HOW VEGETATED FORESHORES CAN CONTRIBUTE TO LIMITING DIKE DIMENSIONS OF SEA DIKES

A CASE STUDY INTO THE ASSESSMENT AND DESIGN PROCEDURE OF INCLUDING THE QUANTITATIVE EFFECT OF THE FORESHORE IN THE FLOOD DEFENCE SYSTEM

Since the magnitude of the effects of climate change is still uncertain, there is a great need for primary flood defences to be adaptive to effectively respond to the changing boundary conditions. Due to the self-organising behaviour of ecosystems, there is more often looked for solutions that work together with nature resulting in Nature-based flood defences. An example of such a Nature-based flood defence is the Wide Green Dike (WGD) pilot study in the Ems-Dollard estuary in The Netherlands which is used as a case study for the research. The WGD is being reinforced with a thick clay layer on the seaward side while also decreasing the outer dike slope to fulfil the safety standards against erosion. Besides the adaptive capacity of this reinforcement, the wide vegetated foreshore can grow along with Sea Level Rise (SLR) and mitigates wave conditions by increased bottom friction. In doing so, the vegetated foreshore lowers the hydraulic boundary conditions at the WGD. The above-described processes are visualised in Figure 1:.

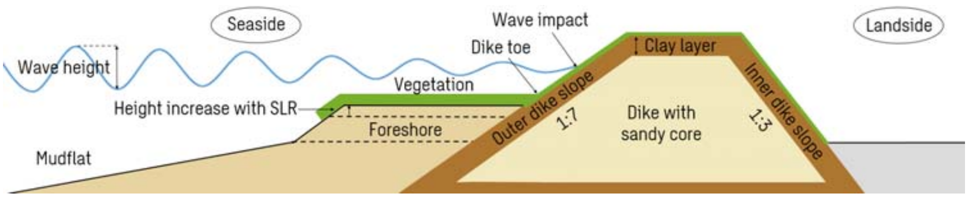

Figure 1: Visualisation WGD pilot study

With the use of a SWAN model, a sensitivity and thereafter scenario analysis was conducted to determine (the sensitivity of) the significant wave height at the dike toe under different model and foreshore settings. Hereby, it could be concluded that the foreshore potential depends on the ability of the foreshore to pace with SLR and the presence of vegetation which causes increased bottom friction.

When comparing the required dike dimensions for the standard scenario, while not taking into account foreshore height increase or the influence of vegetation (scenario 1), with the required dimensions when taking those processes into account (scenario 4), a required height decrease of 22 cm and clay layer thickness decrease of 31 cm arises for an outer dike slope of 1:5. As seen in **Error! Reference source not found.**, the dike dimensions significantly decrease when the outer dike slope is decreased.

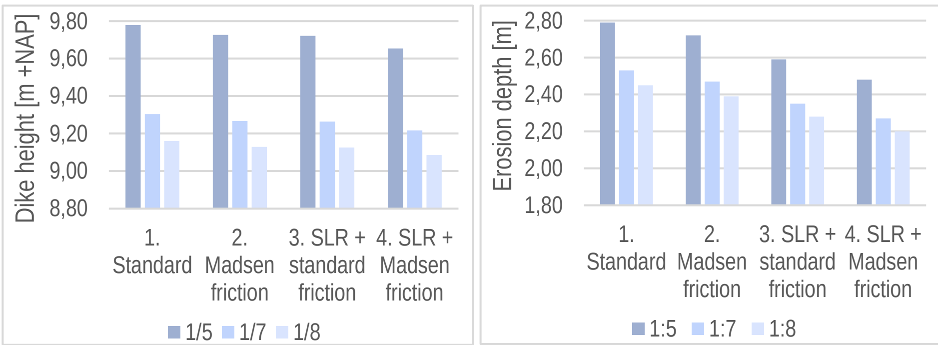

Figure 1: Required dike dimensions for different scenarios

In the current assessment and design procedure, it is possible to include changes in wave conditions for the last 100 m of foreshore. However, since the foreshore can be more than 500 m wide, other approaches are suggested which can include the foreshore potential over the full width of the foreshore. Although these approaches request more effort to implement, they might be necessary for the design of future foreshore-dike systems.

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4 August 2022

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