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## *Case History-2*

# Construction in Okitagawa Discharge Channel

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Figure 1 is the outline of the improvement construction of Okitagawa Discharge Channel. By 2014, 87% of the whole length of the channel has already been finished, as shown in black. The procedure of the construction was that firstly sheet pile were installed, then chemical grouting was conducted, and finally the box culvert was positioned. At present, the red parts in the river mouth are under construction.

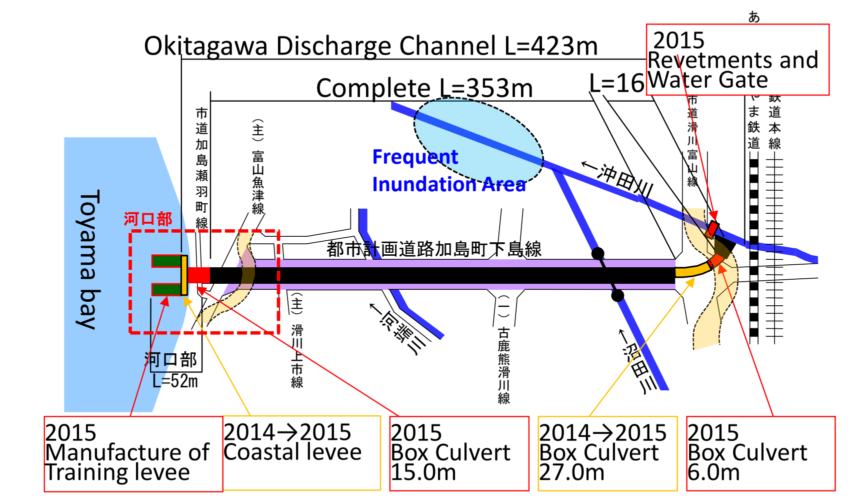



Figure 1

The height of the existing coastal levee is as high as 3.8m. Initially it was around 1.0m, but was raised every time it experienced the wave overtopping. When we construct the mouth of the discharge channel, we need to break this existing coastal levee. There were mainly three points to consider as the design conditions. The first point was the hardness of the ground. The ground contained dense sand and gravel and boulders. SPT N values were more than 50. In addition, we worried about how to deal with the possible underground obstacles such as the wave dissipating concrete blocks. The second point was the narrow space. There were wave dissipating concrete blocks and the sea water itself in the sea side and there was a public road in the land side. The third point was the short construction period. The construction was not able to be carried out in winter or in the season of fishing. We had only four months for construction, from July to October. Other condition to consider was to leave the existing levee as it was as much as possible. This was because there is a risk of the overtopping of the storm wave, if the existing levee was removed all at once.

