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Analytical Study on the Sedimentation at the Entrance of Breakwaters in Caspian Sea (Case Study: Astara Port)

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Abstract

Sedimentation is an important and common problem in management of ports. The aim of this study was to set up the hydrodynamic modeling of the area to estimate the sedimentation rate using MIKE21. Therefore, in this paper an analytical model is developed for studying sedimentation in Astara port. The model is run in MIKE 21 Flow Model FM. The wind and wave sources which have been used in this study are ECMWF 2D and ISWM project, respectively. Also, for determination the rate of sediment transport are used Kamphuis method and Litpack model. Simulation results have shown good agreements compared with field measurements and real observations. The numerical model results are obtained both before and after extension of the breakwaters. Before extended breakwaters, a large amount of sediments entered to the channel and net littoral drift is directed from north to south. Then, four variants for reduction of sedimentation are proposed and finally the best solution is determined. In proposed solution the problem of sedimentation in entrance of Astara port has been removed.

Keywords: Coastal management, Sedimentation, Numerical modelling, Breakwater

1. INTRODUCTION

Ocean and sea coastal zones are the most favorite places to live for the world population. This is because the coastal zone is rich with natural conditions and resources, an abundance of jobs, ease of communication with other regions and countries and other factors. The total area of coastal zone all over the world is not so big and that is why it is impossible to provide to all the area in the coastal zone [1]. One of the tools of management in such condition taking into account existing and changing natural conditions is territorial organization of population and economy i.e. social-economic and physical geography. In the recent years, interest to Caspian Sea has been increased. This interest in some cases should be important to increase the role of this region in the world and its resources for the developed countries.

Harbour basins and approaches are frequently silted requiring maintenance dredging. The amount of maintenance dredging which is the most expensive item in the running costs of harbors depends on the rate of sedimentation in harbor basins. For example, the annual dredging costs of marinas of the Netherlands are estimated about €500,000,000, as reported in [2]. As another case in point, the average annual dredging costs of federal navigation projects in the United States between 1995 and 2000 were estimated to be about M$500, as reported in [3]. Therefore, minimizing sedimentation in harbors is one of the major considerations in port design. Generally, sediments transported into harbors by currents and waves, are deposited in parts of the harbor where currents and waves are not strong enough to keep sediments in motion and reduce water depth. Recently, many attempts have been made to study sediment transport and measures for the reduction of sedimentation in harbor basins. Winterwerp [4] gives a summary of measures for the reduction of sediment deposition reduction measures in harbors for various environmental conditions. Kuijper et al [5] discussed the effects of harbor geometry on sediment deposition in harbor basins, together with the application of CDW (Current Deflection Wall) as a type of geometrical modification to reduce sediment deposition in a harbor basin of the port of Hamburg