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Hydrodynamics Modeling of Giant Seawall in Semarang Bay

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Abstract

Semarang bay was located in the Central Java Province has problems of land subsidence, inundation, limited land and shortages of fresh water. One of the efforts to solve the problems is by building a giant seawall in Semarang bay. BPPT, according to its function and task has a concept of the giant seawall (GSW BPPT concept). The aim of the study is to simulate the hydrodynamics, i.e. surface elevation and sea current components, of the existing condition as well as the GSW BPPT concept. Modeling was carried out using the software package MIKE21 HD FM module, developed by DHI Water and Environment, Denmark. The GSW BPPT concept configures 3 lakes with the stored water coming from the existing river flows. The model shows that the GSW BPPT concept changes the hydrodynamic patterns in the area within 5 km from the structure, and may increase the discharge of fresh water by 140 m^3/sec in western lake, 57 m^3/sec in central lake and 46 m^3/sec in eastern lake.

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Keywords: Hydrodynamic Modelling; Giant Seawall; Semarang Bay

1. Introduction

Semarang bay is located to the north of the Kendal District, Semarang City and Demak District. The area lies on the central part of the island of Java, constrained by Bodri River on the west and Wulan River on the east. Semarang bay has a total area of ~ 600 km^2, a shoreline of ~80 km, an average water depth of ~10m, and 29 outfalls.

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The problems of Semarang bay are land subsidence, inundation, flooding, abrasion, limited land and shortages of fresh water. These problems are due to the changes of land use on the coastal area, over exploitation of groundwater, coastal ecosystem damage, and dynamic processes on the coast that happens both from the land and sea.

These problems result in destruction of residence area, ponds, social facilities, tourism areas and infrastructures especially the main road of the north beach (as called as pantura), which affect the economic activities. These problems can be addressed by means of coastal defense principles, there are two approaches to the design of coastal defense schemes. The first approach is referred to as the soft engineering and the second one is referred to as the hard engineering[1]. The approach of the soft engineering keeps and makes use of the environment and coastal ecosystems such as mangrove, sea grass and coral reef, while the hard engineering approach develops structures constructed on the coastline or offshore, like seawall or giant seawall, breakwater, and groins or combined.

Interaction with the atmosphere on a wide scale affects coastal hydrodynamics; naturally, without any human intervention, the condition of coastal area will configure equilibrium values. Human intervention such as the development on the coastal area needs our attentions, especially how the development will affect the hydrodynamics and the beaches like sedimentation and accretion. There is increasing need to understand the hydrodynamics of coastal and littoral zones because of its important influence on sedimentations in shoreline and other, water quality and biological processes.

Development on the sea or coastal areas requires descriptions of the sea conditions such as hydrodynamic conditions, which can be obtained from survey and measurement. These data can be used for forecasting or mitigation efforts. However, survey and measurement of long periods to describe sea conditions are costly, and one method to describe hydrodynamic conditions on large scales and long periods is done by numerical modeling.

The aim of the study is to simulate the hydrodynamics, i.e. surface elevation and sea current components, of the existing condition, as well as the GSW BPPT concept.

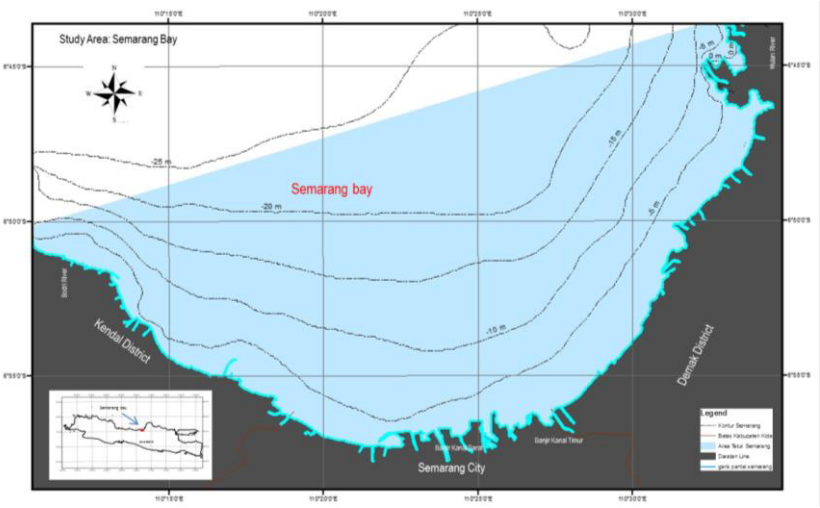

Fig. 1. Domain of the study and bathimetry of Semarang bay

2. Method and Material

1.1. Hydrodynamic model

The 2D-Hydrodynamic Model MIKE 21 is a 2 dimensional model that can simulate the hydrodynamic conditions which take into account variations in density, bathymetry and other external driving force. In general, a two-