

## II - 77 BEACH PROFILE CHANGE AROUND SENDAI PORT

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### 1. Introduction

Beaches all around the World are changing. These phenomena have been taking place all of the coastal areas due to natural and human-induced causes or factors can be variable over a wide range of different temporal and/or spatial scales. Coastal areas which are constantly changing formations change over hourly, daily and yearly time-periods or more than that.

When the beaches have been changed by natural phenomena, then human try to protect their land by built coastal structures; for instance jetties, groins, detach breakwaters and harbor breakwaters; that are effective within the target areas. In some projects, on the other hand, the influences of them caused severe erosion around the coastal regions.

Sendai coast, Miyagi Prefecture, has severely changed in coastal morphology after construction of 2 km long breakwater at Sendai Port since 1973 and other coastal structures along the coast. It was found that shoreline has remarkable retreated since the construction (Uda et al., 1990). The most predominant waves are from ESE and SE, which results in northward littoral sediment movement along this coast (Tanaka and Takahashi, 1995). In fact, shoreline around this area should be moved forward according to sediment trappings around breakwater at Sendai Port; on the other hand, the significant erosion has still progressed. For this reason several studies have already been conducted on shoreline and river mouth morphology change around Sendai Port. It is found that wave reflection from the breakwater caused remarkable changing in the longshore sediment transport (Tanaka, 1983) and resulting shoreline and river mouth morphology evolution (Tanaka and Srivihok, 2004). Most of the previous studies were focused on shoreline and river mouth morphology change and paid less attention to beach profile change. In other words, the previous studies were insufficient to clarify the interesting phenomena around this area.

Therefore, this present study aim to investigate historical beach profile change, which is necessary for the analyses and a consideration related to other morphology change problem, along Sendai Port by analyzing bathymetry data.

### 2. Study Area and surveyed data

Study area is located in the north part of Sendai Coast, northeast area of Japan, as can be seen in Fig.1 from Nanakita River towards the north up to Sendai Port. This area covered 3.4 km alongshore and 2 km offshore approximately, including area around 6.12 square kilometers.

In this study, the process of beach profile change is investigated based on water depth data were obtained for 28 years from 1967 to 1998 around Sendai Port. The surveyed area covers around 3.4 km alongshore, and 2 km

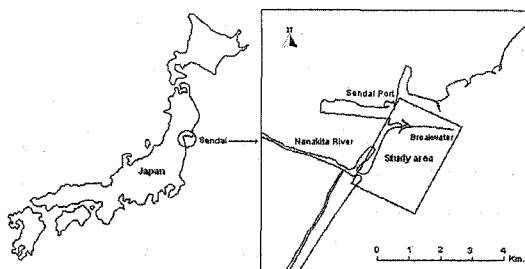


Fig.1 Study area

offshore which is spaced by 50 m alongshore and by 20 m offshore.

### 3. Results and Discussions

The process of coastal area change around Sendai Port has been studied by analyzing 28 sets of bathymetry survey data. The following results were obtained

The analyses of contours lines change had been conducted by compared contours of water depth in 1967 with 1998. The results which can be seen in Fig.2 show shoreline; water depth at 0 m; had particular severely eroded in which area updrift of breakwater. It was found that there were highly significant differences of shoreline movement before and after breakwater construction. It can be noted that position of 1998 contour lines shifted in onshore direction. The maximum erosion, 300 m from 1967 to 1998, occurred at the position around 600 m downwards from breakwater. Moreover, it can be noticed that the other contours were fluctuated even if in the deep area.

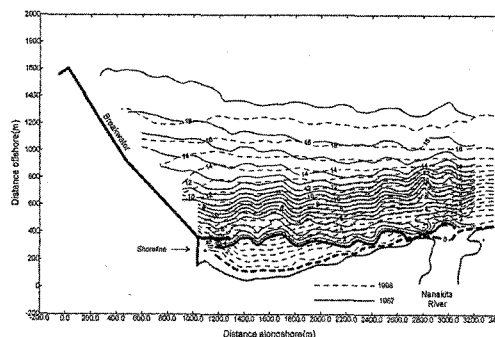


Fig.2 Depth contours change

In addition, trend of bottom elevation change should then be analyzed by using least-square method as can be seen from Fig.3 which show rate of bottom elevation change in long term; 1967-1998. From this figure, the

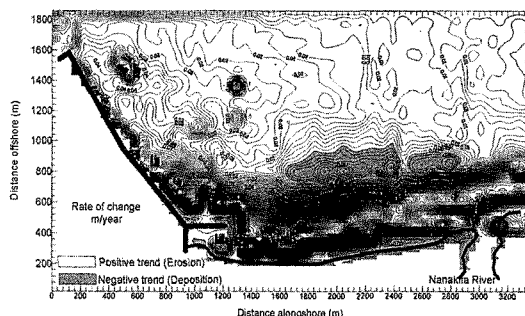


Fig.3 Rate of bottom elevation change

advance trend, positive slope, shows water depth incline to deepen in that area especially in which water depth less than 8 m region. In contrast, the deposition, negative trend, had occurred in which area around depth 12-14 m located in the middle between breakwater and Nanakita river mouth.

