

HISTORY OF COASTAL ENGINEERING IN JAPAN

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This is a completely revised chapter of the author's previous paper (Horikawa, 1996) regarding the history and heritage of coastal engineering in Japan. In the initial part of this paper, the specific cultural background of Japan will be described briefly from the viewpoint of natural conditions such as the geographical and meteorological environments of the Japanese Islands. The era of Japanese history is conventionally divided into the following three periods by considering the activities of coastal development. These are (1) Early times to Meiji Restoration, 1868, (2) Meiji Restoration to the End of World War II (1945), and (3) Postwar to the present. Coastal utilization has been actively carried out throughout the long history of Japan; however, real coastal engineering in Japan started in 1953 after the storm surge damage at Ise Bay due to Typhoon No. 13. Therefore, the contents of this paper are mainly related to achievements in the period after 1953.

1. Introduction

1.1. *Natural conditions of Japan*

Japan consists of four main islands, namely Hokkaido, Honshu, Shikoku and Kyushu from the north to the south, which, together with numerous smaller islands scattered around, are so aligned as to form a slightly bent arc off the eastern fringe of the Eurasian Continent as shown in Fig. 1. The total length of the coastline is about 34 360 km, whereas the total land area is 372 000 km². Hence, the coastline per unit land area is 92 m/km², which is about 1.8 and 42 times those of the United Kingdom and the United States, respectively.

The dominant geography of the Japanese Islands consists of relatively high mountains located in the center and narrow strips of plane lands lying along the coastlines. The mountainous region including hilly areas covers 71% of the total land, and the remaining area is divided into the foot of mountains, the terrace, and the low-lying land in the ratio of 4%, 12% and 13%, respectively. The low-lying land is mainly situated along the coast, particularly at the head

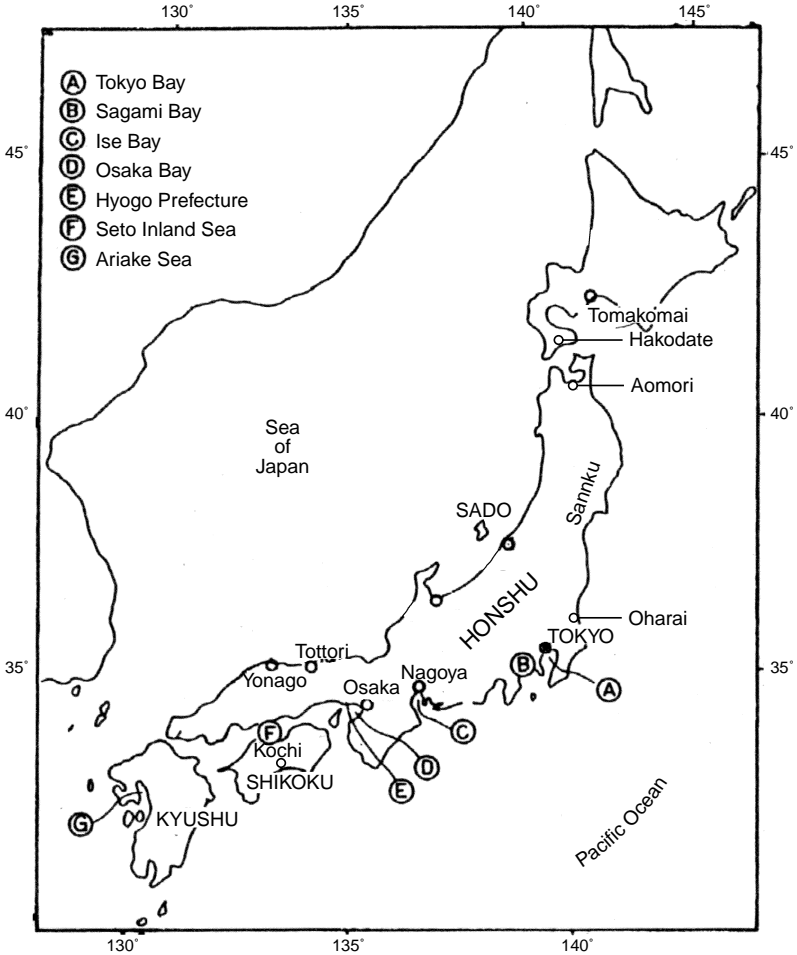


Fig. 1. Map of the Japanese Islands.

of relatively large bays such as Tokyo Bay, Ise Bay, and Osaka Bay as well as along the Seto Inland Sea and Ariake Sea. These areas are densely populated and keep the nation as one of the most advanced societies in the world from social as well as economical perspective.

