

Report of study trip II

Fatimah Zaharah Binti Saleh

8/1/2011

Tohoku University

We began our trip by visiting the Tohoku University. Before meeting the Professor Imamura, we visited an effected building caused by the Tohoku earthquake. We were able to see a crack at the second floor of the building. We tried measuring the heights of the crack from the ground. The traces were approximately 10 meters high from the ground.

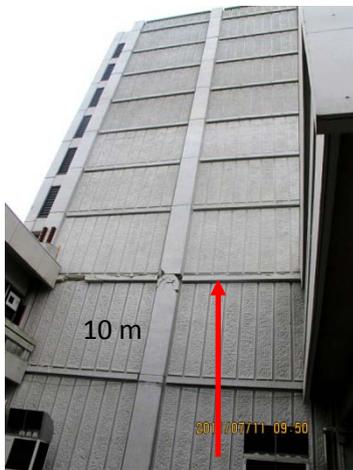


Photo 1.0

We had a lecture from Professor Imamura about the Tsunami disaster and impact due to the 2011 Tohoku earthquake. He gave a brief explanation about the earthquake and the tsunami behaviour that occurred at affected areas. The earthquake was a huge earthquake which affected very wide area in east of Japan with the length exceed 500km and the width is about 200km. The prediction of the earthquake in the Miyagi prefecture are been made and it is about 99.0%. The Tohoku earthquake had given a significant value which the impact contributed larger than expected. This phenomenon had happen which made the place subsided about 1.2 m with horizontal displacement about 5.3 m and uplift is nearly 3.0 m.

- Photo 1.0 and photo 2.0: The traces of crack at Civil Engineering building in Tohoku University

This huge earthquake at the offshore produced tsunami. It showed the unusual characteristic. The record from the bottom pressure gauge at the offshore showed the energy of tsunami increased and the height of tsunami in the deep sea is about 3 meters. Usually, expected tsunami in the deep sea is 1.0 meter or several centimetres. In this case, when the wave approached the coast, tsunami height had increased more than 10 meter for the run up and it caused huge inundation. The propagation of tsunami on land is based on the height of run up and the depth of inundation. The depth of tsunami is sometimes different from the tsunami's run up height. The topography of the land could also affect the result of inundation's distance. The tsunami run up height could decrease at the flat and wide area like Sendai. Prof. Imamura said; the prevention in reducing the impact of tsunami is essential. The plant of pine trees, the canals and sea walls help to reduce the energy of tsunami's waves and thus, can mitigate the tsunami damages.

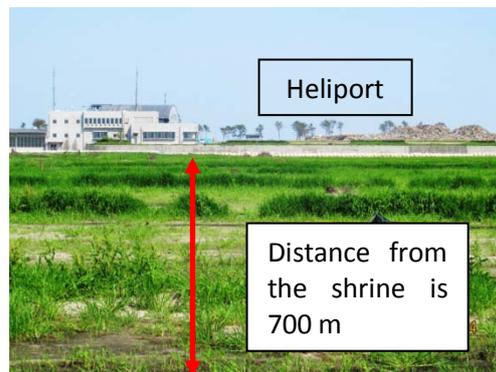
There are 3 questions asked to Professor Imamura, the first one is about the future plan on reducing the impact of tsunami in Sendai. He explained plans to upgrade the construction of seawall with wider expansion and the green forests to be kept. The road will also be constructed with high elevation using soil structures. More tsunami evacuation places will be construct as protection for the people. For the people who stay at the vicinity of the mountains at Sanriku coast, it is recommended that they move to higher places. The second question is about the vertical evacuation. He suggested that the RC (reinforcement concrete) building with more than 5 floors should be the vertical evacuation for the tsunami evacuation. The last question is about the causes of the destroyed buildings. The building code should consider the factor of water force and floating materials wave force. Plant trees in front of the buildings are also recommended as the future mitigation plan.

Arahama Beach

After that, we visited Arahama area the most devastated area caused by tsunami, with Dr Sugarawa. He guided us to see the inundation places around the Arahama beach. Based on the handout which he gave us, the inundation distance is approximately 4.5km from the sea shore. The first place that Dr. Sugarawa showed us was a little shrine.