Furthermore, the analyses of beach profile change had been performed in order to know how it was change before and after breakwater construction. In Fig.4, show beach profile at section x=1500 m which can be seen the location from x-axis of Fig.2. Breakwater had gradually constructed since 1968 and completely done in 1973. During under construction, it can be found the substantial change in profile notably in the shallow area. After breakwater had the full length of itself, 1973, it can be noted that not only nearshore area change but the sea bottom in the deeper area has a significant change also. Moreover, from the relationship of area change and shoreline change, it can be found that the depth of closure in this area has increased from 7.5 m up to 12m in the recently year. In other words, breakwater affected wave interaction then resulted wave reflection which was strongly influenced with sediment movement in deep area; besides, beach slope in this section become steeper after the construction.

#### 4. Conclusions

The process of beach change around Sendai Port has been studied by analyzing 28 sets of bathymetry survey data. From the results, the following conclusions were obtained.

1. Severe beach erosion has taken place in this area especially within 1 km. updrift of breakwater due to wave reflection from breakwater which caused noteworthy change in sediment transport and coastal morphology in this area
2. The depth contours were fluctuated even though in deep area and it was found that most of position of 1998 contour lines shifted in onshore direction
3. Trend analyses showed bottom elevation become deepen especially in which 8m water depth area.
4. The relationship of area change and shoreline change show the depth of closure in this area has increased from 7.5 m to 12m in the recently year.

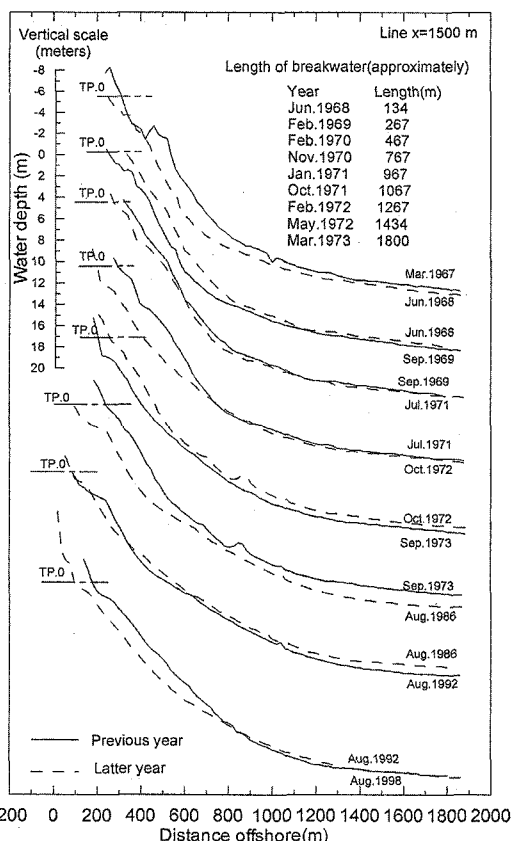


Fig.4 Beach profile change

5. Beach profile trend to steeper and become changed in the deep area after the construction.

#### Acknowledgements

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#### References

1. Tanaka, H. and Takahashi, A., 1995. Short-term shoreline change on Sendai Coast, Computer Modelling of Seas and Coastal Regions, pp. 205-212.
2. Tanaka, H. and Srivihok, P., 2004. Impact of Port Construction on Coastal and River Mouth Morphology - A Case Study at Sendai Port, 9 th Int. Symp. River Sedim., pp. 406-415
3. Tanaka, N., 1983. A study on characteristics of littoral drift along the coast of Japan and topographic change resulted from construction of harbors on sandy beach. Technical Note of the Port and Harbor Research Institute, Ministry of transport. No.453:148pp. (in Japanese)
4. Uda, T., Omata, A. and Minematsu, A., 1990. Beach erosion on Sendai Coast. Proceedings of Coastal Engineering, pp.479-483. (in Japanese)