

Reports on fieldworks of damaged area caused by September 2, 2009 Mw 7.0 Tasikmalaya Earthquake, Indonesia

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The earthquake occurred on September 2, 2009, at 14.55 PM local time in the southern part of West Java Indonesia with magnitude of 7.0 (Mw) and depth of 46.2 km determined by USGS (Fig 1 and 2). This event has reverse fault faulting with striking NE-SW direction. In the southern part of Java, the oceanic India-Australia plate subducts North-Northeastward beneath Sunda plate with a relative velocity about 60 cm/year.

In order to investigate and understanding the effect of this event, We conducted fieldworks in the damaged area. We conducted survey from September 9, 2009 up to September 16, 2009. First, before go to the fieldworks We visited Bandung Institute of technology (ITB) to discuss about this event with Prof Sri Widiyantoro (Geophysics Group ITB), Afnimar PhD (Geophysic Group ITB), and Dr Irwan Meilano (Geodesy Group ITB).

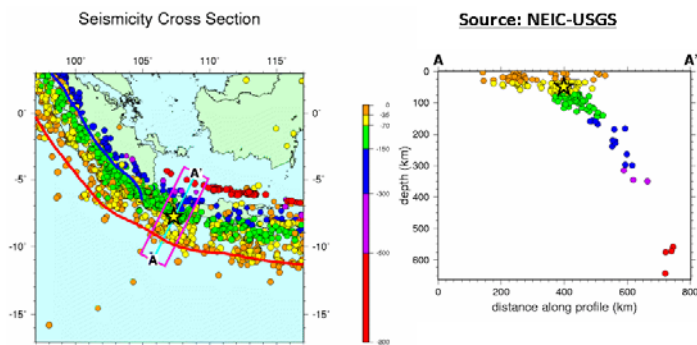


Figure 1. Figure shows seismicity in the Java Island from NEIC-USGS. Filled yellow star indicate the epicenter of Mw 7.0 earthquake. Vertical cross section of AA' through this event is shown.

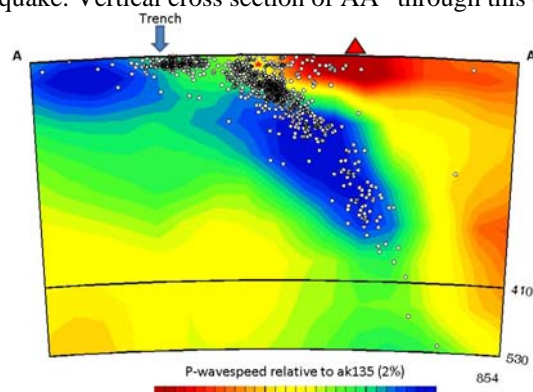


Figure 2. Figure shows P-wave velocity perturbation structure [Widiyantoro, 2009, *In Preparation*] along with seismicity (white circles) and Mw 7.0 event (filled red star) through vertical cross section AA' (In Figure 1). Blue colors indicate high velocity India-Australia oceanic plate subducting beneath Sunda plate.

This earthquake caused small Tsunami, severe damaged, people killed, landslide, and trigger small mud volcano.

A. Tsunami

Badan Meteorologi Klimatologi dan Geofisika Indonesia (BMKG) issued Tsunami Early Warning (TEW) about 3 minutes 44 seconds after this earthquake occurred. However, after 1 hour 10 minutes 54 seconds, the Tsunami warning lifted. BMKG observed the Tide Gauge station in Pelabuhan Ratu and Pameungpeuk. At 15.02 PM local time, Tide Gauge station in Pameungpeuk (Figure 3) recorded anomaly of mean sea level of about 100 cm while in Pelabuhan Ratu station recorded anomaly of about 20 cm at 15.18 PM local time.

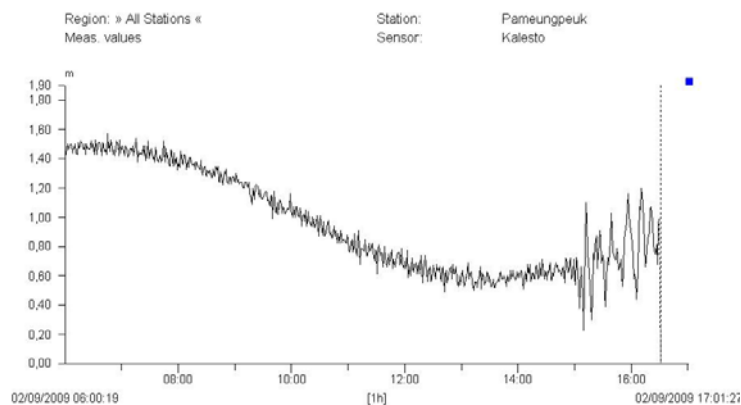


Figure 3. Figure shows Tsunami wave recorded in Pameungpeuk [Source: BAKOSURTANAL Indonesia].

