## Chapter 6

## **Strong Motions**

In spite of the scale of this earthquake, there is unfortunately no strong motion record nearby the causative fault. The nearest seismograph is approximately 80km from the epicenter of the earthquake. Nevertheless, the records from this seismograph are all saturated. The record of this seismograph is shown in Figure 6.1. In addition, some seismograph records taken by USGS network are shown in Figure 6.2. As noted from the figures, the fracture propagation occurred for a period longer than 400 seconds and the total length of the rupture is more than 1,000km with a width greater than 100km. Recently, some acceleration records from Singapore and Malaysia have been reported. However, the near-field effects of the fracture propagation could not be identified from these records.



Figure 6.1 Sesimograph record at Parapat, Northern Sumatra

The seismic intensity survey was conducted by USGS in Aceh and other neighboring countries. This investigation indicated that the seismic intensity was IX on MKS scale. The investigation by Aydan of the JSCE reconnaissance team on the damage to structures in non-tsunami affected areas indicated that the seismic intensity should be about VIII on MKS scale and 5+ on JMA scale. Iemura estimated JMA scale seismic intensity by the questionnaires method originally proposed by Ohta et al., and indicated that the seismic intensity was from 5+ to 6- on JMA scale (IX on MKS scale) as shown in Figure 6.3. Figure 6.4 shows possible maximum ground acceleration as a function of MKS scale inferred from this survey results. The inferred maximum ground acceleration should be ranging between 200-400gals.



Figure 6.2 Seismograph records of USGS network (Iris-USGS Global Seismographic Network)



Figure 6.3 Estimated JMA Seismic Intensity by Questionnaires in Banda Aceh by Iemura et al.



Most of structures nearby the seashore were destroyed by the forces of the tsunami waves and the traces of collapses and failures due to ground shaking could not be distinguished from those caused by the tsunami. Some attempts were made to find collapsed, displaced or toppled simple structures in non-tsunami affected area. The simple structures were walls, poles and reinforced concrete buildings.

The some of garden walls were toppled during the ground shaking as shown in Photo 6.1. From these observations, the maximum ground acceleration should had been acted almost NS direction, perpendicular to the faulting direction. For NS direction, it should be greater than 200 gals and less than 350gal. As for EW direction, it should be greater than 110 gals and less than 170gal.

The walls shown in Photo 6.2 were toppled by the tsunami waves. Through some mechanical considerations, these walls may be useful for inferring the impact force of tsunami waves. Photo 6.3 shows pictures of collapsed RC buildings. These buildings were collapsed mainly in NS direction. Although the details of the reinforcement of these columns are not known, a rough estimation would indicate the ground acceleration should be greater than 100gal for the failure of the columns of these buildings.





Photo 6.1 Earthquake induced wall failure



Photo 6.2 Tsunami induced wall failures



Photo 6.3 Collapsed reinforced buildings in Banda Aceh

## References

- Aydan, Ö. (2002): The inference of the earthquake fault and strong motions for Kutch earthquake of January 26, 2001. A symposium on the records and lessons from the recent large domestic and overseas earthquakes. Japan Earthquake Engineering Society, Tokyo, 135-140.
- IRIS-USGS Global Seismographic Network (2004): The Sumatra-Andaman Islands earthquake. http://www.iris.iris.edu/sumatra/
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