BANK EFFECTS

Forces, Moments and Motions Induced by the Vicinity of Banks on a Sailing Vessel

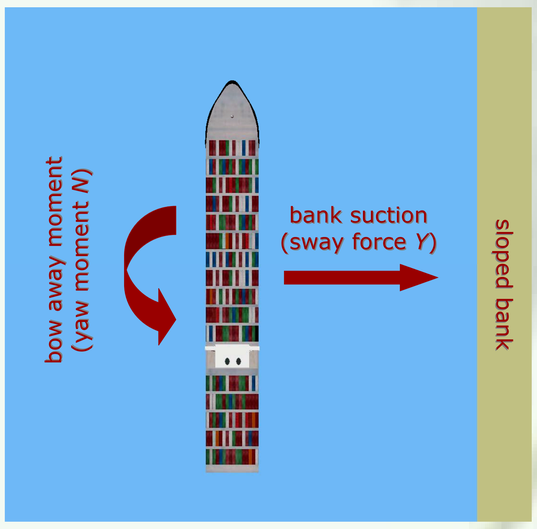
www.BANKEFFECTS.UGent.be

I. Banks, Bank Effects and Calamities

Two spots on the Flemish waterways where ships travel close to sloped and semi-submerged banks: *Sternenschiereiland* ↑ in the harbour of Zeebrugge and the *bocht van Bath* ↓ on the river Scheldt.

The asymmetric flow around a ship induced by the vicinity of banks causes pressure differences between port and starboard sides.

As a result, the whole ship tends to be attracted to (= bank suction *Y*), and her bow pushed away (= bow away moment *N*) from the closest bank.



Loss of controllability due to bank effects can cause severe damage and danger to people and environment.

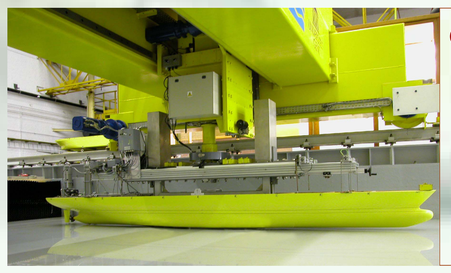
II. Experimental Program

Captive motion model tests are performed in the fully automated towing tank at *Flanders Hydraulics Research*

Input parameters:

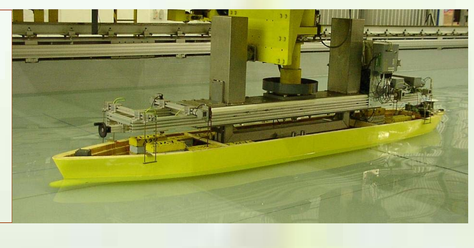
4 surface piercing banks ↑
slope 1/8, 1/5, 1/3, quay wall

5 sloped banks in combination with a submerged horizontal plate ↓



container carrier *Undine*
- scale 1/80
- length over all = 350m
- beam = 42.9m
- draught 1 = 12.0m
- draught 2 = 14.5m
- draught 3 = 13.0 – 14.5m
- displacement = ±130000m³

≈ 8000 TEU container carrier, frequents harbour of Antwerp



LNG-carrier *Mathilda*
- scale 1/70
- length over all = 280m
- beam = 41.6m
- draught = 11.0m
- displacement = ±95000m³

≈ Methania, built at *Boelwerf*, frequents harbour of Zeebrugge

Test Variables:

5 speeds
8, 10, 12, 14, 16 knots

4 propeller rates
0%, 40%, 60%, 80% of *sea full*

5 drift angles
-5.0°, -2.5°, 0.0°, 2.5°, 5.0°

Propeller Asymmetry

Rudder Angle

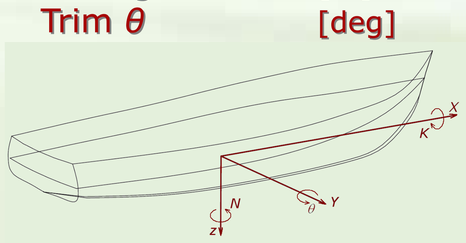
Water Depth
Undine: 10%, 35%, 100% UKC
Mathilda: 35%, 70% UKC

The combination of both ships at all draughts, all water depths, all banks, speeds, propeller rates, drift angles etc. creates the most extensive systematic data set ever executed on bank effects (± 11000 tests!)

