Numerical Beach-Evolution Model for Sedimentation of a Small Port surrounded by a Reef zone

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ABSTRACT
This study utilizes a numerical model to predict the magnitude of sedimentation for a small harbor surrounded by a reef zone. A three-dimensional beach evolution model of a sandy beach with a hard sea bottom such as a shore reef is proposed. Changes in water depth are considered to manifest as changes in the thickness of the sand layer overlaying the hard bottom. The numerical model is applied to the morphodynamics of a small port surrounded by a shore reef area. The port experiences deposition owing to the action of waves and nearshore currents. Finally, the influence of the reef area on the topographical changes and sedimentation around the port is investigated using the presented numerical model.

KEY WORDS: Sediment transport, Beach evolution, Numerical model, Field investigation, Reef zone.

INTRODUCTION
Small harbors’ entrances and ship channels are often located inside surf zone areas, which are subjected to storm waves; consequently, sand deposition is significant in these harbor features. Kute Port, which is located in the eastern part of Shimane Prefecture, facing the Sea of Japan, experiences significant sedimentation at the harbor entrance and channel. This port is surrounded by a shore reef with a hard bottom and is adjacent to the Kute sandy beach, as shown in Fig. 1. In 2018, significant sand deposition occurred in the harbor. Although countermeasures such as the extension of offshore breakwaters and groins were performed, dredging of deposited sand in the harbor entrance was still necessary.

The Kute port is surrounded by a shore reef with a hard bottom and is adjacent to the Kute sandy beach. Sediment transport due to waves and nearshore currents may be influenced by the presence of shore reefs. The enhanced sedimentation mechanism should be identified for developing needed countermeasures against sedimentation. Therefore, field investigations and the development of a prediction model for three-dimensional beach evolution are required. Some predictive models for 3D morphodynamics of sandy beaches with hard bottoms, such as shore reefs, have been presented previously by Ikeno et al. (2002), Hanson et al. (2005), and Hasegawa et al. (2012). Although many models have been used to investigate 3D morphodynamics, their applicability to the prediction of sandy beaches with shore reef areas, such as hard bottoms, has not been sufficiently investigated. In this study, a three-dimensional beach evolution model considering the influence of the reef zone was investigated for its applicability to sand deposition in Kute Port.

Fig. 1 Location of the Kute Port and the Kute Sandy Beach.