

Learning from Earthquakes

Guam Shaken Twice in Two Weeks—Bridge and Two Schools Closed Due to Damage

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The island of Guam was struck by two earthquakes during April and May, 1997. Guam is an unincorporated Territory of the United States, located in the Pacific Ocean at 13.5N, 144.7E, which is about 6,000 km west of Hawaii and 2,400 km east of the Philippines. The island covers 213 square miles, and has a population of approximately 130,000 persons.

The first earthquake ($M_b = 6.2$, $M_w = 6.5$) occurred at 5:45 a.m. local time on April 24. The preliminary location identified for the epicenter is 14.00N, 144.888E (45 km from the north end of the island) at a depth of 100 km. It appears that this event was preceded by a smaller, shallow earthquake in the vicinity of 13.4N, 144.9E (21 km from the north end of the island) approximately 2.4 seconds earlier.

Three strong motion detectors are located on Guam, two in hotel structures and one at the USGS observatory. The maximum recorded lateral acceleration at ground level was 0.202g, and the maximum vertical acceleration recorded was 0.117g. The duration on the NS channel of the USGS strong motion recorder was in excess of 90 seconds, although perceptible motion was limited to 80 seconds at ground level.

The second earthquake ($M_b = 6.0$, $M_w = 6.0$) struck on May 9 at 7:07 p.m. local time. The preliminary location identified for the epicenter is 13.18N, 144.725E (47 km from the north end of the island) at a depth of 29 km. This earthquake is thought to have been associated with the April 24 earthquake. The maximum recorded lateral acceleration at ground level was 0.148g, and the maximum vertical acceleration recorded was 0.071g. The duration of perceptible motion was 60 seconds at ground level.

Although the earthquakes caused concern among the island residents, damage was limited and no deaths or injuries were recorded. Electrical power for the island was lost for 24 hours and 12 hours on April 24 and May 9 respectively, due to the power plant turbines going off line. Other utility services such as water and sewage were not disrupted.

Local engineers reported minimal damage to Guam's numerous hotels and other commercial buildings, consisting mainly of plaster cracking, minor damage at seismic joints, and some cracking in concrete masonry unit (CMU) partition walls. Some residential homes, consisting mainly of one- or two-story CMU load bearing wall systems, sustained minor cracking. The Department of Public Works and other government agencies also reported minimal damage to most public structures, except as described below.

Two public schools, Upi Elementary School at the north end of the island and Merizo Elementary School at the south end of the island, as well as the Ylig River

Bridge, located on the southeast end of the island, incurred enough damage to warrant their temporary closure as a result of the April 24 event. All three structures had sustained significant damage during the August 8, 1993, magnitude 8.1 earthquake, and it appears that the new damage is related to the previous damage. The two public schools sustained cracking in load bearing masonry walls. The bridge, consisting of a 60-foot center span and two 40-foot end spans, suffered damage to an end roller bearing support at one end that resulted in some settlement. Investigation of the structure revealed that the support was severely corroded prior to the earthquake, and it is likely that this was a factor in the bridge being damaged.

All three structures are now open after some minor repair work. At the time of the earthquakes, new structures intended to replace Upi Elementary School and the Ylig River Bridge were already in the process of being designed, and the schedules for their replacement have been accelerated.

To date, over 200 aftershocks have been recorded, with the most severe being magnitude 4.7 and 5.0. These aftershocks have not resulted in any appreciable damage or effects.

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