

On hawser force criteria for navigation lock design

by T. De Mulder¹, K. Verelst, J. Vercruyse (Flanders Hydraulics Research)

W. De Cock (Maritime Access Division), M. Haegeman (Antwerp Port Authority)

ABSTRACT

1. OBJECTIVE

This contribution reflects upon the issue of hawser force criteria in (maritime) navigation lock design. An overview will be given of different methodological lines along which criteria have been proposed. Also the intricate relation with the available verification tools will be explored. Illustrations will focus on in situ measurements and numerical and scale modelling for the Zandvliet (LxW=500mx57m) and Berendrecht (LxW=500mx68m) locks situated in the Port of Antwerp (Belgium).

2. HYDRODYNAMIC FORCES

Traditionally, the design of a lock filling/emptying (F/E) system is investigated on a scale model. On purpose, the complexity of a real vessel positioning system is not accounted for. This leaves the question of acceptable hydrodynamic forces on the design vessel unanswered, unless operational experience with comparable locks proves a certain threshold value to yield an acceptable F/E-system.

3. WATER SLOPES

The hydrostatic force on a vessel is determined by the water surface slopes. Hence, water slopes are a means to quantify (the often dominant) part of the forces on a vessel. Water slopes can be measured (in prototype or scale model) or estimated by means of numerical models (with varying degrees of physical complexity and computational efforts). See Figure 1.

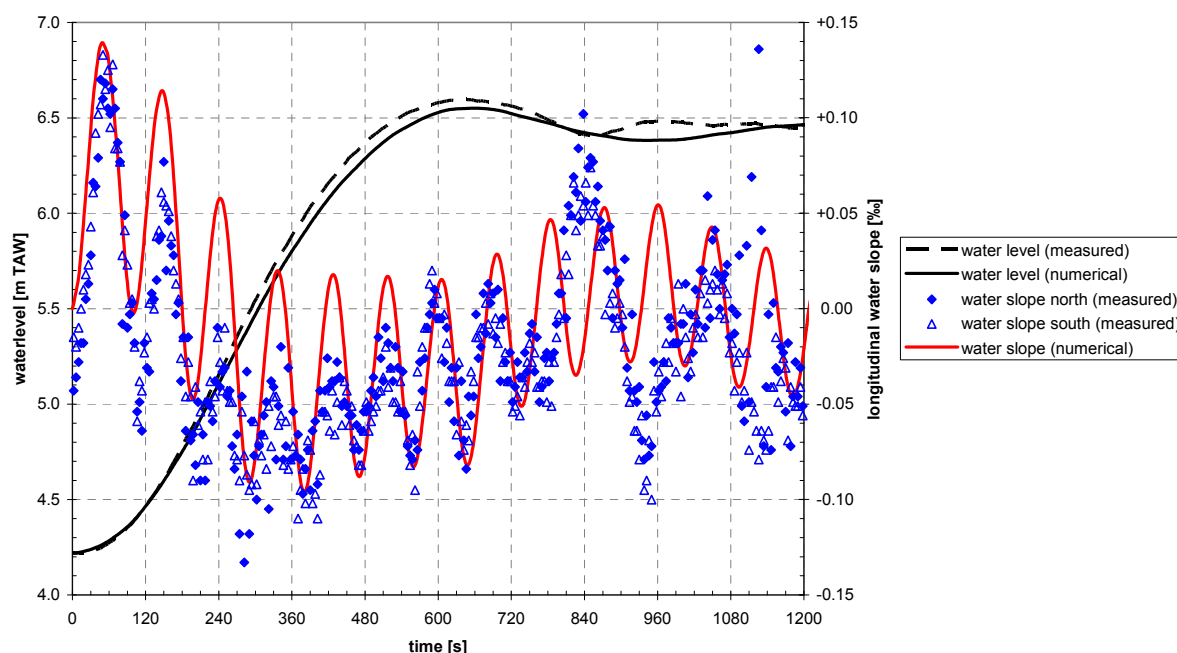


Figure 1: Comparison of in situ measurements and numerical modelling results for Berendrecht lock

4. MOORING LINE FORCES

Mooring line forces should be limited in order to prevent damage of the ropes and bollards. Along this line, both criteria and numerical verification models have been developed, which do take more realism of the vessel positioning system into account, yet at the cost of multiplication of input parameters.

5. COMFORT LEVEL

In the end, the 'comfort level' during lockage should be sufficiently high. This human perception is hard to quantify, no matter how sophisticated hawser force analysis tools have become. Moreover, many quantitative criteria might be too conservative, as some in situ measurements during and outside lock filling/emptying operations tend to suggest.

¹ tom.demulder@mow.vlaanderen.be