

## PART 4

### COASTAL AND ESTUARINE PROBLEMS



## CHAPTER 76

### FIELD INVESTIGATION PRACTICES OF COASTAL STUDIES IN JAPAN

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#### ABSTRACT

This paper is a brief review of the publications on the field studies carried out in Japanese coasts. Japan has many projects of coastal works in relation with the development of industrial area, the protection of coastal land from disaster and some other purposes. Before the execution of these projects, the agencies in charge of them make field investigations for their necessary items. The results of investigations in detail are reported in their official publications and sometimes the abstracts of them are reported at the annual meeting of coastal engineering held by the Japan Society of Civil Engineers. As the official publications of the governmental organizations are distributed in strictly limited circles, they are not well known by scientists and engineers outside these organizations. The author intended to collect some of these official reports and selected some additional reports on field study from the proceedings of annual meetings of coastal engineering, and tried to make a classification of the contents and to give a brief review of them.

#### Art. 1

Japanese engineers have devoted their great efforts to solve numerous coastal problems in order to promote the nationwide coastal development and to extend the coastal protection works against waves and coastal erosion. It is needless to say that the primarily important practice for attacking the practical problems is to obtain the knowledges on the general features of coastal phenomena qualitatively and quantitatively as much as possible. From this point of view the field investigation techniques have been developed worldwide by engineers and scientists during the last decade in many aspects. The aim of this paper is to review and summarize the important practices actually applied in the Japanese coast and to contribute to find the future directions of the coastal investigation.

In this country the results of such field investigations are sometimes published in an abstract at the annual meetings on coastal engineering which were held by the Japan Society of Civil Engineers. However the obtained results described in detail are generally available only for strictly limited circles. Beside it, considering the fact that almost all of those publications are written in Japanese language, the author intends

to give a brief review of them and to make clear the agencies where the correspondences are possible about those reports.

The purpose of a coastal investigation for an engineering project is in most cases to study the stability of coastal structures against waves and littoral drift or to predict the effect of the structures on wave action and the stability of coastline. Therefore waves and sediment movement can be said to have the largest importance in many coastal studies. The coastal phenomena, especially beach erosion or sand deposition, are investigated in two aspects; they are macroscopic aspect and detailed (or microscopic) aspect. The former is, for example, to investigate the morphological changes over a wide area for many years, sometimes for hundreds or thousands years. The latter is the studies in detail. They are; the grain analysis of sediment, tracing the movement of sediment and other dynamical problems. The literatures listed at the end of this paper contain the reports of these sorts of investigations applied in the Japanese coasts. From the contents of those literatures the author made a rough classification of the field practices in the following;

1. Geographical and morphological studies of the district which covers the coastal area to be investigated.
2. Mineral analysis and grain size analysis of beach sediment.
3. Observations of wind and waves. Survey of littoral current.
4. Tracing the movement of bed materials using tracer. Observation of suspended sediment in wave and measurement of wind drift sand.
5. Establishing hydrographic survey periodically in order to make the maps of sea bottom topography. Examination of coastal morphology by aerial photogrammetry.

#### Art. 2

Discussion on the shore process of present topography helps the investigation on the future process of the coast. In the literatures 1-3 and E-1 Dr. Shiraishi describes the process of development of Tomakomai coast in Hokkaido during the past four thousands years and makes an estimation of the volume of deposited sand. The coasts of Niigata and Ishikawa are well known for its receding character. In 2-1 and 2-8 there are descriptions about the historical development of coastal dunes which are now being eroded. It is also suggested that relative rise of sea level took place during a period not so long and it caused beach erosion in these coasts.

There is an example of a sudden crust movement which destroyed the equilibrium in shore process. In the case of Kanto big earthquake in 1923, there took place ground rise of approximately one meter along the coast of Sagami Bay (Fig. 1). After this accident the beach is being eroded under the wave action and by very gradual subsidence of ground (3-5, E-3).

Sometimes the cause of beach erosion is attributed to river improvement works. In Japan many kinds of river works have been carried out over the whole land for about seventy years. As the result the amount of debris carried by flood flow took a decreasing tendency which accelerated the recession of sand beach. A notable example is seen at Niigata coast (Fig. 2). Since the floodway of Shinano River was completed about fifty years ago, there appeared a wide deposit of sand at the mouth of floodway. At the same time beach erosion was remarkably accelerated at the west coast of Niigata city which is located at the mouth of Shinano River.

