying alluvium.

The studied zone neighbors Caracas Downtown. It constitutes the eastern limit of the Colonial City. It is crossed by three of the most important roads that connect the East and the West of the city: Av. Boyacá, Av. México-Universidad and Av. Urdaneta. 'La Candelaria and 'San José' districts are part of the central urban structure with a rectangular grid configuration. However, in the 'San Bernardino' district and in the northern part of the 'San José' district, the streets' layout is very disoriented and the vehicular flow is very complicate. This fact is due to; (1), the topography of the zone; and (2) the original transformation of a coffee plantation into an exclusive residential neighborhood with housing surrounding the main plantation house; originally this area was connected to the urban structure through very few accesses off the main commercial roads. The studied area still holds residential zones that go from densely located small houses to new condominium type housing. Besides the concentration of health care facilities, it also contains: (1) modern office building complexes, such as, the headquarters of: the main commercial banks of Venezuela, the Electricity of Caracas Company, the National Navy; (2) many gas stations; (3) schools; (4) fire stations; (5) hotels; and others.

The possibility of substantial loss of life and structural damage resulting from ground shaking because of the deep alluvial soil, and the concentration of a great variety of health care facilities located in "La Candelaria," "San Bernardino" and "San José" districts, made it ideal for the implementation, assessment and improvement of earthquake planning scenarios in this area of Caracas. These scenarios give special consideration to: (1) the ways of getting to, and off the facility in a surrounding damaged environment and the vulnerability of the urban infrastructure; (2) the dependence of each facility on off-site public utilities (electricity, water, gas, telecommunications systems, etc.) for mid- and long-term continuos operations; and (3) the community.

The method used for the development of these earthquake scenarios consists of tables listing incidents and activities after earthquakes, based on damage assessment methods. Since it has been very difficult to obtain detailed information from the official urban census, a preliminary basic data collection form was designed in order to identify or corroborate, for each entity: location, the owner's name, the property or administration type (public or private), the address, the catastral identification, the number of modules or building units that constitute each entity, the structural system, the number of stories, and the use of each building.

Concurrently, geologists and seismologists made an effort to determine the seismic hazard of the area: (1) the probable magnitude and location of earthquakes that would likely damage Caracas in the future, and (2) the estimate MM intensity in the zone. FUNVISIS, investigates two different categories of earthquakes, representing the range of estimated maximum possible magnitudes that might affect the city: (1) a coastal earthquake in the San Sebastián fault, magnitude, 7.5 km north of Caracas; and (2) a local earthquake of magnitude 6.8, located in the Tacagua-Avila fault that goes West-East, through the northern limit of the city. Caracas is surrounded by fault zones that are part of the San Sebastián (or Morón) Fault subsystem. It is considered that this fault system is the origin of the earthquakes that affect the capital city. The seismicity of Caracas has been cataloged in the moderate range; however, this city has experienced a series of very destructive earthquakes in the past (1641, 1812, 1900).

REFERENCE

Map of Depth to Bedrock in the Caracas Valley. (1969). In Investigaciones Sísmicas en el Valle de Caracas y en el Litoral Central. Ministerio de Obras Públicas, MOP. Caracas, Venezuela.

KEYWORDS

Seismic Vulnerability; Earthquake Planning Scenarios, Seismic Risk, Medical District; Caracas; Venezuela.