Case History-1

Activities of Restoration and Reconstruction of Iwate Prefecture from the Grate East Japan Earthquake Tsunami

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The outline of the jurisdiction area of Ofunato Civil Engineering Centre is shown in Figure 1. Iwate Prefecture has 1.5 thousand square meters area, which is the largest in Japan and as large as 80% of Shikoku Island. The National Athletic Meet is to be held in Iwate Prefecture in October this year. A lot of visitors including Imperial family will visit Iwate. Ofunato Civil Engineering Center lies in the south coastal area of Iwate Prefecture. It takes two hours from Ofunato City from the Prefectural capital, Morioka City. The Center manages Ofunato City, Rikuzentakata City and Sumida Town. A beautiful rias coastline can be found in the coastal area, which is designated as the national park. Before the disaster, 1 million visitors were visiting every year, but the disaster have changed the situation.

The huge earthquake with the magnitude of 9.0 on March 11, 2011 was a terrible disaster that was accompanied by the ground subsidence in a wide area and tsunami with significant height. In Iwate Prefecture, the number of casualties and missing people is 5800, and the number of damaged buildings was 2.6 thousand. In the jurisdiction area of our civil engineering center, the number of casualties and missing people is 4 hundred in Ofunato City and 1.8 thousand in Rikuzentakata City, which is the largest in the prefecture.

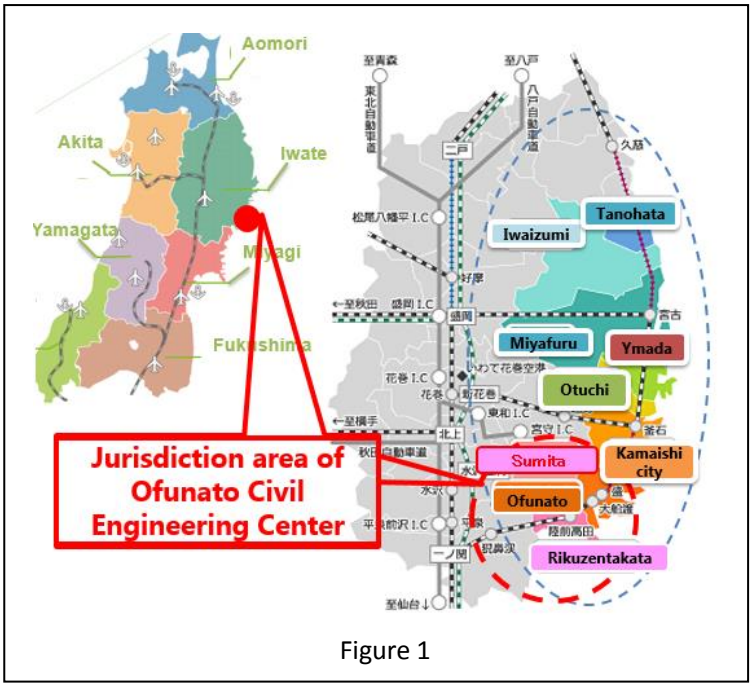

Figure 1

The situation of damage in Ofunato City was as follows. According to the city, the first tsunami arrived at 14:54 with the height of 0.2m. Then tsunami with the height of 8m arrived at 15:18, and the maximum height was recorded as 11.8m.

The situation of damage in Rikuzentakata City was as follows. The height of tsunami exceeded TP 15m and ran up Kesengawa River by 8km. This district was composed of beautiful sand beach and 70 thousand palm trees. It was designated as National Scenic Beauty in 1940 and was one of the most famous beaches in Tohoku District. Most of the beautiful beaches and palm trees disappeared due to tsunami. In the city center, the city office was completely destroyed.

Plan for Restoration of Iwate Prefecture is composed of 'Basic Plan for Restoration' and 'Execution Plan for Restoration'. At present we are in the second phase of 'Full-fledged restoration period', and this year is the final year of this period. By 'Multi-Protection Community Planning', we are planning to promote safe and reliable community planning based on the concept of 'disaster mitigation' to minimize the damage due to natural disasters such as tsunamis.

The planned height of the coastal levees was determined in the following way. The prefecture established a committee composed of academic experts on hydroengineering and other fields in April 2011. In the committee, the coastal area was classified into 24 zones and the height of the coastal levee was discussed in each zone. Here, L1 tsunami with relatively high frequency of occurrence of a few decades or couples of hundred years was considered, rather than L2 tsunami of low frequency of occurrence such as the one in the Great East Japan Earthquake.