#### Art. 3

Petrographic studies have been carried out in many coasts by geologists. The examples are found in the literatures 2-7 for Niigata, in 2-9 for Ishikawa, in 3-7 for Tokai coast and in 3-5 for Sagami Bay. The practices applied to these coasts are not proper in Japan. However many beaches in Japan are nourished by debris poured out with flood flow from rivers and the petrographic studies are generally very useful ways to investigate the source of sediment supply. The common items of the investigation are as follows;

1. Grain diameter analysis (the biggest gravel diameter, median of diameter, uniformity and skewness of diameter distribution, etc.).
2. Size analysis of gravel (flatness, etc.).
3. Rock composition of sediment.
4. Mineral composition of sediment; content of heavy mineral in 3-7, and content of magnetic mineral in 2-9.

A part of the literature 2-9 was published by Prof. Aramaki at the 10th Conference on Coastal Engineering in 1966 (E-6).

#### Art. 4

The wave gauge commonly used in Japan is that of water pressure type developed at the Ministry of Transportation. Step-resistance wave gauge was also applied at some coasts in Japan. A more simple system for the observation of wave height was developed by Mr. Utai (1-1). In this system a transit with special attachment is used to trace and record the movement of buoy set at a proper location in the sea. The results of observations by these systems are found in 1-15, 2-1, 3-1 and 3-3. The literature 1-2 shows an example of wave observation by stereophotography.

Concerning the measurement of wave direction, an adequate method must be chosen according to the site and purpose of observation. The literature 1-9 shows a direct measurement of water motion using electro-magnetic current meter, while 1-14 gives the record of wave direction estimated from the simultaneous data of some wave gauges. 2-6 shows the results of observation used a radar system which makes possible the routine observations of wave direction at fixed places off the shore.

There are two sorts of method for the measurement of littoral current. One is to set a current meter at the site (to set on the bottom or to suspend from a moored ship), and the other is to trace the floating buoy which is transported by the current. In the Niigata coast a current meter was set in a frame fixed on the sea bottom and buoys were trajectory from the shore by a special trajectory (2-3).

#### Art. 5

In order to examine the local movement of bed sand, radioisotope or fluorescene are often used as tracers. A compiled description on the application of tracers in Japan is found in the Proceedings of the Symposium "Radioisotope in Hydrology", 1963. The results of recent observations by these tracers are found in the literatures 1-5, 1-11, 2-3, 2-4, 2-5, 3-10, 3-11 and E-5. To estimate the sand movement near the shoreline, test barriers or test groins are sometimes constructed. The literature 3-12 shows the estimation of littoral drift along Kashima coast from the observed data obtained at the test barrier. The maximum scoured depth during a storm was measured using a simple apparatus (Fig. 3) at Niigata coast (2-4).

Concerning the field observation of suspended sediment in sea water, it is required in many cases to know the average condensation over a certain extent of time. For such a purpose Professor Fukushima developed a simple sampler made of bamboo. The results of its application are found in 1-4, 3-4, 3-7 and 3-12. The reports on the field study of wind drift are in the literatures 2-7 and 3-4.

#### Art. 6

Repeating of sounding survey carried out over a certain area with a definite interval of time is very useful to know quantitatively the change of sea bottom. In Japan the contour map of the sea bottom is made approximately every six months over the area where a project is in progress. Comparison of two contour maps of succeeding times makes us known the change of sea bottom which took place during one typhoon season or one winter storm season. In Niigata west coast the comparison of bottom profile of present time with that of about fifty years ago shows that the bottom was eroded over the area of water depth less than 35m (2-2). An example of the seasonal change of bottom profiles at Tokai coast is found in 3-7, (Fig. 4).

The literatures 1-16 and E-7 are the reports of the study on the recession of coastal cliff by means of aerial photography. The use of aerial photogrammetry will be developed for wide applications in the future coastal studies.

#### Art. 7

Literatures from the Proceedings of Annual Meetings on

- Coastal Engineering, Japan Society of Civil Engineers.  
(Published in Japanese)
- 1-1 G. Utai: Measurement of wave height using a transit, 1955.
  - 1-2 T. Iijima & others: Wave characteristics in surf zone observed by stereophotography, 1956.
  - 1-3 N. Shiraishi: Observation of littoral drift for the works of harbour construction, 1957.
  - 1-4 H. Fukushima & M. Kashiwamura: Sand drift and its observation, 1959.
  - 1-5 T. Iijima, S. Sato & others: The characteristics of wave and littoral drift on the coast of Fukue, 1960.
  - 1-6 N. Sakamoto, T. Iijima & S. Kimura: Characteristics of wave along the Pacific Coast due to typhoon and their estimation, 1961.
  - 1-7 F. Kakunuma: Size distribution of beach sand along Ozu coast in Atsumi Bay, 1961.
  - 1-8 H. Fukushima & others: Study on littoral drift along Hidaka coast, (1), 1962; (2), 1963.
  - 1-9 Y. Nagata: Observation of wave direction by electro-magnetic current meter, 1963.
  - 1-10 H. Fukushima & others: Study of Ishikari River mouth, 1964.
  - 1-11 T. Iijima & others: Study on the littoral drift along Kashima coast, 1964.
  - 1-12 Y. Iwagaki & others: Investigation of the coefficient of bottom friction at an actual beach, 1965.
  - 1-13 T. Arata & R. Koh: Morphological study of Iwafune Harbour, 1965.
  - 1-14 T. Iijima & others: Observation of wave direction by using wave gauges, 1966.
  - 1-15 J. Itao & others: Wave characteristics in the coast of Japan Sea, (1), 1966; (2), 1967.
  - 1-16 K. Horikawa & T. Sunamura: A study on beach-cliff recession by using aerophotography, 1967.

