QUICK-LOOK REPORT ON OAXACA, MEXICO EARTHQUAKE
EERI RECONNAISSANCE TEAM

A major earthquake occurred at 11:52 (PST) in Mexico on Wednesday, November 29, 1978. The magnitude was measured by USGS in Colorado and the University of California at Berkeley, as either 7.9 or 7.8 on the Richter Scale. USGS located the epicenter at 16.12 N, 96.43 W. The earthquake was followed by strong after shocks.

In view of the reported magnitude of the earthquake and contradictory press coverage that varied from, "Big buildings collapse in Mexico City, 75 buildings damaged." to later reports of "minor damage," President J.A. Blume and the Executive Committee of EERI decided to dispatch an EERI team to prepare a reconnaissance report. The team consisted of: Ted Algermissen, Clarence Allen, Lloyd Cluff, Haresh Shan, who were on their way to attend a UNESCO conference in Cuernavaca, and Bob Olson who was also invited to join the EERI team.

This report covers the findings of an other section of the EERI team consisting of Neville Donovan, Nick Forell and Joe Nicolette, who together with Leonard Zeevaert, the latter had come from Mexico City to attend the Micronization Conference in San Francisco.

Not enough can be said of Mr. Zeevaert's support and hospitality in Mexico City. Not only did he devote every available minute of his time to guide us through the city, but his encyclopedic knowledge of construction in Mexico City was invaluable.

Our survey of Mexico City disclosed minor damage to only a few buildings, which clearly conflicts with the newspaper reports. It was the opinion of Mr. Zeevaert, later borne out by the Geophysics Institute of the University of Mexico City, that ground accelerations were less than 2% of gravity with long periods in some instances over 2 seconds. The damage that did occur can be explained from the resonance of buildings to earthquake and site periods. According to Mr. Zeevaert, the site period in Mexico City varies from 2.0 seconds in the core of the city to 5 seconds at the airport.

In general, those interviewed commented that the earthquake was strongly felt, though it had little effect. Most said that their first reaction was one of dizziness and loss of balance. The motion was described as a slow rocking or rolling motion, similar to that of a boat. The duration of the earthquake was described as between 1-1/2 minutes and 2 minutes for the first shock. No sound was associated with the earthquake activity. A number of people stated that they could see the tall buildings sway and in one instance twist.

The team found two major buildings that showed appreciable external damage. The first is the Treasury Building at the corner of Dr. Lucio and Dr. Lavista Streets which is a nearly block long 10 story concrete frame building with glass block infill. The only visible damage was to the glass block infill and an exterior concrete first floor wall abutting to the structure. Access to the interior of the building was not granted and no external sign of damage to the structural frame was in evidence. The large degree of eccentricity of the lateral load resisting system, by virture of the location of the utility core and the glass block infill, would explain the concentration of damage. at ends of the structure. The other building is an eighteen story concrete frame with brick infill owned by the Bank of Mexico. It has a large two story commercial base with a smaller apartment tower rising from it. Damage consisted in a fractured brick infill and cracked corner columns at the 3rd floor where the apartment tower rises above the base structure. It seemed likely that the damage was caused by the discontinuity of structural stiffness between tower and base.

Except for minor cracking of finishes and some instances of new soil settlement caused by the earthquake, no significant damage aside from these two cases was found.

It should be noted that any survey of earthquake damage in Mexico City is obscured by the unique soils conditions and foundations in this City. Soil subsidence and foundation settlements over the years have been severe and foundation systems vary from spread footings to pile supports practically

from building to building. The difference in foundation behavior and settlement have no doubt created locked-in stresses in buildings that can result in damage under the slightest agitation, obscuring the significance of earthquake related damage. It can not be sufficiently emphasized how many of those buildings observed should have suffered earthquake damage, but did not.

At the University of Mexico, through the courtesy and assistance of Gustave Analon and George Prince, the team had the opportunity to examine the seismograph and strong motion records from Mexico City, the Gulf Coast and Oaxaca. Of specific interest was the strong motion record from Oaxaca, just received, which indicated three shocks, the first and most significant of which recorded accelerations of up to 22% of gravity. The duration of the main shock was close to seven seconds and the record rather than indicating a rapid decay after the main pulse showed a sustained activity of well over 10% of gravity throughout.