The structure of the coastal levee was designed to be stable against L1 tsunami and to be tenacious against L2 tsunami, accepting the limitation of disaster prevention expecting excessively on the facilities: for examples, the inclination smaller than 20%, no steps in the back slope, erosion prevention at the foot of the slope.

Regarding the community planning and safety assurance, Land Readjustment Project is in process in 'Takata district' and 'Imaizumi district' in Rikuzentakata City. New communities are being constructed by raising the height of the land. In the estuary of Kesengawa river and the coastal area on Hirota Gulf, flood gate of Kesengawa river, coastal levee of Takata Coast, restoration of Kawara River, Restoration Memorial Park, restoration of sand beach and Matsubara, are undertaken by the prefecture and other organizations. In Takata district, there are two lines of levees. The first levee is for preventing erosion, which is the same as before the disaster. The second one is for tsunami protection and its height is TP 12.5m, which is increased from TP 5.5m before the disaster. In the second levee, approximately 26000 gravel compaction piles were constructed to try prevent liquefaction. On the other hand, in Ofunato Station district, as shown in Figure 2, the level of the ground surface in the yellow region will be raised by 2.5m. What assures the safety and relief in this district is the coastal levee along Ofunato port. The planned height is TP 7.5m.

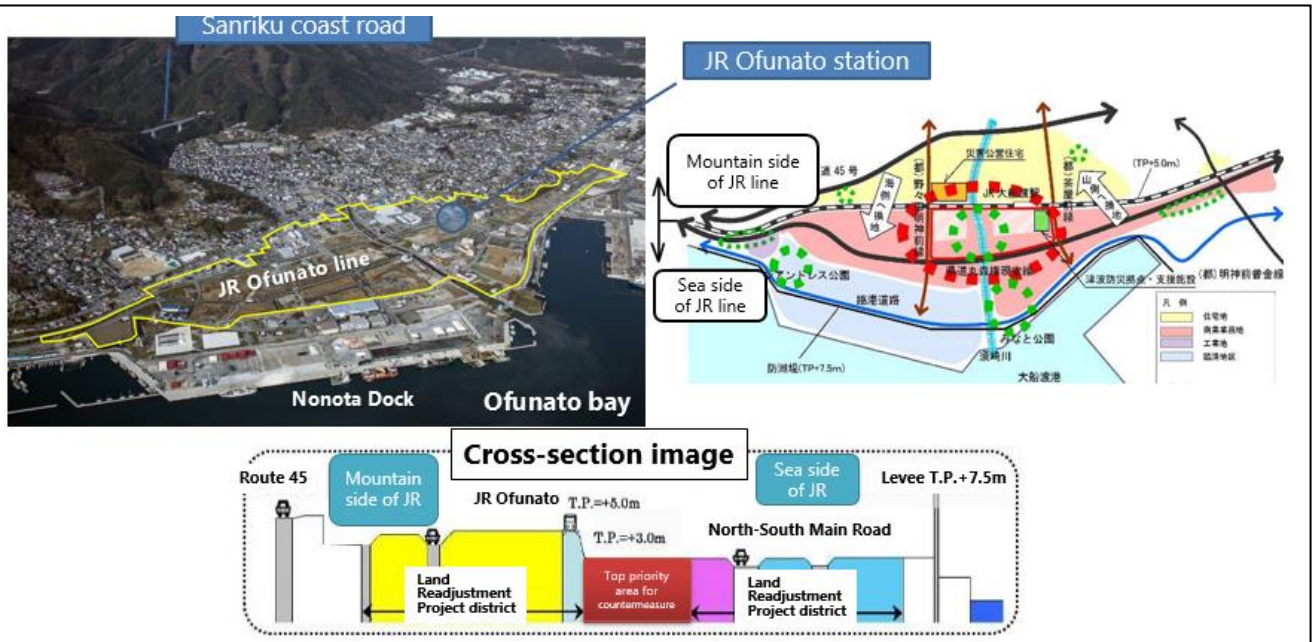

Figure 2

Out of 7 districts of the planned construction districts of the coastal levees in Ofunato Port, Gyropress method was or will be adopted in the four districts, as shown in red lines in Figure 3.