This little shrine is the only place which was safe from the tsunami. It is believed that it was protected by its location situated in front of a heliport. The protected shrine is located approximately

1km from the coast. At the location, we were informed by Dr. Sugarawa that the pine trees were planted along the coastline and the distance was approximately 30 km.



- Photo 2.0: The only survived shrine located in the inundated paddy field.
- Photo 3.0: The heliport which protected the little shrine from the tsunami.

We visited the Arahama beach, the tourist location, which had seawall and break waters. The seawall was 5m height from the sea level and these facilities were constructed for the storm surges protections. The break waters helped to reduce the energy of tsunami waves. We were able to see several buildings which had been washed away by the tsunami. As a tourism place, a tsunami siren had been installed. However, it was also collapsed together with other buildings because of the tsunami.

We went to a paddy field area to make sediment observation. The technique of hand auger was applied in order to see the tsunami deposits. As a result, we found the 869 Jogan deposit. The Jogan deposit consists of the marsh deposit below the volcanic tephra (AD915), while the 2011 earthquake deposit consists of the thick massive layer of medium-grained sand. In order to identify the origin of the sand layer, we need to do laboratory experiment.



Photo 4.0: The sea wall at Arahama Beach.



Photo 5.0: Hand auger

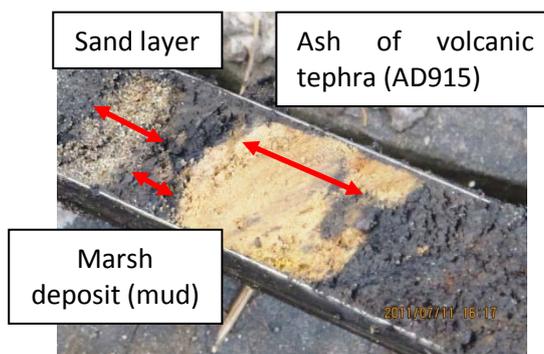


Photo 6.0: Deposit of the 869 Jogan tsunamis

Matsushima

On the 2nd day, we went to Matsushima to see the condition of the area. Matsushima is a group of islands in Miyagi Prefecture. It is one of the tourism attraction places and it is stated as one of the Three Views of Japan. The location is strategically surrounded with the small islands which made the area faced minimum damages from the tsunami of the Tohoku earthquakes. The islands served as a fortress to reduce the energy of oncoming tsunami. As a result, there is no significant damage which can be seen in this area. The tsunami height in this area was 1.1 – 2.0 meters. We were able to see the tsunami evacuation sign on the top of the sidewalks and the sign led us to the place of evacuation.



Photo 7.0



Photo 8.0 (a)



Photo 8.0 (b)

- Photo 7.0: The group of small islands at Matsushima
- Photo 8.0: (a) The evacuation sign which leads to the place of evacuation (b)

Onagawa

We continued our journey to Onagawa. On our way to the destination, we had passed Higashi Matsushima-shi and Ishinomaki city. From the bus window, we saw heavy damages occurred in the vicinity of the housing area. The dead trees were found which were caused by salty water brought by the tsunami. There were big debris lies on the side of the roads and very wide area had affected by this event.



Photo 9.0



Photo 10.0

- Photo 9.0: The dead trees caused by the salt water.
- Photo 10.0: The debris.

We arrived at Onagawa after 1 hour journey. Onagawa is a town located in Oshika District, Miyagi. At the first sight of view, there was totally destructive scene in the wide area. The place was once a small town and there was a community lived near the sea. The location is situated direct to the open sea, which contributed the significant mass of the tsunami. The energy of the tsunami was high and the waves were approached the area with the massive impact. The land was subsided up to 1.2 meter and it was clearly seen by the increase of the water level. The water level of the sea was nearly approached the land and at some places we were able to see the sea water appeared at the road. From the observation, there were big buildings collapsed and

been dragged by strong wave current. There were RC buildings which fell down and were apart from the building site. The highest tsunami height that approached at this place was more than 15m. We measured tsunami height that arrived to the damaged buildings. The traces at buildings might have come from the second or the third waves. It is believed that the tsunami height was reached more than the 3rd floor. The tsunami swept away along the valley, approximately 2km of inundation distances. The Onagawa reconstruction community plans to establish a tsunami memorial park for remembering the event. Therefore, some selected damaged buildings are planned to be kept as memorial sites.

