

Comparing the estimation of sedimentation rate and volume in Imam Khomeini Port's access channel using the methods of Hydrography, Bijker's theory and modeling by Mike21

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Extended Abstract

Sedimentation in ports' access channels is a major problem for the port authorities as well as the vessels navigating in these channels. This phenomenon creates dangers for the ships in this vital part of the port in addition to imposing heavy costs on the port. In this research, we evaluated and estimated the sedimentation rate and volume in Imam Khomeini port's access channel based on field information as the research goal. In this research method, analyses on the geographic status such as bed level, analysis of wave time series and tide (as current) were carried out in the region by Mike 21 software, and appropriate modeling was presented. To investigate the rate and volume of sedimentation, the methods of hydrography, Bijker's theory and modeling by Mike 21 were used. In the present study, hydrodynamic model of current and sediment transport will be carried out using valid engineering methods. At the same time, all information and library data and the results of existing field data are collected and analyzed, and the results obtained from different methods (Hydrography, Bijker and Mike 21) are calibrated. In line with the objectives of the study, the following cases can be summarized as:

- Collecting required data and statistics such as wind, wave, current, sediment characteristics of the region or grading, and sounding data.
- Investigating the variety of dredging methods and equipment available in the world.
- Examining different types of discharge methods, and diverse applications of the extracted sediment.
- Computations and modeling.
- Summing up and conclusion and analyzing the results.

The hydrographic boat moves on specific paths according to a predetermined schedule in order to estimate the depth or carry out the sounding. The boat is equipped with a dual or multi-frequency GPS device and a sonar device. The boat receives its horizontal position from the GPS. The sonar sends an audio wave to the bed during the movement, and gives the depth for each point by calculating the wave's round-trip time and the sound velocity profile, and on the other hand, the GPS provides the horizontal position of that point.

Today, various software are capable of simultaneous recording of this information, which is used in hydrographic vessel. Based on the obtained results and investigating the hydrographic maps, the actual amount of sedimentation in the channel ($0/000078m^3/s/m$) was obtained. Given that, the criterion hydrographic method was taken into consideration

for the work and calculations in other ways, the error percentage of the results obtained from Bijker's and modeling of Mike's calculations were 12% and 20% respectively. Accordingly, the dimensionless coefficients of $\alpha=0.88$ and $\beta=1/2$ were obtained for Bijker's theory and the results of the calculations by Mike21 respectively, which indicates good accuracy. Based on the results, the optimal method of dredging and the morphological changes of the region can be achieved based on the obtained models. Considering the sediment granularity diameter $D_{50}=6\text{m}$, it can be concluded that the most suitable method for dredging with regard to available facilities in the port is the use of self-propelled hopper suction dredger. However, if the dredging unit is equipped with new equipment such as bed leveler device, more optimal methods can be obtained. By this method, the total volume of sediment was 244466.280 cubic meters for an area of 57213810.4 square meters. Of course, this was the volume of solid materials, and according to the experts of the Ports Organization, this amount is 20% of the total volume of the total sediment (solids and water). It can be concluded by a simple calculation that the sedimentation rate in a one year period is about 13.7 cm per square meter per year, which shows a good approximation compared with the field measurements conducted by the Ports and Maritime Organization with a value of 13.5 cm per year. Bijker (1971) presented a method for calculating sediment transport in a combined state of wave and current. This method was expanded to calculate the sediment transport of the coastline. Bijker modified the Fryjling-Kalinske formula for the bed sedimentation along with the Einstein method to evaluate sediment transport applied in coastal environment. For this reason, the Bijker formula is very popular among the European engineers. Among the world's leading mathematical models in analyzing the phenomena governing the sea environment, Mike21's mathematical model is one of the most well-known ones. This advanced software has been founded, completed and developed by the Hydraulic Institute of Denmark over time and in collaboration with the Water Quality Institute of this country. This software is a comprehensive system for modeling two-dimensional free flows in which fluid flow layering cannot be ignored.

Keywords: Sedimentation, Bijker, Mike 21, Imam Khomeini Port, Access channel, Hydrography