

LIQUEFACTION-CAUSED GROUND FAILURE DURING THE  
FEBRUARY 4, 1976, GUATEMALA EARTHQUAKE

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ABSTRACT

Seismically induced liquefaction (the transformation of granular materials to a liquefied state due to increased pore-water pressure) caused ground failures in the February 4, 1976, Guatemala earthquake. Failures occurred predominantly in areas of recent deposition such as deltas and stream channels, and around some small ponds and wet areas in the highlands. Water-laid saturated pumiceous sand deposits were highly susceptible to liquefaction. Lateral-spreading landslides with more than 9.6 m horizontal displacement and a meter of subsidence occurred on slopes as gentle as 3.2 percent on the youngest part of the delta in Lake Amatitlan (14 km south of Guatemala City) due to liquefaction of a shallow (1 m deep) layer of pumice sand and gravel. Associated ground cracks and sand boils formed as much as several hundred meters from the lake shore and were generally oriented parallel to the lake shore or to river banks. Lateral spreading across these cracks destroyed some well-built reinforced brick houses that appeared to have suffered no direct shaking damage. At the Rio Panajachel delta on Lake Atitlan, 65 km west of Guatemala City, cracking and associated subsidence due to lateral spreading caused moderate damage along the lake shore. In the swampy lower Motagua River Valley, bank collapses were common and ground cracks and sand boils were noted as far as 100 meters from river banks. Liquefaction effects were also reported from Lake Izabal, Guatemala; from Puerto Cortés, Omoa, and the San Pedro Sula area in Honduras; and from Lake Ilopango, El Salvador. The ground failures at Omoa affected houses built on sand dunes. There were ground cracks and damage to shoreline structures at a delta in Lake Ilopango about 240 km from the fault rupture.

INTRODUCTION

Damage from liquefaction-induced ground failure during the Guatemala earthquake of 4 February 1976 was both intense and widespread. Liquefaction produced ground failures not only in the epicentral region in the lower Motagua Valley (Fig. 1) but also as far away as Lake Ilopango, El Salvador, 240 km from the epicenter. A number of houses were destroyed by ground failure and subsidence on the delta at Lake Amatitlan. Ground failure also severely damaged several structures at Panajachel on Lake Atitlan. Moderate damage occurred at Puerto Cortés and San Pedro Sula, Honduras. Light damage from scattered ground failures also occurred in the Lower Polochic Valley, on the western shore of Lake Izabal, and at Lake Ilopango.

While the loss of life and property from liquefaction was only a small proportion of the total casualties from the Guatemala earthquake, the concentration of damage was intense in those areas where liquefaction did occur. Since many areas of widespread ground failure were sparsely populated, damage was light, but the potential for damage in future earthquakes could be high if these areas are developed. Further, some areas with moderate liquefaction

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