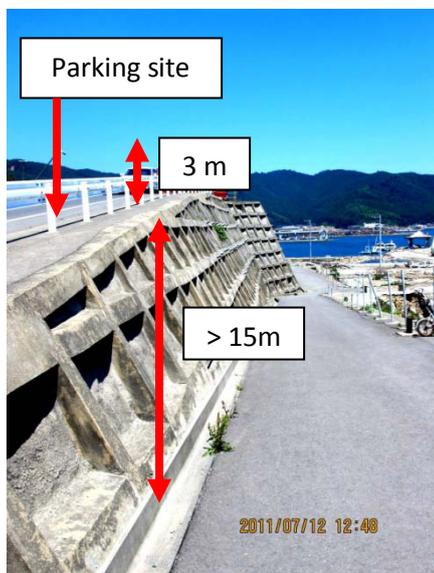


Photo 11.0



Photo 12.0

- Photo 11.0: The photo shows the height of tsunami which could reach the parking site and it is more than 15m height.
- Photo 12.0: The appearing of sea water in the land shows the evidence of subsidence.



Photo 13.0



Photo 14.0

- Photo 13.0: A fell down building which are separated from the building site caused by the strong waves.
- Photo 14.0: The building has moved about 70 m from the origin site with the tsunami's buoyancy.

Rikuzentakata-shi

We began our 3rd day trip by visiting the Rikuzentakata city. This time, we were accompanied by Mr. Moritsugu Kaneko. It took almost 2 hours to arrive at the city. The damaged areas can be seen at almost all around the city. Rikuzentakata city is the smallest city in Iwate prefecture with a population of 23000. Their main product is seafood such as scallops and oysters. The elevation of this place is quite low. Due to the event of March 11, the land was subsided on the ground by 80cm and the sea water is appeared on the ground. Most of the wooden buildings were swept away by the tsunami and some reinforce-concrete buildings still remained at their sites. At some sites, cleaning process is being done by workers.



Photo 1.0



Photo 2.0

- Photo 1.0: A damaged City Hall at Rikuzentakata city. About 120 workers at this hall were dead.
- Photo 2.0: A high school was completely washed away by tsunami and being transferred to another city.

There are no resident seen in the area of the affected city. The central government hires the private constructors to do the debris cleaning in terms of recycle separations activity. The records stated that there were 1508 people died and some of the survivors are staying at temporary houses which are built at the mountains. This city had been well prepared for tsunamis and earthquakes. A sea wall was constructed with 6.5 meters high but the tsunami had struck the land higher than expected. According to Mr. Kaneko, the tsunami had struck through the river about 7 km long. A question was asked about the future recovery of this city. The major issue that they are facing is how to manage the debris properly. They need to find the proper place to replace the debris in order to undertake the next step to redevelop the city. This matter arises because it affects the people's mentality on how they are going to recover their places. Discussions and considerations between the central government and the local people are still undergoing.



Photo 3.0



Photo 4.0

- Photo 3.0: Subsidence, the sea water appeared in the land when high tide.
- Photo 4.0: This broken sea wall was inland and now are surrounded by sea water due to the subsidence.



Photo 5.0



Photo 6.0

- Photo 5.0: The constructors collect the concrete pieces and make it as sea wall.
- Photo 6.0: Debris almost covers the places and the solution to manage it is still indecisive.

Ofunato city

We continued our journey to Ofunato city. It took about 20 minutes to arrive from Rikuzentakata-city. The location of this city is situated to the north of Rikuzentakata-city. The damages that occurred at the sea side were worse compared to the inland. The shape of the bay is long and narrow which made the tsunami strikes the coastline and the people who live near the sea were affected. We were briefly explained by Mr. Taiji Iwaki, the chairman of a non-profit organization (NPO) called Yume-net Ofunato. In this city, there had been preparedness on tsunami mitigation. It was based on the history for the past tsunami events, starting from the Meiji area to the 1960 Chile earthquake.



