Field monitoring of ship-induced loads on (alternative) bank protections of non-tidal waterways

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Where in bygone days sound water management practices were geared to the facilitation of inland navigation and the absolute safety of the citizen against flooding, a more integrated water management policy altered the line of approach dramatically throughout the latest decades. Making space for water, runs the new slogan. Sustainable decision making and action taking is done considering multiple viewpoints. Nonetheless, civil engineering has a strained, dual relation with this modernised way of water management. On the one hand, people depend heavily on technical constructions to control a waterway; on the other hand, the use of technical design principles is not very appropriate in the new approach towards a more natural (re)design of the water system.

Taking into account the environmental aspects, a lot of attention is paid to the design of a softer form of bank protection, in which attempts are made to reconcile both the technical and biological requirements of the revetment. For a reasonable construction and maintenance cost, environmental benefits are increased and sustainable techniques are attained. But how effective are technical-biological bank protections in operation?

Our case study concerns the (alternative) bank protections along the river Lys in Belgium, which is situated in the northwestern part of the Scheldt river catchment. In the seventies, the watercourse was straightened and canalized to allow inland navigation up to CEMT-class IV. Nowadays, on demand of the inland navigation sector, vessels up to CEMT-class Va are allowed as a provisional measure. Due to the intensive navigation the rigid armoured concrete revetment is undermined, which results in progressive bank erosion (Figure 1a).

Within the framework of the development of a trans-European transport network (TEN-T), the upgrading of the connection between the Scheldt and Seine river basins is proved to be an advantageous investment. With regard to the river Lys, this revaluation implies the deepening of the profile in order to gain a narrow (one-way traffic) profile for vessels up to CEMT-class Vb. To tackle the bank erosion problem, a softer technical-biological revetment type, i.e. timber piling in combination with reed, is opted for, as part of a large Lys river restoration plan (Figure 1b).

Commercial navigation generates maximum hydraulic forces on the upper half of the bank protection, around the still water level. Although the duration of the wave train of a ship is very limited, it is a complex wave system, consisting of different components which are frequently superimposed. Its characteristics, such as propagation directions, wave heights, and wave periods alter with ship design and navigation orientation and interact with topographic boundaries and local hydraulic conditions. As a result, theoretical calculations of the ship-induced loads on a specific embankment are not straightforward. Accordingly, field measurements provide a welcome alternative for the determination of these forces.

As part of a research project regarding the design of alternative bank protections, we developed a prototype monitoring system along the river Lys at Zulte, Belgium. It is instrumented to acquire field data of the ship wave characteristics, the bank directed slope supply currents and the impact of the ship wave climate on the technical-biological bank protections. The layout of the monitoring system, the applied measurement techniques and the data acquisition process are elaborately described in the paper together with the prospects of the ongoing field campaign.

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