Measured data:

Hull:

Resistance *X*	[N]
Sway force *Y*	[N]
Roll moment *K*	[Nm]
Yaw moment *N*	[Nm]
Sinkage *z*	[m]
Trim *θ*	[deg]



Rudder:

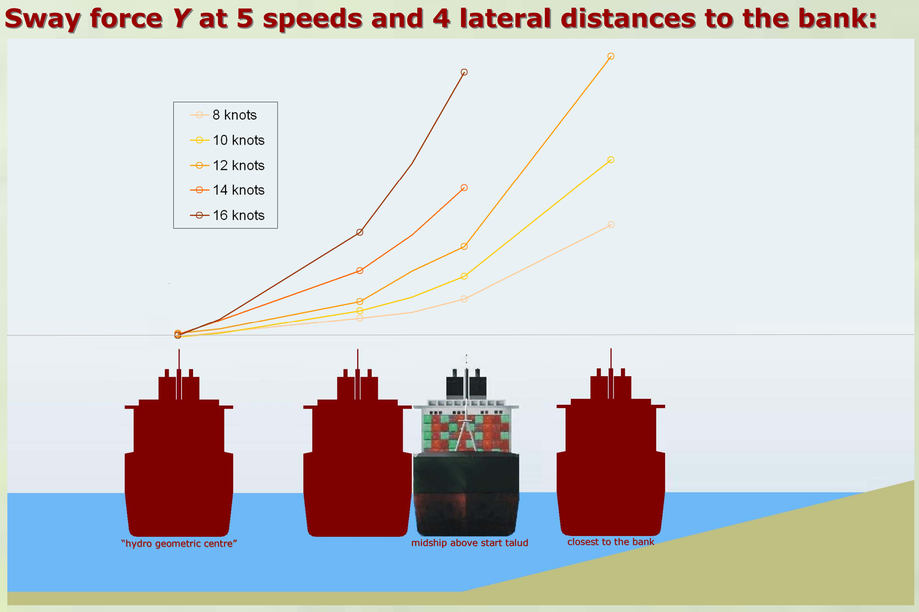
Lift L_R	[N]
Drag D_R	[N]
Torque Q_R	[Nm]
Rudder angle *δ*	[deg]

Propeller:

Thrust T_P	[N]
Torque Q_P	[Nm]
Propeller rate *n*	[rpm]

Water Surface:
Three wave gauges

Sway force *Y* at 5 speeds and 4 lateral distances to the bank:

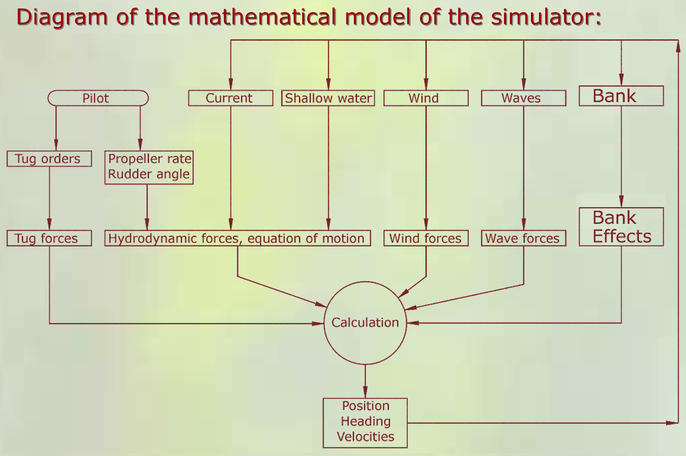


III. Mathematical Model and Validation

A mathematical model of bank effects will be created and incorporated in the full mission bridge simulators at FHR

State of the art full mission bridge simulator (property of FHR) for training purposes and research

Diagram of the mathematical model of the simulator:



The *Douro Queen* safely navigating close to steep banks

Ghent University, Faculty of Engineering, Maritime Technology Division
Technologiepark 904, 9052 Ghent, Belgium
www.maritiem.ugent.be
ir. Evert LATAIRE Evert.Lataire@UGent.be
Prof. dr. ir. Marc VANTORRE (supervisor) Marc.Vantorre@UGent.be
In co-operation with: Flanders Hydraulics Research (FHR)
Berchemlei 115, 2140 Antwerp, Belgium