INTERNATIONAL INSTITUTE OF SEISMOLOGY AND
EARTHQUAKE ENGINEERING (IISEE)

REPORT OF STUDY TRIP
(Niigata & Miyagi Prefectures)

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1. INTRODUCTION

On 14 November and 15 November 2011, we visited Nagaoka city and Yamakoshi village in Niigata prefecture to observe the damages which were affacted by unpredictable Chuetsu earthquake on October 2004 and observe how the village survived and recovered from this earthquake. We also observed Ojiya's hospital in Ojiya city which survive from the earthquake. Dr. T. Yokoi and Dr. Ishara supervised us, and also Mr. Ajima, our coordinator accompanied us during this fieldtrip

On 16 November – 17 November 2011, we visited Onagawa town and Wakabayashi ward in Sendai city, Miyagi prefecture which were affected by the great Tohoku earthquake and tsunami on March 2011 to observe the damages, run up and inundation of tsunami March 2011. We also visited Aoba Ward to observe the ground failure caused by the earthquake and Tohoku university. During our fieldtrip in sendai, Dr.T. Hara joined and supervised us.

The Chuetsu Earthquake

At 17.56 JST (Japan Standard Time) on Saturday, October 23, 2004, an earthquake with measuring magnitude 6.8 occured 13 km beneath the chuetsu region in Niigata prefecture. As shown in fig 1, an intensity level of 7 was recorded in Kawaguchi Town, and the intensity level of 6^+ was recorded in Ojiya city, Oguni Town and Yamakoshi village. In Nagaoka city, the intensity level was 6^-. Strong afterschock recorded on the same day, measuring magnitude 6.0 at 18.11 and 6.5 at 18.34 JST with the intensity level was 6^+. The Geographical Survey Institute (GSI) of the Government of Japan published preliminary estimates that a fault having a length of 22 km and a width of 17 km moved approximately 1.4 m.

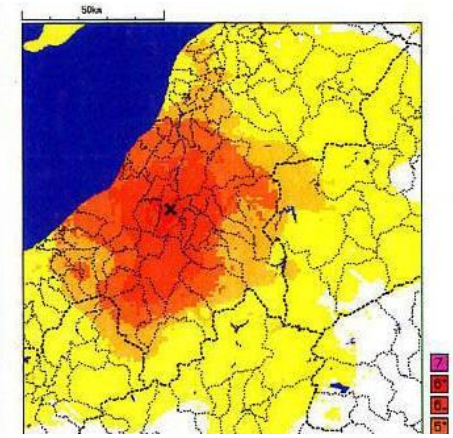

Fig 1. The shakemap of Chuetsu earthquake (source: JMA)

The Niigata prefecture area effected by the earthquake that we visit were :

The Nagaoka Earthquake Disaster Archieve center at Nagaoka city

Nagaoka city is located in the center of Niigata prefecture and the surrounding Chuetsu region.
The intensity level of 2004's Chuetsu earthquake in this area was 6^-. The Nagaoka Earthquake Disaster

Archieve Center (fig. 2) act as core of 7 memorial facilities established to apply the memories, records and lessons from disasters to the safety and security in the futue. Here, we learned about the Chuetsu earthquake while holding an ipad (fig. 3). By pointing ipad's camera on Niigata prefecture map that lies on the floor we can get the damaged information of the areas affected by Chuensu earthqueake (fig. 4). Mr. Higushi from Nagaoka Earthquake Disaster Center gave guidance and explaination during our visit here.

Fig 2 The Nagaoka Earthquake Disaster Archieve center

Fig 3. Learn about Chuetsu earthquake while holding an ipad

Fig 4. The damaged information provided on ipad

Ojiya Hospital at Ojiya City

In Ojiya city, the level of intensity 6+, the damage was mostly to the infrastructure of the city, the waterworks, sewage, telephone poles and roads. Only the very old and weak structural houses in Ojiya collapsed. The average house was not damaged structurally, only the items inside were damaged. However because of lack of running water and continuing aftershocks, all homes in Ojiya city were evacuated and the town people were living in civic centers, town halls or in tents in parking lots, parks, and even camped out in greenhouses in the country or slept in the car. The greenhouses were warm on sunny days but cold at night. The temperature drops down to 3 degrees celsius (37F) or just a little

above freezing. But there were plenty of blankets for those sleeping there.