The University of Mexico differed in their assessment of both magnitude and location of the earthquake. In their opinion the earthquake had a magnitude of 7 or less with the location of the epicenter off shore from Puerto Angel.

The survey of Oaxaca again revealed no significant structural damage. At the University of Mexico Medical School, the location of the strong motion recorder, some minor spalling of concrete were observed at the old hospital building and some plaster damage at an ornate Greek revival structure were observed. The main classroom buildings which are 2 story light steel frame buildings with masonry infill walls and screen walls suffered no damage whatsoever. In the city of Oaxaca, except for one brick building that was severely cracked, no significant damage was found. The minor cracks in concrete and masonry which were noted, had no relationship to type and quality of construction, but appeared of a random nature.

The trip from Oaxaca to Puerto Angel at the coast is arduous and leads over the last 150 kilometers over high and extremely steep mountain ranges. The unimproved road for long stretches is curved steeply from the mountain sides. A number of landslides were encountered between Miahatlan and Pochutla. No

doubt most were caused by earthquake activity; however, it should be noted that the cut and fill slopes of the road are extremely steep, almost to the point of instability. Signs of previous slides caused by the rainy season exist everywhere.

There are a number of villages and farm structures along the road, none of which appeared to have been damaged. The town of Candelaria Loxicha, which according to the information obtained from USGS is located close to the epicenter, and has a large church. Except for minor cracks above the alter, no damage was found in this or other buildings.

Puerto Angel is a small seaside town with few modern structures. The harbor has a small pier and shelters quite a number of fishing boars. No damaged buildings were found, and the condition of the pier and fishing boats beached for maintenance make the statement in the press that: "The ocean has fallen back 80 meters from the Oaxaca coast line." highly improbable.

At Puerto Escondido the team met up with groups from the Geophysics Institute of the University of Mexico City, and the field team from USGS Menlo Park headed by C. Knudson. Mr. Ponce from the University of Mexico City was in the area at the time the earthquake occurred and described the motion as violent and lasting 50 seconds. Both teams had recorded numerous after shocks. On Friday night a strong after shock was felt at the Hotel Rincon del Pacifico which triggered one of C. Knudson's instruments. However, an identical instrument 1000 meters away was not affected! The press reports that the towns of San Baltasar Loxicha and Santa Caterina Loxicha, approximately 35 kilometers inland, had been destroyed by the earthquake were unconfirmed.

No effects of the earthquake were found in the Puerto Escondido area with two noteworthy exceptions. Of the bridges examined between Puerto Angel and Puerto Escondido, a short span low bridge was permanently offset, in the westerly direction, on its supports. Some damage occurred to the abutment wing-walls. The other damaged structure was the administration building of the 45th Infantry Battalion at the Puerto Escondido military station. This building is a 2 story concrete frame structure 2 bays wide and 8 bays long.

The bays are approximately 5 meters square in plan and story height is approximately 4 meters. Except for the 4 lower westerly bays all have masonry infill allowing for strip fenestrations. In the southerly direction the girders cantilever on modules to support solid concrete sun-screens. This building suffered substantial damage. All of the brick infill was severely cracked and on the lower floor some of the column-beam joints had the concrete cover spalled away. The building appeared well engineered and constructed. In the spalled column-beam joints horizontal column ties were observed. Permission to take photographs was not granted. It is noteworthy that a great number of buildings of similar construction, which had structural discontinuities and irregular configurations and which were in close proximity to this building showed no damage whatsoever.

The most significant observation made by this reconnaissance team is the astonishing discrepancy between the reported magnitude of the earthquake and the minor damage caused by it. At magnitudes of 7.8 or for that matter 7.0 as reported by the University of Mexico City, damage should have been substantial. Of further interest is that the limited amount of damage that was observed could neither be related to distance from the epicenter nor to the structural quality of the buildings affected. The damage pattern was random with many buildings unaffected that by all criteria should have been severely damaged.

Prepared for the EERI Team
by Nick Forell
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