



***Numerical Investigation of Effective Harbor Geometry Parameters on
Sedimentation inside Square Harbors***

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Abstract

Sedimentation is one of the most important problems in harbors that results in considerable economic costs. Harbor planforms affects the flow pattern in the harbor basin and consequently, plays an important role in sediment transport and sedimentation. In the present study, a two dimensional hydrodynamic and sediment transport model has been developed to investigate the effect of harbor planform on sedimentation and sediment transport in harbor basin. Various planforms have been examined by the numerical model and results are plotted for alternative harbor planform geometry parameters, namely, planform aspect ratio, entrance location and entrance width which are presented in a dimensionless form.

Introduction

Sedimentation is a common problem in harbors, which reduces the required navigation depth and disturbs the vessels passage. In order to provide safe passage for vessels, frequent maintenance dredging in harbors is needed. The amount of maintenance dredging, which is the most expensive item in running costs of harbors, depends on the rate of sedimentation in harbor basin. For example, annual dredging costs of marinas in The Netherlands are estimated about M€500, as reported in [1]. As another case in point, The average annual dredging costs of federal navigation projects in United States between 1995 and 2000 was estimated to be about M\$500, as reported in [2]. Therefore, minimizing sedimentation in harbors is one of the major considerations in harbor design. Generally, sediments, transported into harbors by the action of 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. Therefore, harbor geometry, which considerably affects flow pattern inside the harbor, plays a crucial role in sediment transport and deposition pattern inside the harbor basin.

Recently, many attempts have been made to study sediment transport and measures for the reduction of sedimentation in harbor basins. Yin et al [3] conducted an experimental study on water and sediment movements inside square harbors under the effect of tidal and steady currents and suggested some general criteria that enhance flushing process in the harbor and consequently reduce the need for dredging therein. 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 basin, 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 (Germany). Yüksesek [6], conducted an experimental study on the effects of layouts of