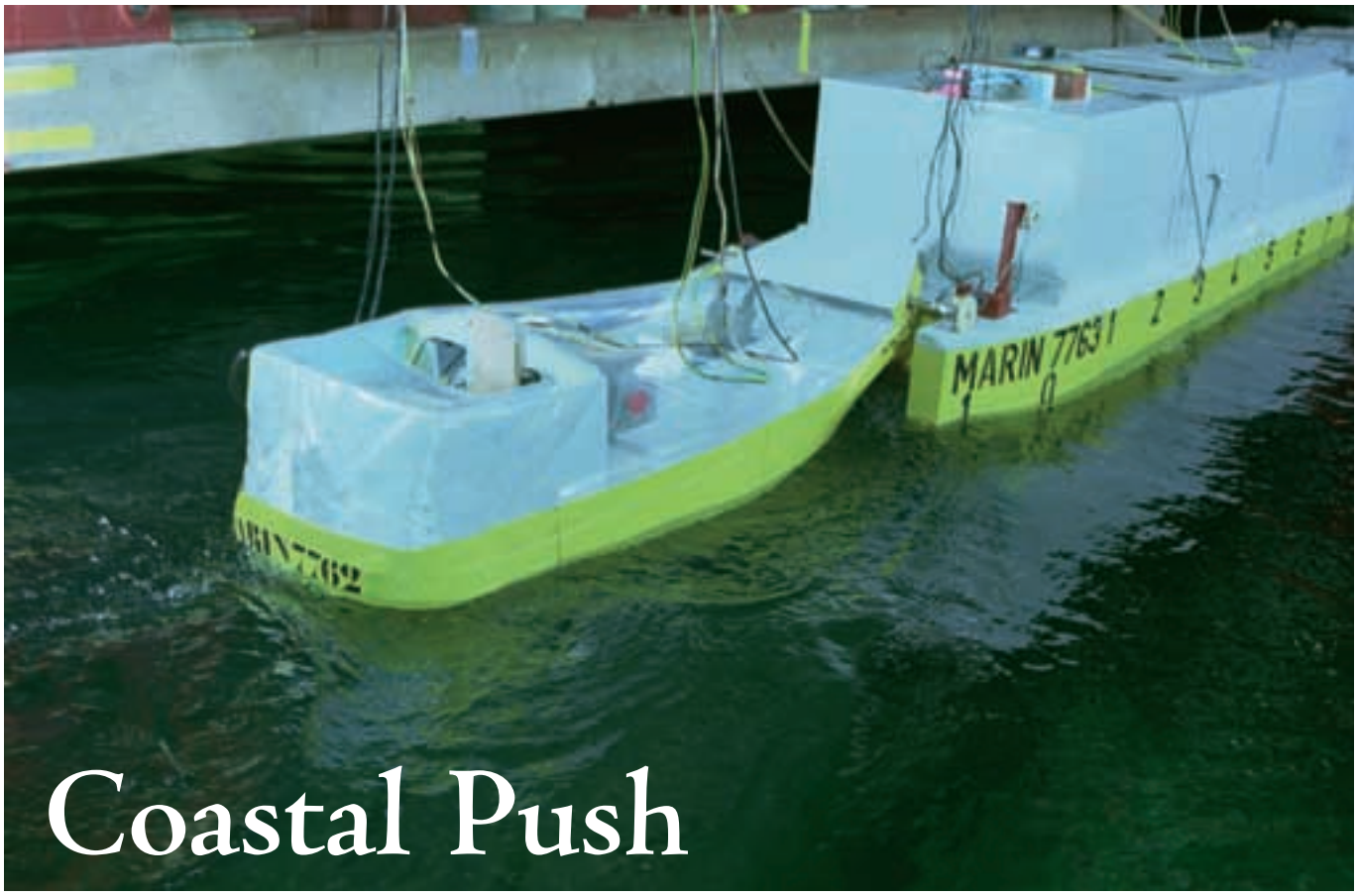
Irregular seas, wave defection 60 deg.
H = 3.75 m. T = 8.35 s.
Speed 10 knots



971129

Coastal Push Tug-Barge Development

In 1997 MARIN was involved in the design of an open-hatch tug-barge system that would eventually operate along the Belgian coast and in the Rhine River. The work, which was performed on behalf of Hessenatie Consult, concerned information about the loads on the coupling system and design verification in terms of the sustained speed and inflow of water under adverse weather conditions.

Reint Dallinga

The first stage consisted of calculations about resistance and behavior in waves. Issues explored were the effects of bow form and the shape of the notch on resistance, and the sustained speed, the effects of loading conditions and hinge height on coupling loads.

Model tests were used to check computer calculations and verify behavioral aspects that are less accessible by means of calculations - for example, the flow of water into hatchless holds - and to identify any unpredicted unfavorable characteristics. Tests were performed with a 'complete' free

running model with irregular waves coming from various directions. The combined results of calculations and tests were used to establish operability limits for the anticipated wave climate in terms of sustained speed, hinge loads, inflow of water, and crew comfort on board the tug.

Resistance and Propulsion

MARIN assisted in the design of the hull form. The constraints were container capacity, overall length and beam. This resulted in a large length-beam (L/B) ratio and a large block coefficient (0.96). To improve propulsion performance the sections were designed moderately V-shaped with large rounded transitions to the bottom. Further attention was paid to lifting the bottom near the notch to reduce resistance on the notch as much as possible. Computer calculations were performed to determine the tug's required power. These were then checked by propulsion tests in calm water.

Maneuvring

The initial hull was designed with a large L/B ratio. The related high course stability raised doubts regarding the turning ability and hence maneuverability.

Model tests

The calculated sustained speed and hinge loads were checked via tests with free-running models in regular and irregular waves. Measurements focused on cargo acceleration on the barge, the tug's pitch angles, related accelerations at the relatively high tug bridge, tug propeller thrust, and hinge loads. Another important focus was the flow of water into the barge's hatchless holds. In addition maneuvring tests were performed.

The model tests confirmed the nature of the calculated hinge loads; they showed the dominance of the barge's yaw motions over the related horizontal hinge loads. Consequently, the effects of loading condition and hinge height are relatively small.

Observations during the tests drew attention to the acceleration levels at the tug bridge in relation to crew safety and comfort. In the final operability assessment these factors proved to be an important aspect in the performance of the system in waves. MARIN

Irregular seas, wave direction 240 deg.
H = 3.75 m. T = 8.35 s.
Zero speed

970912