

## Learning from Earthquakes

### The November 22, 1995, Aqaba Earthquake

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The Aqaba earthquake woke many people at 6:15 a.m. local time on Wednesday, November 22, 1995 when it hit with a reported local wave magnitude of 6.4 on the Richter scale. The epicenter was located in the Gulf of Aqaba near the city of Dahab, Egypt, about 450 km southeast of Cairo. Several sizable aftershocks followed, including a magnitude 5.1 event on the evening of November 23. This report reviews damage in Egypt; damage was also reported in other countries along the Aqaba Gulf. Although the earthquake was felt in Cairo and other cities, the damage was concentrated in Nuweibaa.

Several hotels were damaged in Nuweibaa. The most dramatic incident was the complete collapse of a three-story reinforced concrete hotel built more than ten years ago (Fig. 1). Evidence of low quality materials and poor quality

construction could be seen in the rubble. At another hotel, cracks were observed at the beam-column connection at the roof as well as at the mezzanine floor. Slender columns supporting arched facades were also damaged. At a third hotel, a large entrance arch and the main hall suffered structural as well as non-structural damage. Other buildings suffering structural damage included a two-story building in Nuweibaa where short columns along the perimeter of the building, which supported the ground floor slab over a basement, collapsed under excessive shear deformation. Several other buildings suffered extensive cracking and failure of nonstructural infill walls.

In the city of Sharm El-Sheikh, 80 km southwest of Dahab, the airport control tower was inoperational due to limited damage. The exterior skeleton seemed intact to this team of investigators. Local damage was reported in a hotel at an expansion joint. The damage may have been due to pounding at mid-height of a column by the intermediate staircase in the adjacent building portion.

The Nuweibaa port area was also affected by the main shock.

Two of the four berths were particularly damaged. The gravity blocks of the quay wall appeared to have rotated and the plain concrete capping beam had cracked. The reclaimed land behind the quay wall, which is covered by a plain concrete platform and an asphalt wearing course, had settled non-uniformly, causing extensive cracks. From eyewitness reports, liquefaction of the reclamation material seems to have occurred. This liquefaction resulted in fountains of water springing from beneath the platform causing it to crack and subsequently settle. The external fence of the port collapsed at several locations as did the architectural masonry walls of two buildings.

According to Egyptian authorities, the death toll was five people, four dying in the collapse of the three-story hotel. Thirty-eight were injured by falling debris.

### The January 1, 1996 Indonesia Earthquake

The first strong earthquake of the new year hit at 8:05 GMT (4:05 p.m. local time) on January 1, 1996, in Sulawesi, Indonesia. The U.S. Geological Survey reported a magnitude of 7.7 ms; the Indonesian Meteorology and Geophysics Agency (BMG) reported a Richter scale magnitude of 7.0. The epicenter was about 160 km north of the provincial capital, Palu. BMG reported a meter-high tsunami in the Dampal Selatan sub-district that damaged roads and shops in Soni, Bangkir, and Dongko villages.

As of January 5, a total of eight deaths had been reported, apparently all due to the tsunami. One person remained missing. The local office of public works estimated damage to buildings from the earthquake and tsunami at approximately \$1.2 million. The official damage list included 189 houses, 15 classrooms, 17 other public buildings, and 2 bridges.



Figure 1 - Collapse of a 3-story hotel in Nuweibaa.