Woodford, Jamaica, Earthquake of January 13, 1993

On Wednesday, January 13, 1993, at eleven minutes past noon, EST, an earthquake of magnitude 5.4 occurred on the island of Jamaica. The Earthquake Unit of the University of the West Indies, Mona Campus, placed the epicenter about 10 km north of downtown Kingston. (Population of the greater Kingston area is about 700,000.) The tremor sent adults and children rushing out of their work places and classrooms in near panic. Persons who were driving stopped to check for flat tires or loose lug nuts. Car alarms went off in parking lots. The maximum intensity of the quake was MM VII.

Reconnaissance work was conducted by small groups of persons with interests in a particular aspect or area of damage. Persons included Margaret Wiggins-Grandison and Donald Miller from the Earthquake Unit; Rafi Ahmad of the Department of Geology; John Pereira and Al Adams, structural engineers; Paul Saunders and others from the Office of Disaster Preparedness; and Richard Patterson, from the Physics Department. One private company offered a vehicle and a driver to assist in the reconnaissance. Officials from the
Government Department of Works investigated public facilities, while the Ministry of Education assessed damage to schools. The Jamaica Public Service Company (electricity) and the National Water Commission inspected their own facilities. Mayor Marie Atkins, of Kingston, called a meeting on January 18 to hear from individual agencies on the damage that had occurred.

History

Damaging earthquakes are not new to Jamaica, but new to current residents of Jamaica’s capital city. The last earthquake of intensity MM VII or more that occurred in Kingston was on August 3, 1914.

This January 13 Woodford earthquake occurred on the eve of a national Earthquake Awareness Day, the anniversary of the 1907 Kingston earthquake. On January 14, 1907, at 3:29 pm, an earthquake occurred which, along with the fire which raged through downtown Kingston in the aftermath, claimed some 1,000 lives and left 90,000 homeless. The maximum intensity was MM IX.

In Jamaica’s 300-year documentation of felt earthquakes, nine events with intensities exceeding MM VII have occurred in the Kingston area. The largest occurred in 1692, MM X. This left half of the then capital, Port Royal, submerged some 25 to 30 feet under the sea. The site still interests divers and archaeologists. None of these previous high intensity events was recorded by seismographs, hence the epicenters are unknown.

The Woodford event was the first significant Jamaican earthquake to be recorded by the national seismograph network, which has been operating for about 30 years. The epicenter was located on land, a fact that raises new concerns about earthquake hazard in Jamaica. It was formerly believed that all large damaging earthquakes in Jamaica had origins on faults running north or south of the island, such as the Cayman Trough/Oriente Fracture Zone.

Seismology/Geology

The earthquake was located at 18.060° North, 76.766° West, with a focal depth of 15.3 km. As of the date of this report (mid-February), about 150 aftershocks have been recorded, twenty-seven of which have been felt with intensities of between MM II and MM IV. The magnitudes of the felt aftershocks coincide with the detection capability of the eastern part of the local network (M > 1.7). The epicenters of these aftershocks plot in a NE-SW lineation, perpendicular to the NW-SE trend of shocks in the epicentral area, the Wagwater Trough. Depths range from 5 km to 17 km with most being around 10-12 km.

Kingston is built on an alluvial plain which slopes from sea level at Kingston Harbour to over 500 feet at the base of the mountains. The mountains rise to over 7,400 feet. Many small earthquakes are detected annually in these mountains. The depth of the alluvium under Kingston is undetermined; it deepens toward the harbor. Some development has occurred on reclaimed land at the waterfront. High-rise buildings have become fashionable since the late 1960s and a number of them exist in downtown and in New Kingston. Much liquefaction took place in these areas in the 1692 and 1907 earthquakes.

Lithologies in the Wagwater Trough are volcanics and volcanic derived clastics, as well as some limestone. The trough is fault bounded by the Wagwater and Plantain Garden faults.

No clear sign of surface faulting has been found in Jamaica for this earthquake or any other. There were some vague reports of surface faulting following the 1907 event. Nevertheless, an offshore epicenter is generally accepted for that event.