Literatures from governmental and other agencies.  
(Published in Japanese)

- a. Reports for the coast of Japan Sea.
- 2-1 Beach erosion at Niigata coast, 1960.
  - 2-2 " " " " , (Continued), 1964.  
Civil Engineering Section, Niigata Prefectural Government; Gakkomachi, 1-602, Niigata.
  - 2-3 Report of the investigation of Niigata coast, (4), 1966.
  - 2-4 " " " " " , (5), 1967.
  - 2-5 " " " " Sakata Harbour, (4), 1966.
  - 2-6 " " " " Kanazawa Harbour, (5), 1967.
  - 2-7 Report of the study on beach sediment in Niigata coast, 1962.  
The First Harbour Construction Bureau, Ministry of Transportation; Hakusanura 1-332, Niigata.
  - 2-8 Report of the wind drift at the Niigata East Harbour, 1964.  
Niigata Harbour Work Office, Ministry of Transportation; Iriifunecho 4-3778, Niigata.

- 2-9 Report on the mouth of Shimbori Outlet, 1962.  
 Kaga-Sanko Reclamation Office, Hokuriku Agricultural Bureau, Ministry of Agriculture and Forestry; Hirosaka 2-2-60, Kanazawa.
- b. Reports for the Pacific Coast.
- 3-1 Observation of wave by wave gauges, (Report Vol. 4), 1954.
- 3-2 Investigation of littoral drift by radioisotope, (Tech. Memo. No. 5), 1963.  
 Port and Harbour Research Institute, Ministry of Transportation; Nagase 3-1-1, Yokosuka.
- 3-3 Observations of wave at Onahama Harbour, 1967.  
 The Second Harbour Construction Bureau, Ministry of Transportation; Takashima 1-2-5, Nishi-ku, Yokohama.
- 3-4 Report on the sand movement by wind and wave at the estuary of Tone River, 1964.  
 The Lower Tone River Work Office, Ministry of Construction; Sawara 1-4149, Sawara, Chiba Prefecture.
- 3-5 Report on the investigation for the protection of Katase-Kamakura Beach, 1958.
- 3-6 Report on the investigation of Sagami River Mouth, 1961.  
 Civil Engineering Section, Kanagawa Prefectural Government; Nihon Ohdori 1, Naka-ku, Yokohama.
- 3-7 Report of the investigation of Tokai coast, 1962 (JAP Memo. 1).
- 3-8 Investigation on the distribution of suspended sediment at Tokai coast, 1963, (JAP Memo. 4).  
 Japan Atomic Power Co. Ltd.; Ohtemachi Blg., Ohtemachi 1, Chiyoda-ku, Tokyo.
- 3-9 Report of the investigation of Tomakomai Harbour, 1960.  
 The First Scientific Research Laboratory, Hokkaido Univ.; N. 12, W. 8, Sapporo.
- 3-10 An investigation on littoral drift, relating harbour construction, 1963.  
 Port and Harbour Research Institute, Ministry of Transportation; Nagase 3-1-1, Yokosuka.
- 3-11 On the natural features of Kashima coast, Vol. 2, 1962.
- 3-12 On the natural features of Kashima coast--on the littoral drift, 1964.  
 The Second Harbour Construction Bureau, Ministry of Transportation; Takashima 1-2-5, Nishi-ku, Yokohama.
- c. Reports published in English.
- E-1 N. Shiraishi: The measurement of littoral drift at shore-line harbours, Coastal Engineering in Japan, Vol. 2, 1959.
- E-2 H. Fukushima & M. Kashiwamura: Field investigation of suspended sediment by the use of bamboo samplers, Coastal Engineering in Japan, Vol. 2, 1959.
- E-3 M. Hom-ma, K. Horikawa & C. Sonu: A study on beach erosion at the sheltered beaches of Katase and Kamakura, Japan, Coastal Engineering in Japan, Vol. 3, 1960.