B. Landslide

This earthquake also triggered large landslide in Cikangkareng-Cianjur (Figure 4) that caused about 43 people killed, 20 people missing, severe damage, and 13 houses buried.





Figure 4. Figure shows large landslide that are triggered by the earthquake in Cikangkareng-Cianjur. 43 people killed (20 people still missing) and 13 houses buried.

C. Damaged Houses, Damaged Buildings, Damaged School, and Victims

We visited the area which suffered severe damaged such as Pangalengan, Cikangkareng-Cianjur, Sindangbarang-Cianjur, Cikelet-Garut, Pameungpeuk-Garut, Cisompet-Garut, Cigalontang-Tasikmalaya, Darmacaang Cikoneng Ciamis, and Sukahening-Tasikmalaya. We conducted observation and correspondence with a local people to estimate intensity and damage house relative index. We show here our estimation of intensity for observation point during fieldworks (Figure 5).

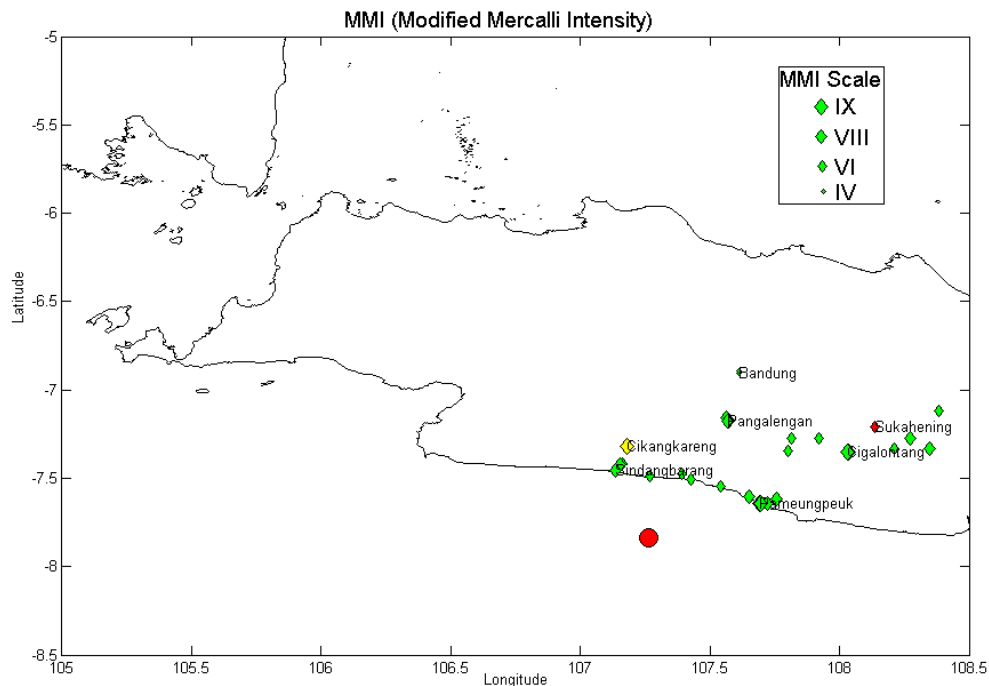


Figure 5. Figure shows estimation of intensity map (MMI Scale) for observation point during the field work. Red circle indicates the epicenter of earthquake. Green diamonds with different sizes indicate intensity scale for each observation point. Yellow diamond indicates the region where landslide occurred in Cikangkareng-Cianjur while red diamond indicates the place where small mud volcano erupted after the earthquake.

We can see clearly from Figure 5 that Pangalengan, Cikangkareng, Sindangbarang, Pameungpeuk, and Cigalontang has severe damaged with high intensity (MMI). There are many houses collapse and people killed. Interestingly, even though Pangalengan and Cigalontang relatively far distant from the epicenter show severe damage locally and ground cracked. These phenomenon need further investigation and collaboration with others study.

I also calculated damaged house relative index (DHRI) ranging from slight, moderate, and heavy damage (Figure 6). This estimation based on visual inspection during the fieldworks.