The first example is the levee in Nonoda district. The subsurface investigation revealed the existence of large gravels and concrete masses. Gyropress Method was adopted, as shown in Picture 1, because it was expected to be able to install tubular piles to the designated depth. The bearing stratum was confirmed by the variation of press-in time per 1m. This method requires the information of press-in time at the position near where the subsurface information was obtained.

The second example is the construction in Nagahama district, which is on the opposite side of Nonoda district. In this district, the new levee was planned to be constructed in front of the existing levee, considering the situation of the land behind the old coastal line. Therefore, the construction work had to be on the sea. As it was difficult to occupy the sea with the temporary works, Gyropress Method that can save the temporary works was adopted, as shown in Picture 2. The bearing stratum was confirmed by applying press-in force greater than the required capacity using Gyropiler. This method requires enough pull-out resistance of the completed piles.

The final examples are the constructions in Atohama district and Shimizu district. In both districts, the construction work has not been started yet but has already been ordered. The planned area is adjacent to the existing prefectural road with more than 10 thousand traffics and with many large cars running into and out of the factories. As the construction space was narrow, the Gyropress Method is going to be adopted.

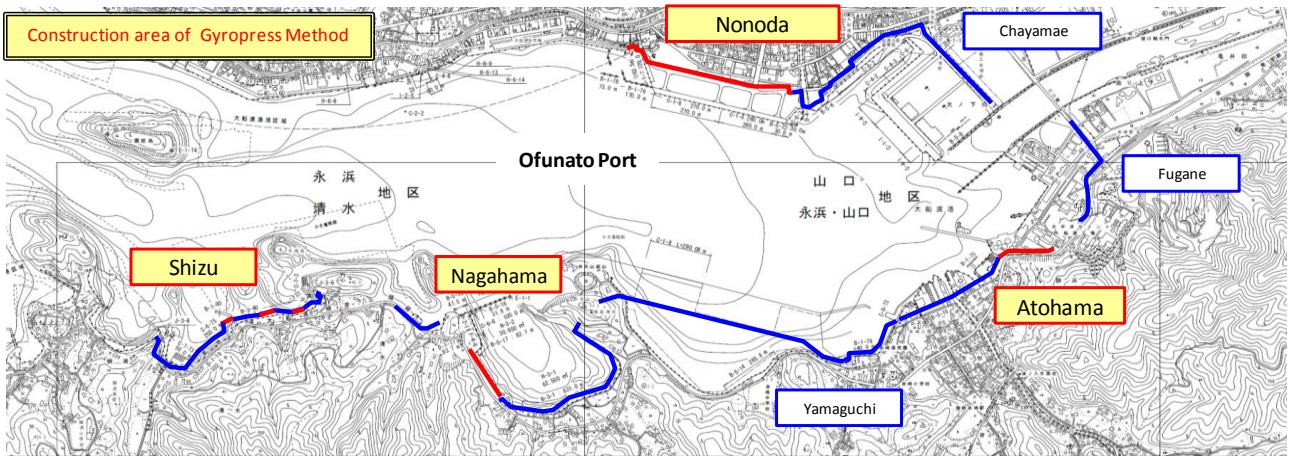

Figure 3

The advantages of the Gyropress Method are the high construction accuracy, its applicability to hard ground conditions, reduction of cost and labor by saving temporary works, its applicability to narrow area, and low noise. On the other hand, the remaining solution will be as follows. As the method of confirming the bearing stratum is not yet fixed, it is necessary to choose a method in each construction site. The method utilizes the completed piles as reaction piles. The base of the completed piles may be deformed while it is clumped by the Gyropiler. Some water is injected into the pile base to prevent plugging and frictional heat in the base teeth. This sometimes increases the cost of disposing the mud coming from inside the pile during the piling work.

Five years and four months have passed since the disaster. Last year and this year will be the busiest years for restoration and reconstruction projects. Although we are still on our way, the accomplishments so far is supported by a lot of people inside and outside of Japan. We appreciate all the supports so far and the continued supports in the future.

Picture 1

Picture 2

*This is an article that was lectured by Mr. R. Tanaka of Iwate Prefecture at the 9th IPA Press-in engineering seminar in Kochi on July 12, 2016, and translated into English by IPA Newsletter editorial committee.