The Ojiya General Hospital (fig. 5) is one of survived buildings located in downtown Ojiya city, near the epicenter of the earthquake. This building was constracted with the base isolation. Base isolation (fig. 6) is structural elements which protecting a building or non building structure's integrity from earthquake ground motion shaking. Approximately 15 cm displacement was recorded within the Chuetsu earthquake 2004 and no damage occured in this building.

Fig 5. Ojiya general hospital building

Fig 6. Base isolation

Yamakoshi village

Yamakoshi village lies on a mass of old landslide in a valley. The area is dotted with slope terraced paddy fields and carp ponds (fig. 7). The mountanious district of which Yamakoshi forms part is known as a landslide hazard area during the spring snow melt. The epicenter of the earthquake was Yamakoshi village which is about 8 kilometers east of Ojiya. It was devastated and the houses become uninhabitable. All residents evacuated from the area. The roads from Ojiya to Yamakoshi were impassible. Only helicopters were able to go there. Apparently the average house in Yamakoshi had been structurally damaged. Most of the heaviest damage was east of the Shinano River where Yamakoshi and other damaged villages are located. Before Chuetsu earthquake in 2004, there were no large natural dam and big river in Yamakoshi village but then the large scale of landslide blocked the Imo river flooded houses in its flow area (fig. 8) and created several natural dams (fig. 9). The typhoons that attacked Yamakoshi village just before the earthquake and the heavy snow after the earthquake, made the area became the most vulnerable place at that time.

Fig 7. Terraced paddy fields and ponds in the Yamakoshi village

Fig 8. flooded house caused by blockage of Imo river

Fig 9. Natural dam caused by the landslide and blockage of Imo river

The Great Tohoku Earthquake and Tsunami

On Friday, March 11, 2011 at 14.46 JST , earthquake with measuring magnitude 9 occured 32 km beneath Pasific ocean, 72 km eastern Tohuku, Miyagi prefecture. The duration of the earthquake was approximately 6 minutes, with the eneregy released more less 600 milion times than the energy of hiroshima bomb. The tsunami hit coastline area in the eastern Honsu with the wave height 3-40 m and inundated the land more than 5 km. The highest tsunami run up, 40.5 m was recorded in Miyako in Tohuku's Iwate prefecture. In sendai area, tsunami wave travelled up to 5 km in land. The earthquake also generated landslides, fires, and caused severe damages of infrastructure building, caused a number of nuclear accidents which was released radiation. More than 900 aftershock has been recorded since the earthquake.

Fig. 10 shows shakemap of Tohoku earthquake and tsunami 2011. The intensity level of 7 was felt in Kurihara, Miyagi Prefecture, Intensity level of 6^{+} felt in Fukushima, Ibaraki and Tochigi. And Intensity level of 6^{-} was measured in Iwate, Gunma, Saitama and Chiba, and in Tokyo the level intensitisy was 5^{+}.

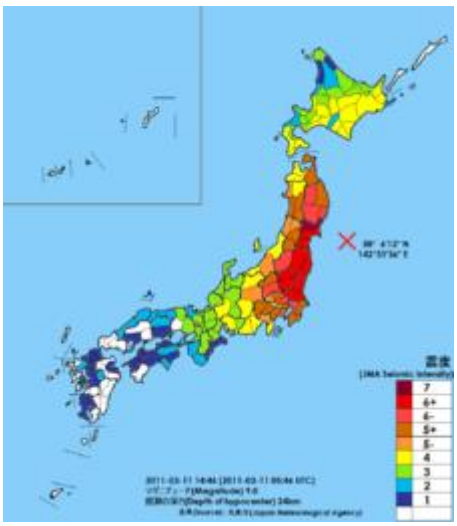

Fig 10. Shakemap of Tohoku earthquake and tsunami (source: JMA)

Sendai 3rd Joint Goverment Building

The Sendai 3rd Joint Goverment Building building (Fig 11) experinced 6- intensity level of March 2011 Tohoku earthquake. Seismoscope record 18 cm displacement of this building caused by the earthquake Seismoscope is a tool to measure the oscillation of earthquake (Fig 12). Mr. Kangaya from Land and Infrasructure gave us guidance and explaination during our visit here.

