A1: Hydraulics and morphology of longitudinal training dams

Project:	**A: Optimizing longitudinal training dam (LTD) design**
Researcher:	Timo de Ruijsscher
Project leader:	Dr ir Ton Hoitink
Supervisors:	Dr ir Ton Hoitink, dr ir Bart Vermeulen, prof dr ir Wim Uijttewaal, dr ir Erik Mosselman, prof dr ir Remco Uijlenhoet (Promotor)
Started:	03 2015
Contract until:	03 2019

timo.deruijsscher@wur.nl

Research description

In the Dutch river system, measures are taken to keep the river system sustainable for the future. One way of doing this, is by replacing transverse groynes in the inner river bend by so-called longitudinal training dams (LTDs, see Figures 1–2). As a pilot project, LTDs are constructed over a ten-kilometre stretch in the Waal River. LTDs are expected to reduce long-term subsidence, increase the lowest water levels, increase the discharge capacity during floods and create ecologically more favourable conditions. However, existing knowledge about the effects of LTDs on erosion/deposition and regional flow patterns is highly limited.

The main aims of this research are to understand (a) the effect of the intake geometry of an LTD on the morphological patterns and associated flow structures in the inflow region, (b) the morphodynamic evolution of the bed in both the main channel and the side channel after construction of an LTD, (c) the dynamic behaviour of subaqueous dunes in the Waal River, and the influence of the LTD construction thereon and (d) the physical mechanisms governing exchange processes in LTD gaps. To achieve these goals, both physical scale model experiments and field measurements will be used.

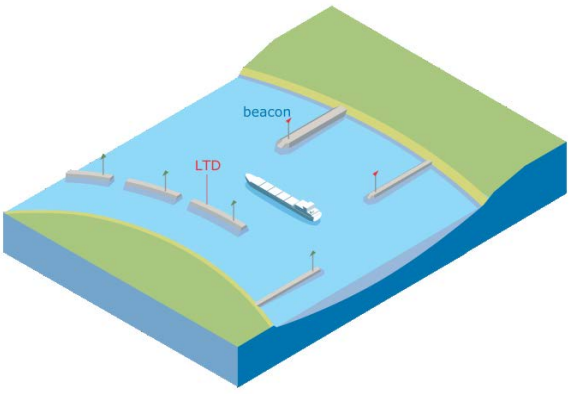

Figure 1. Schematic view of an LTD and the remaining groynes, adapted from (Rijkswaterstaat 2012).

Figure 2. The LTD in the Waal River near Ophemert, looking upstream. Picture from Rijkswaterstaat Oost-Nederland.

Results

In order to prepare the physical scale model experiments in the Kraijenhoff van de Leur Laboratory for Water and Sediment Dynamics at Wageningen University, a 1:60 physical scale model is built (see Figure 3). Scaling analysis is based on previous work by Vermeulen et al. (2014), including the use of polystyrene lightweight granules, as substitute sediment. To study the bed forms and their evolution during experiments, a new measurement approach has been developed (De Ruijsscher et al., in prep). A so-called laser line scanner consists of a laser projecting a line on the bed (see Figure 4). The reflected signal is picked up by a 3D-camera and the bed profile is reconstructed. Problems that occur using this method are data scatter and missing data. Both are reasonably resolved by using a fitting algorithm called LOESS (Cleveland & Devlin 1988), which also appears to be a useful tool for filtering bed forms of different spatial scales.

Figure 3. Scale model of the upstream section of a longitudinal training dam (1:60) in a 2.5-metre-wide flume in the Kraijenhoff van de Leur Laboratory for Water and Sediment Dynamics in Wageningen.

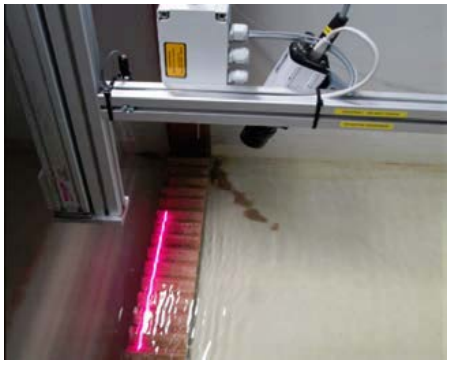

Figure 4. Laser line scanner set-up. A red laser line is projected on the bottom of the flume, which reflection is recorded by a 3D camera (top right).

Next steps

As the preparations in the lab are nearly completed, the scale model experiments will start in September. Field surveys including ADCP measurements will be carried out at the LTD near Ophemert starting autumn 2016. Two horizontal ADCPs and optical backscatter (OBS) devices will be mounted at a traffic pole at the upstream side of the Ophemert LTD. Finally, end of 2016 the first data gathered by Rijkswaterstaat will be accessible, which allows analysis of the morphological data.

References

Cleveland, W.S. & Devlin, S.J., 1988. Weighted regression: an approach to regresion analysis by local fitting. Journal of the American Statistical Association, 83(403), pp.596–610.

Rijkswaterstaat, 2012. Infographic: Kribverlaging en langsdammen van de Waal. Available at: https://www.ruimtevoorderivier.nl/project/kribverlaging-en-langsdammen-waal.

De Ruijsscher, T.V., Dinnissen, S., Vermeulen, B., Hazenberg, P., Hoitink, A.J.F. (in prep). Application of a line laser scanner for bed form tracking in a laboratory flume. Water Resources Research.

Vermeulen, B. et al., 2014. River scale model of a training dam using lightweight granulates. Journal of Hydro-environment Research, 8(2), pp.88–94