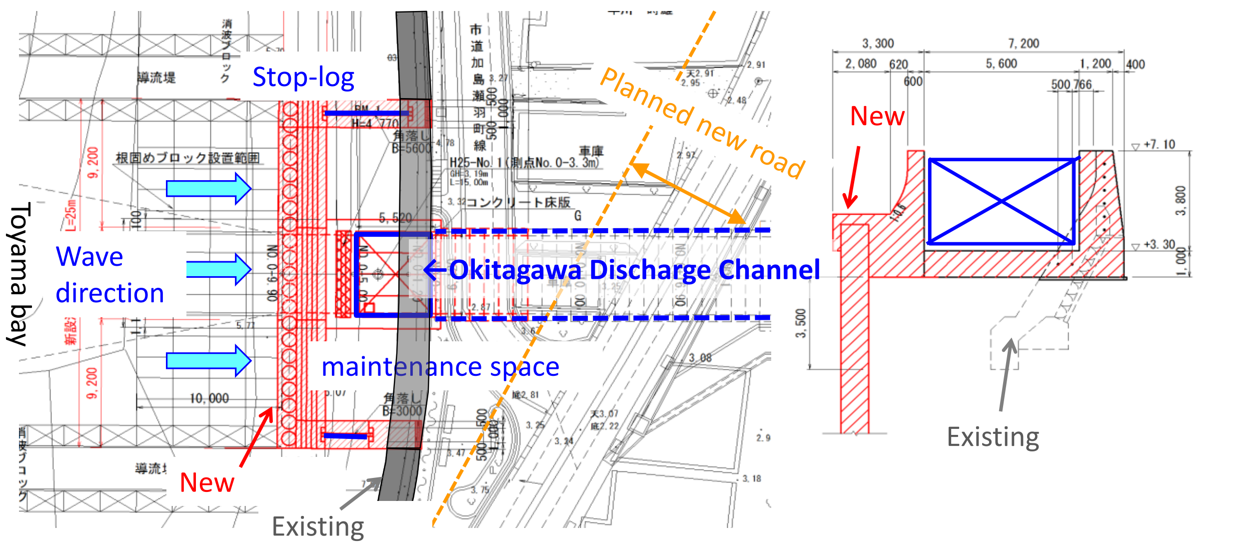



Figure 2

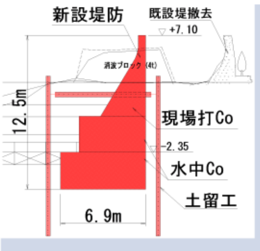
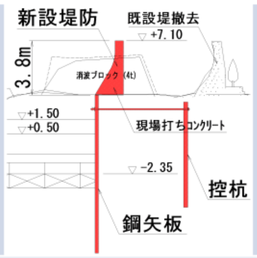
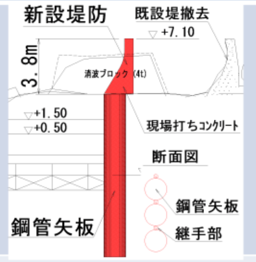
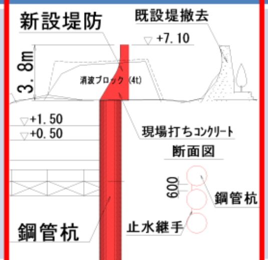
| | ① Gravity-type revetment | ② Counterfort retaining wall | ③ Cantilever wall (Tubular sheet pile) | ④ Cantilever wall (Tubular pile) |
|---|---|---|---|---|
| Plan |   |   |   |   |
| Overview | • Square concrete blocks<br>• Requires temporary wall | • **Hard Ground Press-in Method**<br>• Not requires temporary wall | • **Tubular sheet pile**<br>• Not requires temporary wall | • **Tubular pile**<br>• Not requires temporary wall |
| Work-ability | Long construction period due to the temporary retaining wall, high risk of winter construction | • **Not possible if wave dissipating blocks exist**<br>• Long construction period due to tie rod and counterfort | • **Not possible if wave dissipating blocks exist** | • **Possible even if wave dissipating blocks exist**<br>• Higher construction speed than ③ |
| | × | △ | △ | ○ |
| Economic efficiency | △ | ○ | × | ◎ |
| TOTAL | × | △ | × | ○ |

Figure 3

As summarized in Figure 2, at the cross point of the coastal levee and the discharge channel, the levee normal was determined to be shifted towards the sea side, for the following three reasons. The first reason was to ensure the maintenance space for the discharge channel. This required the gates for heavy equipments to go into the space. Secondly, it was necessary to ensure the strength of the new levee to be higher than the existing levee, according to the agenda with the coast administrator. If the new levee normal was the same as that of the existing one, we had to construct the gates on the normal, which deteriorates the strength of the levee. The third reason was a new road just behind the existing levee, which was planned to be constructed in the future. It was necessary to plan the construction not to block the planned road. Therefore, it was not possible to shift the levee normal towards the land side.

There were 4 alternatives for the new coastal levee. A gravity-type revetment, a counterfort retaining wall, a cantilever wall (Tubular sheet pile, Hard Ground Press-in Method) and a cantilever wall (Tubular pile, Gyropress Method). These alternatives were compared in terms of workability, economical efficiency, flexibility to problems (such as obstacles) and the impact on surroundings (noise and vibration). As a result, Gyropress Method was adopted.

