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CARACTERIZACION GEOLOGICA Y GEOTECNICA DE LOS SITIOS-TEST DEL PROYECTO DE MICROZONIFICACION SISMICA EXPERIMENTAL CETE-MEDITERRANEE - FUNVISIS

Se escogieron dos sitios-test con características topográficas y geológicas contrastadas:

- El sitio piemontino de El Vigía, ubicado encima de una estructura fallada activa, de importancia regional correspondiente al cabalgamiento de la cordillera andina venezolana sobre los depósitos terciarios y cuaternarios de la depresión del Lago de Maracaibo, los cuales constituyen el soporte directo de la ciudad señalada y del terminal del poliducto SUMANDES (MARAVEN), los sedimentos cuaternarios más recientes, de edad holocena, ubicados al Oeste de la ciudad, experimentaron fenómenos de licuación durante el gran terremoto andino de 1894, que inutilizaron la antigua vía férrea de El Vigía a Santa Bárbara, en la costa del Lago de Maracaibo.

- El sitio inundable de la costa oriental del Lago de Maracaibo (COLM), mundialmente conocido por el proceso de subsidencia que afecta a varias poblaciones (Tía Juana, Lagunillas, Bachaqueros) desde hace más de 50 años, como consecuencia de la extracción de petróleo. Tal subsidencia ha ocasionado un descenso del terreno del orden de 6 metros por debajo de la cota del lago, el cual se ha superado por medio de la construcción de un dique costero en unos 40 Km de largo y de sistemas de polders. Posteriormente al terremoto de Caracas de 1967, la industria petrolera ha venido desarrollando estudios para la evaluación de la vulnerabilidad sísmica de esta obra de importancia vital y para el mejoramiento de su comportamiento en caso de terremoto.

El presente trabajo enfatiza en la caracterización geológica y geotécnica de las principales unidades de suelos presentes en la COLM, destacándose una unidad de suelos fluvio-lacustres, de origen recientes y dispuesta en forma de cuña hacia tierra adentro, donde se apoya sobre una unidad de sedimentos más consolidados del Mioceno, cerca del dique, tal cuña de sedimentos alcanza un espesor de unos 30 metros y se encuentra constituida por suelos arenosos y limosos, con delgadas intercalaciones de arcillas de plasticidad intermedia a alta, en los primeros metros. Estos suelos se desarrollan probablemente con el desarrollo de un cordón litoral edificado por el lago anteriormente al proceso de subsidencia. En profundidad, se registra un aumento del contenido de arcillas con, algunos casos, una fuerte componente orgánica atribuida al desarrollo de niveles importantes de turba correspondientes a ambientes de sedimentación lagunar originados detrás del cordón litoral.

Debido a las variaciones laterales y verticales señaladas en la unidad de suelos recientes se ha propuesto estudiar las respuesta dinámica de un mayor número posible de perfiles de suelos característicos del sector investigado en la COLM, de esta manera de obtener los factores de ampliación para diferentes tipos de sismos cercanos y lejanos en base

a la utilización de un modelo lineal, y para fines de comparación con los datos experimentales obtenidos por medio de mediciones microsísmicas efectuadas conjuntamente por el CETE-MEDITERRANEE y FUNVISIS.

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THE VENEZUELAN INSTRUMENTATION USED IN THE MICROZONING OF THE EASTERN COAST OF MARACAIBO LAKE AND THE CITY OF EL VIGIA

A microzoning project has been developed in two places of great economical influence for Venezuela, these areas are: The Eastern Coast of Maracaibo Lake (Edo. Zulia) and the city of El Vigía (Edo. Mérida). THE VENEZUELAN FOUNDATION FOR SEISMOLOGICAL RESEARCH -FUNVISIS- (Venezuela) and THE CETE MEDITERRANEE (Nice, France) have been accomplishing this project for Venezuelan oil industry (INTEVEP and MARAVEN). In the course of the project, the instrumentation of the studied areas was executed in order to gather the data for determining the soil responses in the presence of an earthquake.

It this experiment FUNVISIS installed eight (08) instrumental stations in the Eastern Coast of the Maracaibo Lake and eight (08) instrumental stations in the city of El Vigía. These stations were operated during one (01) month and the selection of the places was accomplished according to conclusions obtained in several meetings between CETE MEDITERRANEE and FUNVISIS. It had taken into account as essential points for the station places determination: objective pursued in the study, geology of the zone, safety of the equipments, noise and others disturbing factors of the obtained data and logistics factors.

The FUNVISIS instrumentation was performed with several kinds of equipments with different characteristics (seismometers and accelerometers) for the propose testing them and concluding about their behavior in microzoning studies. We used our own low cost equipments and the majority of them gave good results for these kind of experiment.

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ANALYSIS OF THE SEISMOLOGICAL DATA COLLECTED BY THE VENEZUELAN TEAM (FUNVISIS), DURING THE MICROZONING OF THE EASTERN COAST OF MARACAIBO LAKE AND THE CITY OF EL VIGIA

During the last five centuries, Venezuela has experimented several catastrophic earthquakes, which are responsible for thousands of deaths and severe damages to civil infrastructures. In order to minimized loses (human and material) that future earthquakes may produce to the population and cities in the country, the Venezuelan Foundation for Seismological Research has developed several research programs for the evaluation and mitigation of the seismic risk in Venezuela. One of this programs consider the application of the methodology of microzoning to cities and industrialize places, where high seismic risks are expected. Because of the worldwide application of the microzoning technique is relatively new, FUNVISIS decided to join effort on this matter with the CETE-Mediterrané of France, with two objectives in mind. First, to learn the details of the technique from a group of experts on this field, and second, to apply the methodology to places in Venezuela that are considered highly vulnerable to earthquakes.

Due to the high cost involved in microzoning studies, FUNVISIS, seek sponsors for developing a pilot program in Venezuela. Because of the possible vulnerability of some of the Oil industry installations, some of them located within seismic zones, MARAVEN and INTEVEP (subsidiaries companies of Petróleos de Venezuela), decided to sponsor the project at two well-determined zones in Western Venezuela: The Eastern Coast of Maracaibo Lake and the city of El Vigía.

During the execution of the pilot program, FUNVISIS deployed a small seismological and accelerographic network, in order to gather the seismicity of the zones and for determining the soil response due to the energy liberated by earthquakes. The data was collected in a digital format by portable computers, running an adaptation of the Soufriere System software (Beckel et. al., 1990), which was originally developed for seismological centers, along with home made equipments.

To process the seismic information, the XPLOT family of programs (Mendoza, 1992) was used. Due to the versatility of this software, we were able to mix accelerographics and seismological records gathered in different stations, to obtain the spectral ratios (transfer functions) of a particular location with respect to a reference station.

Once we obtained the experimental spectral ratios, site effects produced by the seismicity in the selected places were evaluated. The results obtained by the Venezuelan team (FUNVISIS) were in good agreement with those found by the French team (CETE Meditarrané).