DEFINING THE OPTIMAL DREDGING LEVEL FROM NAUTICAL VIEWPOINT

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Many access channels and harbours suffer from sedimentation and formation of mud layers. In order to keep navigation safe and economic, extensive maintenance dredging is required. Dredging, however, has its price, especially in muddy areas: the efficiency of dredging is reduced and dredging activities may affect the environment. Moreover, the bottom is hard to define as the mud layer acts as a transition zone between water and (solid) bottom. Therefore, the concept of the "nautical bottom", defined as "the level where physical characteristics of the bottom reach a critical limit, beyond which contact with a ship's keel causes either damage or unacceptable effects on controllability and manoeuvrability" (PIANC, 1997), was introduced.

Up till now the required level of dredging has always been based on the physical characteristics of the mud layer, which not necessarily results in efficient dredging. For the harbour of Zeebrugge the level corresponding with a density of 1150kg m^{-3} was adopted as the nautical bottom, based on rheologic characteristics. Ship behaviour, however, also matters and knowledge on ship manoeuvrability in muddy areas can be useful to redefine the nautical bottom and the level of dredging.

A comprehensive research project, consisting of model tests and manoeuvring simulation runs, was carried out in 2002-2004 at Flanders Hydraulics Research (Antwerp, Belgium) with the scientific support of Ghent University. The experimental program comprised captive manoeuvring tests with ship models in the towing tank for manoeuvres in shallow water, the bottom of which was covered with mud simulating material. Based on the test results, mathematical models were developed for performing full mission bridge simulations in varying bottom and under keel clearance conditions.

During the simulation runs, the Zeebrugge pilots could experience the behaviour of a 6000 TEU container carrier navigating above and in contact with mud. It was concluded that an increase of the critical density to 1200kg m^{-3} can be considered, possibly resulting into a reduction of maintenance dredging. On the other hand, sufficient tug capacity has to be available in order to guarantee safe manoeuvres.

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References

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