The Japanese archipelago, however, is situated in the Circum Pacific Earthquake Zone and in the zonal route of typhoons. As it is located on the fringe of the Eurasian Continent, strong low pressures migrate across the Sea of Japan

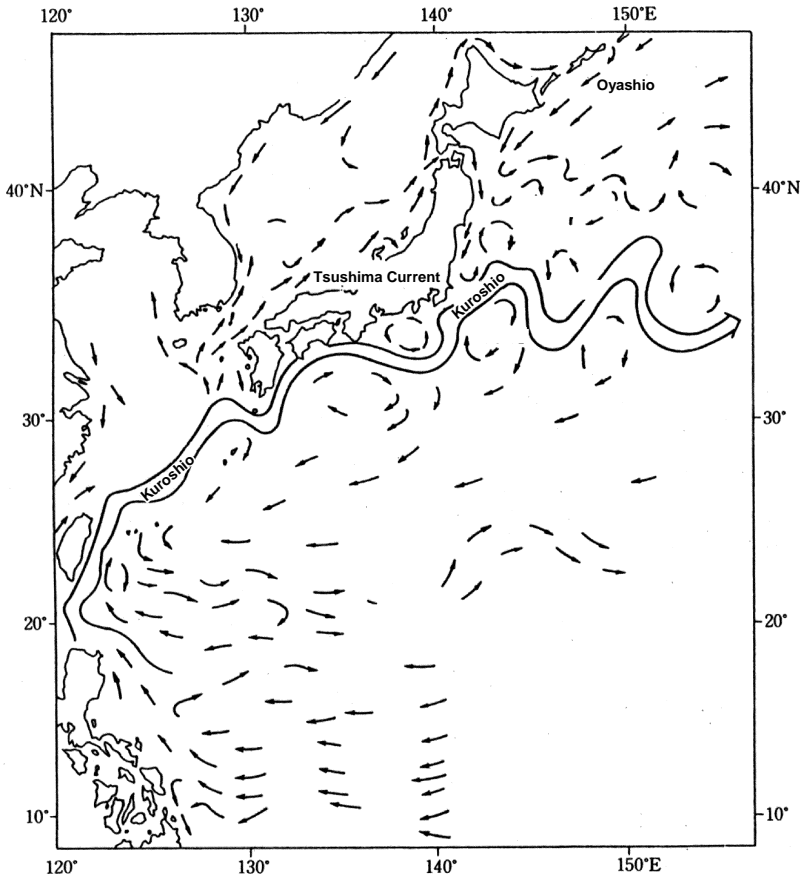


Fig. 2. Ocean currents.

in winter. Therefore, we have frequently suffered from numerous disasters caused by huge waves, storm surges, tsunamis* and earthquakes.

Figure 2 illustrates the paths of main ocean currents surrounding the Japanese Islands, among which Kuroshio and Oyashio are representative ones.

*The Japanese word “tsunami” has been accepted internationally as a technical term to express seismic sea waves possibly since the 1896 Sanriku Tsunami. The words “tsu” and “nami” mean anchorage basin and waves, respectively. Hence “tsunami” originally meant dangerous big waves appearing in a harbor basin or in a bay. Sometime in the period of Edo (1603–1867) the word “tsunami” was used in order to record in literature disasters caused by seismic sea waves.

The former is a warm current and the latter a cold current. These currents control the climate of the Japanese Islands and the variety of fishes migrating to the coastal waters of Japan.

1.2. *Japanese civilization*

It is well known that Japan is a daughter of China in civilization (Reichauerh, 1981). In ancient times, Japan was heavily isolated from the Eurasian Continent, where Chinese civilization had developed as one of the oldest civilizations in the world. It is truly a fact that the great distance of open sea from the Japanese Islands to the neighboring countries, Korea and China, was a very big barrier to the primitive art of navigation. However, there was an active exchange or inflow of ancient culture through the Korean peninsula or directly from China. Therefore the Japanese culture received a strong influence of higher civilization first and then became a unique one.

2. Historical Development of Coastal Region

2.1. *Early times to Meiji Restoration*

Because Japan is an island country, the people have traditionally utilized the coastal zone covering the seaward and landward areas from the shoreline in their daily life. The nearshore area has been widely used for fishing and marine transportation, whereas the coastal land area has been used for agriculture including salt production.

On the other hand, the Japanese people “imported” Chinese culture to Japan more than 1000 years ago, as indicated by the first Chinese records of the Japanese mission to China in 57 AD. The Japanese government dispatched envoys to China three times during the Tang dynasty (607 to 610) and seventeen times during the Sui dynasty (630 to 838). In the initial stage, they took the northern sea route following the western coast of the Korean peninsula. Later, they took the southern sea route crossing the East China Sea with tremendous risk of heavy wave attack. This was possible through the use of advanced naval architecture technology developed in the southern region of China.

On the other hand, domestic trade was actively pursued in the medieval ages through coastal sea routes, such as the Seto Inland Sea route and later on, the routes of the Sea of Japan as well as the Pacific Ocean. These activities were accomplished by the construction of numerous harbors along the Japanese