Fig 11. Sendai 3rd Joint Goverment Building

Fig. 12 Seismoscope

Research Center for Prediction of Earthquake and Volcanic Eruption, Tohoku University

Tohoku University was established in 1912. Research Center for Prediction of Earthquake and Volcanic Eruption consists of three laboratories; the Crust Physics Laboratory related to earthquake prediction, the Physical Volcanology Laboratory related to the prediction of volcanic eruptions, and the Marine Geophysics Laboratory to study the plate dynamics in subduction zones. More than 60 observation stations operated by the center are distributed widely in Tohoku district to provide invaluable data for prediction studies and also for fundamental studies in geophysics. The center is the leading center for solid earth physics in northeastern Japan, and also contributes to the education of students in earth science. Prof. Norihito Umino, the director of earthquake observatory of Tohoku University gave us guidance during our visit in Research Center for Prediction of Earthquake and Vulcanic eruption, Tohoku University.

Fig. 12 Research Center for Prediction of Earthquake and Volcanic Eruption building, Tohoku University

Fig 13. Seismometer in borehole below Research Center for Prediction of Earthquake and Volcanic Eruption building

Fig 14. Seismic signal from seismometer

Onagawa town

Onagawa town is a small fishing town with population of 10 thousand people. The Tohoku earthquake A hill just behind the port was designated as an evacuation route where public hospital is situated (fig 15). Traces of run up of tsunami height record on the first floor of hospital building in the hill which was nearly 16 meters. Tsunami run up height was also recorded through over the rooftop of three-floor hotel building (fig. 16). Some buildings looked survived from the earthquake, but collapsed with its foundation uprooted from the ground during the giant tsunami hit this port area several times (fig. 17)

Fig 15. Traces of the tsunami run up record in first floor hospital building which located on the hill

Fig 16 Tsunami run up record of through over the rooftop of three-floor hotel building

Fig 17 Collapsed building with the uprooted foundation

Tohoku Regional Development Bureau

Tohoku Regional development bureau is incharge of 6 prefecture in Tohoku region and has 1,880 cctv installed along major national highways. There are 8 of 50 inci monitor in the midle and 48 of 20 inci monitor in the left and right side wall which display cctv (fig. 19). Mr. Kawashima from Tohoku Regional Development Bureau gave explaination during our visit in Tohoku Regional Development Berau. when Tohoku earthquake occured, monitor displays in Tohoku Regional Development Berau office were blank, because some cctv cameras damaged and washed away by tsunami and also communication with this office broken. The standard procedure for Tohoku Regional Development Berau if disaster occured is emergency restoration for the area affected immediately. But, in March 11 earthquake, street and road were totaly damaged because of tsunami, so there was no access to the affected area. It took only 2 month from 6 month planned to built a temporary bridge to connect with the isolated area.


Fig 18. Tohoku Regional Development Berau


Fig 19. Display monitor of cctv camera (courtesy of D. Mungunsuren)

Aoba Ward (ground failure)

Aoba ward is located in hill zone. Landslide caused by the Tohoku March 11 earthquake made damged house, ground failure and collapse of retaining wall (fig 20& 21).

Fig 20. Landslide and dameged house

Fig 21. collapse of retaining wall

Wakabayashi ward (coastal area)

The landscape of Wakabayashi ward is flat and has long straight coastaline (Fig 22), different from Onagawa city which is hilly. Level intensity of the earthquake here was 6-, severe building damaged and traces of tsunami run up around 3 m height measured in this area (Fig. 23).

Fig 22. Wakabayashi coastaline

Fig 23. trace of tsunami run up in one floor building

Conclusion

The Chuetsu eartquake and the Tohoku earthquake are different types of earthquake. The Chuetsu earthquake occured beneath the hill area, and triggered the landslide. There were also river flow changed and natural dam created by the landslide. The Tohoku earthquake occured beneath sea and triggered tsunami giant wave. Many building survived from the earthquake but totaly damaged by giant tsunami which hit the coastal area several times. Mostly the building and houses in Japan built based on the seismic code so it can survive from the earthquake.

Quick response and well cooperation between Japan's government, society and other related institutions make affected area by disaster recover soon. And ofcourse it also depend on the survivors willingness to recover after disaster. However, it is not easy to recover from disaster. we can not be avoid disaster and victim, a good preparedness and early warning system can save many peoples lives. The preparation of disaster prevention, also can reduce and minimize casualities of disaster.

Indonesia has the same experience of the great earthquake and tsunami in Sumatra last Dec 2004. And until now the recovery process is still in progress. Since Indonesia prone to earthquake and tsunami, similar to Japan, we have no choice other than learn how to live in harmony with the disaster.

References

1. http://www. aob.gephys.tohoku.ac.jp/aob-e
2. http://www.pref.miyagi.jp/english/index.htm
3. KONOGAI, Kazuo, Preeliminary Report: Mid-Niigata Prefecture Earthquake, 2004