RCEM 2019

THE 11TH SYMPOSIUM ON RIVER, COASTAL AND ESTUARINE MORPHODYNAMICS

BOOK OF ABSTRACTS

AUCKLAND, NEW ZEALAND
16TH–21ST NOVEMBER 2019

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Bottom stress and hydrodynamics: field study on Perkpolder (NL)

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1. Introduction

A big part of The Netherlands territory is below sea level; for this reason, a lot of lands have been reclaimed through the years by means of the creation of polders. However, this process caused the loss of intertidal areas, that are essential for the safeguard of natural habitats. From the last century the European governments provided the depoldering of some areas. The study area (Perkpolder, NL, located in the Western Scheldt) it is one of these pilot locations. The morphology and the evolution of the entire area and of the channels network have been influenced, over the last four years (since the tidal basin was created), by the local tidal conditions inside the basin. These conditions, in turn, determine the flux of sediment, nutrients and biota. With the aim to evaluate the hydrodynamic condition and its effects on sediment transport in the Perkpolder area, water velocity and depth have been continuously measured in six different locations in the Perkpolder area, four in the channels and two in the mudflat

2. Bed Shear Stress (BSS) and critical bed shear stress calculation

Starting from the velocity measurements, the BSS and the critical values of the BSS, on both mudflat and channels, have been evaluated according to two different approaches suggested by van Rijn: the formula used for the BSS is (van Rijn, 1984):

$$\tau(t) = \frac{\rho}{c^2}\bar{u}(t)^2 \qquad (1)$$

Where ρ is the density, $\bar{u}$ is the horizontal velocity averaged on the vertical and c is the adimensional Chézy coefficient, while the critical values of the BSS have been calculated by taking into account the cohesion and the packing effect, as explained in the formulas (van Rijn, 2007):

$\mathrm{d}_{50} < 62\mu\mathrm{m}$

$$\tau_{cr,bed,fine} = \left(\frac{d_{sand}}{d_{50}}\right)^{0,5} \tau_{cr,0} \qquad (2)$$

$$\tau_{cr,bed,sand} = (1 + p_{cs})^3 \tau_{cr,0} \qquad (3)$$

$\mathrm{d}_{50} > 62\mu\mathrm{m}$

$$\tau_{cr,bed} = (1 + p_{cs})^3 \tau_{cr,0} \qquad (4)$$

Where $\mathrm{d}_{sand} = 62\mu\mathrm{m}$, p_{cs} is the percentage of clay and silt and $\tau_{cr,0}$ is the critical BSS calculated without considering the cohesion and the packing effects.
The values as obtained have been compared to evaluate the sediments transport capacity of the water flow.

3. Tidal Phase Prevalence Index (TPPI)

To have a better qualitative factor, that allows to compare the impact of the water flow, both in ebb and flood phase, and the behaviour of the different cross sections, a new parameter has been introduced.
This parameter is called "Tidal Phase Prevalence Index" (TPPI) and it is expressed through the following equations:

for $\theta > \theta_{cr}$

$$TPPI = \frac{1}{T/2}\int_0^{T/2} (\theta - \theta_{cr})\, dt \qquad (5)$$

for $\theta < \theta_{cr}$

$$TPPI = 0 \qquad (6)$$

Where T is the tidal period, θ is the Shields parameter and θ_{cr} is the critical Shields parameter.
Since θ_{cr} and, consequently, the TPPI value depends on the equivalent *Nikuradse roughness* K_s, a sensitivity analysis has been carried out changing the value of K_s.
In the table below the TPPI values calculated with the K_s value suggested by van Rijn are reported:

Ks	Measurement Point	$d_{50} < d_{sand}$				$d_{50} > d_{sand}$	
		TPPI fine flood	TPPI fine ebb	TPPI sand flood	TPPI sand ebb	TPPI flood	TPPI ebb
D90*3	BC3_1	0.323	0.301	0	0	NA	NA
	AC3_1	0.23	0.214	0	0	NA	NA
	BC4_1	NA	NA	NA	NA	0.002	0.002
	AC2_1	NA	NA	NA	NA	0	0
	MC2_1	NA	NA	NA	NA	0	0
	MC2_2	0.009	0.007	0	0	NA	NA

Table 1: TPPI values

4. Conclusions

The bed shear stress results much higher in the channels than on the mudflat. The sediment dynamic on the mudflat are dominated by deposition, whereas in the channels are governed by erosion, and it is in agreement with the observed morphological evolution. Mudflat and channels, are still getting modified by the action of the water, making difficult the vegetation engraftment. TPPI gives a qualitative indication about erosion-deposition rate TPPI values confirm that the intertidal basin is characterized by a flood dominance.

References

van Rijn L. C. (1984). *'Sediment Transport, Part I: Bed Load Transport'. Journal of Hydraulic Engineering* 110(10):1431–56.

van Rijn L. C. (2007). *'A Unified View of Sediment Transport by Currents and Waves, Part 1: Initiation of Motion, Bed Roughness and Bed Load Transport'. Journal of Hydraulic Engineering,* 133(6):649-667