Photo 7.0



Photo 8.0

- Photo 7.0: The Ofunato town was affected by the tsunami
- Photo 8.0: The railways station had totally destroyed. The station was run for JR Line and Sanriku Railway.

The activities such as building wave breakers, tsunami evacuation signs and performing the tsunami drills are being done periodically in this city. This recent tsunami event had created massive impact with the unexpected damages to the city. The height of the tsunami that reached was more than 15 meters from the sea level and casualties were nearly 500. The function of the city had entirely collapsed as the tsunami destroyed almost all the places. Although there were countermeasures which had been taken into an account, some of the residents failed to evacuate because of unexpected self-estimation to the event. The progress of cleaning the debris is quite slow; there is still much work to be done. The question is about the suggestions how to overcome the natural disaster matter. The nature itself is unpredictable, and we have to be modest to think of it and the optimistic side of view should be embedded in facing the risk of natural disaster. The public facilities should be constructing at the higher places so that it can be as shelters for the people and the industrial facilities which are facing the sea should be built in the high rise building with the suitable building code which have tsunami resistance's element. The natural disaster has no borders in ruining the places and the forces of the nature might be beyond our expectation. Thus, cooperation between countries should be enhanced in order to face the natural disaster risks.

Kamaishi port

We arrived at the Kamaishi port office at 2.30pm. It was a temporary office since the premier office was vanished by the tsunami. We met with Mr. Nagao, a chief from the port office. Firstly, we were given a lecture by him about the port and the disaster that happened on March 11, 2011. Based on the wave gauge record which had been installed 20km from the coast, the wave height on the offshore was 6.7 meter. When it reached the coast, the wave was magnified by 2-3 times which caused a massive tsunami. The highest inundation height that had been recorded based on the traces from the affected building was 18.3meter. In the area of Kamaishi port, there was a breakwater that started to be constructed in 1978 at a mouth of Kamaishi bay and it took 31 years until it was finally completed in March 2009. The purpose of constructing this breakwater was to prevent threat of tsunami disaster from the Pacific sea side. It became a major attraction in this area as the breakwater had been recorded in Guinness Book of World Records as the deepest breakwater in the world.



Photo 9.0



Photo 10.0

- Photo 9.0: The estimated tsunami inundation signboard is available at Kamaishi area.
- Photo 10.0: The destroyed building's structure at the Kamaishi port

The breakwater was one of the main elements of the countermeasures which were established at the Kamaishi city. The Kamaishi Tsunami Protection breakwater has 63m deep from the sea level, with 1960 meters long. It is located at the bay mouth. As the results of the protection of the breakwater, the inundation height inside the bay was reduced to 11.7meter. The breakwater was broken into several parts due to the high impacts of the tsunami energy. Although the breakwater was hardly be tsunami barrier but the effect of its existence cannot be denied. It helped to reduce the energy of the tsunami and lessen the oncoming waves at the shore lines. According to the Mr. Nagao, the wave simulation had been done and the result showed that the percentage of wave run up reduced by 50% compared to the scene without the barrier.



Photo 11.0

- Photo 11.0: Kamaishi Tsunami Protection ; the breakwater



BEFORE



AFTER

Photo 12.0

- Photo 12.0: The condition of the breakwater in Oofunato; before and after the tsunami

We had an opportunity to watch the breakwater closely and the well-built significant construction was able to see. The re-construction of this breakwater will be surely taken into consideration in a reliable manner in terms of reoccurrence of the natural disaster, the costs and the effectiveness for the Japanese people especially the Kamaishi residents. The study for recovery of this city is still ongoing and it takes years to overcome all the difficulties on this damaged city.



- Photo 13.0: The damage of break water from the north side. The red one is a light house.
- Photo 14.0: The damage of break water from the south side.
-

Conclusion

The power of nature that cannot be underestimated and we cannot easily take it for granted. There is always a high potential of a risk in facing the natural disaster. Thus, preparations on countermeasures of tsunami mitigation are important and needed to be taken into account. Education on tsunami is vital in order to increase the public awareness. Hopefully, the deeper understanding on the workings of the tsunamis will help the mitigation of tsunami disaster.