- E-4 T. Furuhata: New electric ocean wave recorder, MR-MARK III--for the coastal station, Coastal Engineering in Japan.
- E-5 S. Sato: Sand movement at Fukue coast in Atsumi Bay and its observation by radioactive glass sand, Coastal Engineering in Japan, Vol. 5, 1962.
- E-6 M. Aramaki: A petrographic study on littoral drift in the Ishikawa coast, Proceedings of 10th Conference on Coastal Engineering, 1966.
- E-7 K. Horikawa & T. Sunamura: A study on the erosion of coastal cliff by using aerial photographs, Coastal Engineering in Japan, Vol. X, 1967.



Fig. 1 Sites of coastal observation appeared in the report.

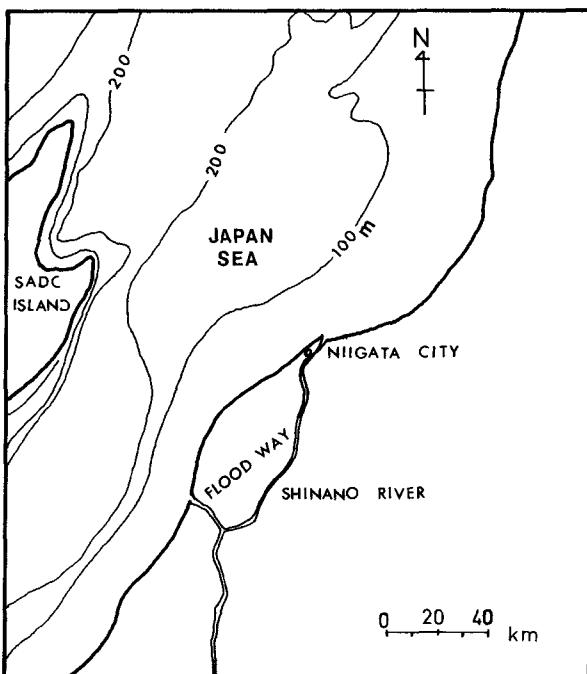


Fig. 2 Niigata coast and Shinano river.

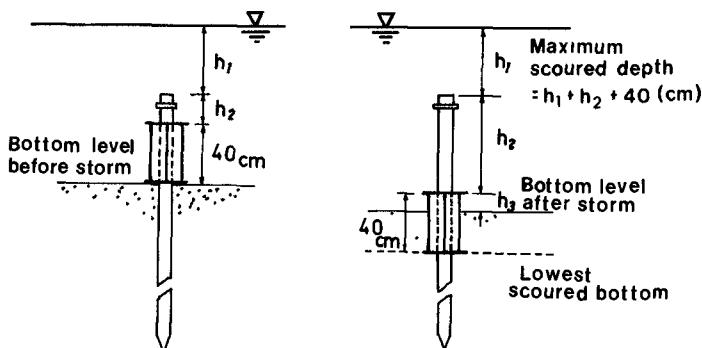


Fig. 3 Apparatus for the measurement of maximum scoured depth.

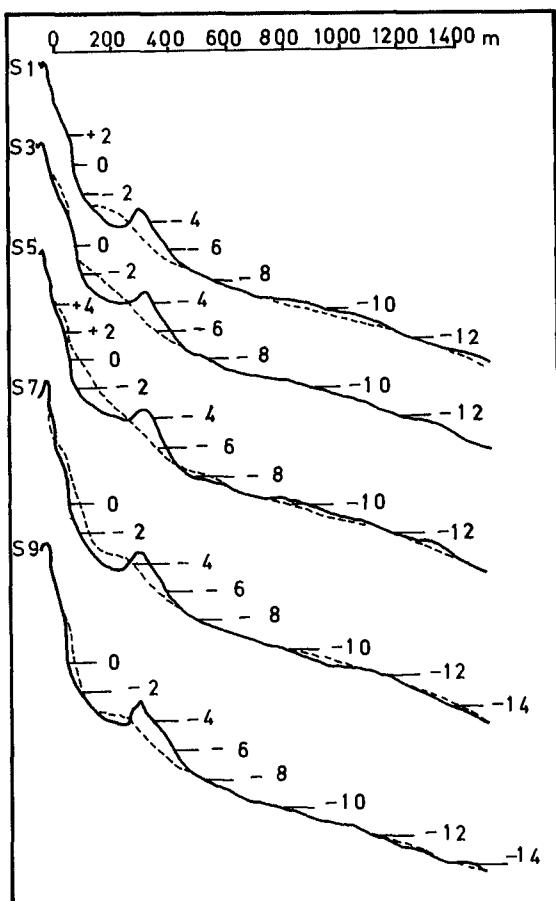


Fig. 4 Comparison of beach profiles before and after a typhoon season in Tokai coast. (1958 July and 1958 Nov.)