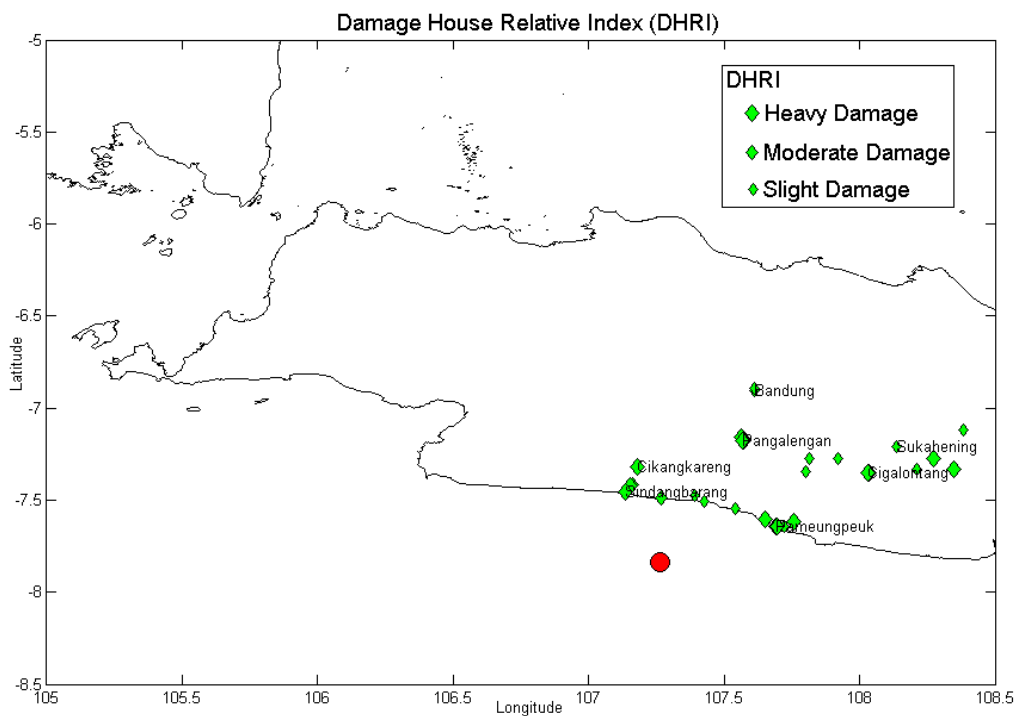


Figure 6. Figure shows estimation of DHRI map for observation point during the field work. Red circle indicates the epicenter of earthquake. Green diamonds with different sizes indicate DHRI scale for each observation point.

The heaviest damage house regions occur in Pangalengan, Pameungpeuk-Garut, and Cigalontang-Tasikmalaya. Below are some photographs that were taken during the field works.



Figure 7. Damaged elementary school in Pangalengan



Figure 8. Damaged house in Pangalengan



Figure 9. Damaged house in Cikelet-Garut



Figure 10. Damaged house in Cigalontang-Tasikmalaya



Figure 11. Ground Cracked in Cigalontang-Tasikmalaya after the earthquake



Figure 12. Damaged Senior High School in Cigalontang-Tasikmalaya



Figure 13. Damaged Yunior High School in Cigalontang-Tasikmalaya



Figure 14. Tents in Cigalontang-Tasikmalaya



Figure 15. Damaged Bank Building in Ciamis

According to *Badan Nasional Penanggulangan Bencana* (BNPB) has reported up to September 13, 2009 at 16.00 PM local time, there are 81 people died, 45 people missing, 1238 injured, and 177,490 evacuated in West Java. Also for Damaged houses and building, they reported as follows:

- Houses (Heavy damage: 65,738; Moderate damage: 36,336; Slight Damage: 122,977)
- Praying Place (Heavy damage: 2,417; Moderate damage: 569; Slight Damage: 2847)
- School (Heavy damage: 2,109; Moderate damage: 1,049; Slight Damage: 2,106)
- Pesantren (Heavy damage: 13; Slight damage: 55)
- Office Building (Heavy damage: 343; Moderate damage: 41; Slight Damage: 291)

D. Small Mud Volcano

This earthquake also has been reported triggered a small mud volcano in Sukahening-Tasikmalaya. I also visited this place. Figure 16 shows the location of small mud volcano. This small mud volcano erupted after the earthquake occurred and the height of blow up reached 2 meters soon after the earthquake on September 2, 2009, however, it is getting lower now.



Figure 16. Figure shows the location of small mud volcano that are triggered by this event in Sukahening-Tasikmalaya.

E. Summary

The September 2, 2009 Mw 7.0 Tasikmalaya Earthquake caused:

- Severe damage in houses, office building, prayer place, and school especially in Pangalengan, Sindangbarang-Cianjur, Cikelet-Garut, Pameungpeuk-Garut, Cigalontang-Tasikmalaya, Darmacaang-Cikoneng-Ciamis.
- At least 81 people died due to this earthquake in West Java Province.
- Landslide in Cikangkareng-Cianjur.
- Small Tsunami wave about 16 cm in Pelabuhan Ratu and 100 cm in Pameungpeuk. BMKG Indonesia issued Tsunami Early Warning 3 minutes 44 seconds after this earthquake occurred.
- Small Mud Volcano in Sukahening-Tasikmalaya. After the earthquake, the height of small mud volcano reached 2 meter and it's getting lower now.