Squat in muddy navigation areas

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Abstract

The presence of a fluid mud layer on the bottom of a channel has a significant influence on ship behaviour in general, and squat in particular. Two effects play a dominant role:

- the pressure field around the moving hull causes undulations of the water-mud interface that themselves modify the distribution of vertical forces over the length of the ship and, therefore, sinkage and trim;
- if the ship's keel penetrates into the mud layer, the hydrostatic (buoyancy) force acting on the submerged hull increases due to the higher density of the mud.

The behaviour of deep-drafted vessels in muddy navigation areas has been investigated comprehensively at Flanders Hydraulics Research (Flemish Government, Antwerp) by means of self-propelled and captive model tests with models of a suction hopper dredger (1986-1989) and container carriers (2002-2004, 2008-2009). During these tests, the mud layer was simulated by a liquid with appropriate density and viscosity. The vertical motion of the ship model and the mud-water interface were measured during the tests.

The paper will provide a description of the phenomena that dominate the ship’s squat in muddy areas. It can be concluded that the average sinkage of a vessel navigating in muddy channels is generally reduced by the presence of mud layers, but the dynamic trim is affected significantly by the generation of interface undulations. For ships navigating above mud layers, the maximum sinkage is comparable to or slightly less than the values occurring if the mud layer were replaced by a solid bottom. Compared to the situation in which the mud layer is not present, however, the muddy bottom interface always increases the maximum sinkage, even in case of contact with the mud layer.