Tide-induced Geomorphological Change of the Sea Area near the Northern Breakwater of Taichung Port

Chih-Chung Wen^1, Yong-Jun Lin^2, Li-Hung Tsai^3, Shu-Huei Jhang^4, Tsung-Lin Lee^5, Meng-Sian Jhuo^1

1 Department of Safety, Health and Environmental Engineering, Hungkuang University, Taichung, TAIWAN China
2 Center for Weather Climate and Disaster Research, National Taiwan University, Taipei, TAIWAN China
3 Port and Marine Technology Center, Institute of Transportation, Taichung, TAIWAN China
4 Department of Marine Environmental Informatics, National Taiwan Ocean University, Keelung, TAIWAN China
5 Department of Interior Design, Nan Jeon Institute of Technology, Tainan, TAIWAN China

ABSTRACT
Taichung Port is located in central Taiwan and faces the Taiwan Strait. Based on the statistics of Taichung Port, TIPC (2003), the average difference in tides was 3.63 m from 1971 to 1996. The large difference in tides plays an important role in the geomorphological change in this area. In addition, the northeastern monsoon affects this area, and the wind-driven flow and longshore current effects are also obvious. To investigate the effect of the external forces contributing to this terrain, the SW, HD and ST modules of MIKE 21 are used in this study area. The two-dimensional MIKE 21 model is used to calculate the wave and current pattern. The main mechanism of the geomorphological changes of the sea area near Taichung Port is investigated in this study.

KEY WORDS: tide, geomorphological change, MIKE 21

INTRODUCTION
The breakwaters of a port often interrupt alongshore sand transport so that sand is easily deposited in the upstream beach and the downstream beach is often eroded. Large shoreline variation occurs near the breakwater of Taichung Port. In recent years, the increasing capacity of carriers has increased the demand for deep-water ports. Thus, the offshore breakwater may extend to deep water areas where the depth may be more than 20 meters to enlarge the port capacity. However, in the case of large-scale port facilities, the breakwater will extend several kilometers from the sea shore. For example, the length of the northern breakwater of Taichung Port is approximately 3 km, and its length is much greater than its northern groin (approximately 400 m). Taiwan is an island, and the deposition and scouring of its coastline is affected by geographical, meteorological, and artificial structures and sediment brought by rivers, which is driven by tides and near-shore currents. Taichung Port is located in central Taiwan's west coast, and its nearby alluvial plain’s slope is 1:2,000. The port sites are located on a flat and straight beach. The northeast winter monsoon and summer typhoon-induced waves make the sand drift violently, and the seabed topography often changes because of the magnitude of wind-driven waves.

Taichung Port ranges from the south bank of Tachia Creek and the north bank of South Tatu Creek, and it faces the Taiwan Strait. To protect it against waves, the North Shore Dike was built in 1972 (Fig. 1a dotted-line area). After the completion of the North Shore Dike, slight deposition was found in the Komei Wetland in 1986 (Fig. 1b solid line). After approximately nine years worth of sediment brought by Tachia Creek, rapid deposition is found between the North Breakwater and the North Groin (Fig. 1b double-solid line position). Because of the continuous sand supply and the first extension of the North Breakwater in 1990-1999, the deposition extends from the Komei Wetland to offshore. The sand shifts across the North Groin. To further protect Taichung Port, the North Groin was extended offshore between 2000 and 2002. Fig. 1d shows Taichung Port today (2014). Fig. 2 shows the layout of Taichung Port today.