Intensity and Damage Observations

Observations of intensities reported from this quake came mostly from Kingston and environs. The pattern of damage appeared to be very similar to the 1907 damage, but to a lesser degree. The maximum intensity, MM VII, was confined to areas in eastern parishes surrounding the epicenter, with a radius of roughly 25 km.

Two submarine fiber optic cables were damaged by a submarine rockfall in the channel south of Kingston. A similar cable break occurred in 1907. Numerous small landslides and rockfalls occurred in the mountains along road cuts. One of these was very large, blocking 300 feet of road north of seismograph station GWJ. The dust rising from this slide was visible to many residents in the neighboring valleys and ridges.

Two other moderate slides occurred, blocking main roads in the mountains. A rockfall occurred in the limestone hills behind Rockfort, an industrial area east of downtown. Also, in Rockfort, there was an increased volume of flow from a mineral spring which flows from the limestone hills. This flow flooded and began to erode the main road to the airport and other eastern parishes.

Supermarkets closed due to the tremendous amount of breakages. Jamaican householders living on the suburban slopes overlooking the city lost tens of thousands of dollars in nonstructural damage.

The buildings that experienced
severe structural damage were poorly built, unreinforced and under-reinforced structures. About 50 buildings, mostly private homes situated in August Town, Woodford, Mavis Bank, and Above Rocks were in this category.

Older Jamaican houses are normally constructed of red clay bricks or wood. No damage was reported to these structures.

Modern Jamaican houses are usually made of six-inch concrete blocks, reinforced with steel. Many of these structures suffered some degree of cracking, from hairline to more gaping cracks. Some of them suffered because of weak concrete and inadequate lateral reinforcement. In general, however, these un-engineered buildings fared well, particularly those in the epicentral area.

Some engineered reinforced buildings did suffer structural damage. At Mona Reservoir, the equipment control room suffered cracks to its columns near the roofline, because a narrow row of windows had replaced the wall needed to support a heavy slab roof. One building sustained crushing of a column near the base in downtown Kingston. The damage to engineered structures resulted from poor design factors and faulty anti-seismic construction techniques. The geology/geography building on campus is in need of retro-fitting, as are a few other campus buildings.

A number of government buildings were cracked and had to be inspected. It is believed that in most cases the damage was non-structural.

One house, called the dream house of the Caribbean the week before the tremor, experienced severe cracking; one column split in two. This house was in the Jack’s Hill suburb of Kingston, very close to the epicenter and situated on an old landslide.

Social and Lifeline Aspects

According to government officials, about 500 families were affected in some way by the earthquake.

In Kingston, schools and businesses closed, sending the pupils and workers home. This caused traffic jams all over town. People were afraid to re-enter buildings that were badly cracked and in some cases workers were told to stay home until an inspection was done.

One bridge on Kingston Harbour sustained some cracks, apparently nonstructural. In addition, the roadway leading to the bridge had a number of gaping cracks.

The National Water Commission reported two pipes broken, one in Golden Spring area, near seismograph station STH, and the other in Portland Parish, northeast of the epicenter.

Electricity supply failed in some areas during the earthquake due to line movement. In these cases outages were brief. In other areas, however, transformers blew, and work had to be done to restore power to these areas. This was achieved within 24 hours.

Telephone service also failed. In some cases this was related to the power failure, and service soon returned to normal. In other cases it took a few days for service to be restored. The breakage of the submarine fiber optic cable affected some overseas communications, but these were re-routed through the telephone company’s earth satellite stations.

Recommendations

Though many persons acted in an appropriate way during the earth-
quake, like getting under desks or in doorways, the general feeling was near panic. Jamaicans need to realize that Jamaica will have strongly felt and damaging earthquakes. The level of awareness of the population needs to be raised.

More monitoring of the formal and informal building sectors needs to be implemented. Many houses that escaped serious damage this time may not be so fortunate in a larger event.

No strong motion instruments were in operation at the time of the earthquake. There is a need for placing accelerographs both at free field sites and in high rise structures that are becoming common in Kingston.

There is also an urgent need to upgrade the local network to enable more data to be collected for determining source parameters and focal mechanisms.

This report was submitted by Margaret Wiggins-Grandison (EERI 1989), The Earthquake Unit, University of the West Indies, Mona Campus.

The publication and distribution of this report was funded by NSF grant #CES 8822367.