The comparison of the 4 alternatives is shown in Figure 3. The first alternative is the gravity-type revetment. This plan uses square concrete blocks and temporary earth retaining walls. As it requires the temporary retaining walls and the chemical injection as the countermeasure against the ground water, the construction period is the longest of the four and the cost is not reasonable. The second alternative is the counterfort retaining wall. Although it can save

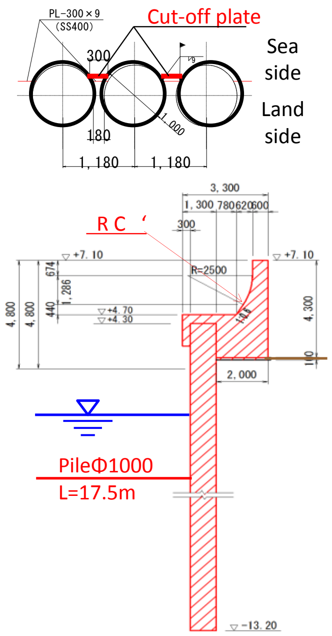



Figure 4

the temporary retaining walls, it requires the counterfort pile walls and tie rods, and the construction period will not be short enough. The third alternative is the cantilever wall with steel tubular sheet piles, constructed by Hard Ground Press-in Method, where the piles themselves are used as the coastal levee. Although it has a high performance in water cut-off, the workability under the existence of the obstacles and the economic efficiency is low. The fourth alternative is the cantilever wall with steel tubular piles, constructed by Gyropress Method. The piles themselves are used as the coastal levee. As it is better than others both in terms of the workability and the economic efficiency, we determined to adopt it.

Figure 4 is the detail of the structure of the coastal levee, designed on condition that the construction method is the Gyropress Method. The length of construction is 25m in the direction of crossing the discharge channel. The diameter of the pile was determined to be 1000mm, considering the economic efficiency and the availability of the press-in machine. The weak point of this construction method is the cut-off work between the piles. There is 18cm gap between two piles. If nothing is done to close this gap, sand outflow will be caused by the effect of the wave in the future. Therefore, cut-off steel plates were welded onto the piles, and in addition, grout injection was conducted behind the piles by using boring machines.

Figure 5 shows the progress of the construction of the discharge channel. The yellow sections are the construction work of the coastal levee, which were completed in March this year. The red sections are the box culverts and were completed in June this year. The green sections are the training levees to prevent the estuary closing. The construction have just started in July. The situation of piling construction by Gyropress Method in the yellow section is shown in Picture 1.

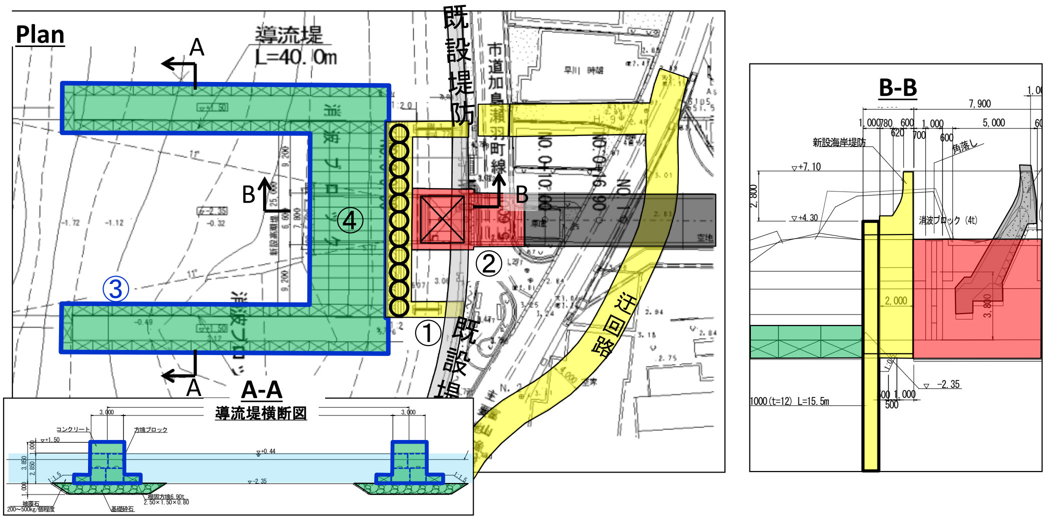



Figure 5

Picture 1

Coastal levee with steel tubular piles was the optimal option for this site with unfavorable conditions. The method will be adopted more in the future, especially where speed and certainty is required. Demand for Gyropress Method will be increased, if the construction productivity is standardized and the economic efficiency is improved further.