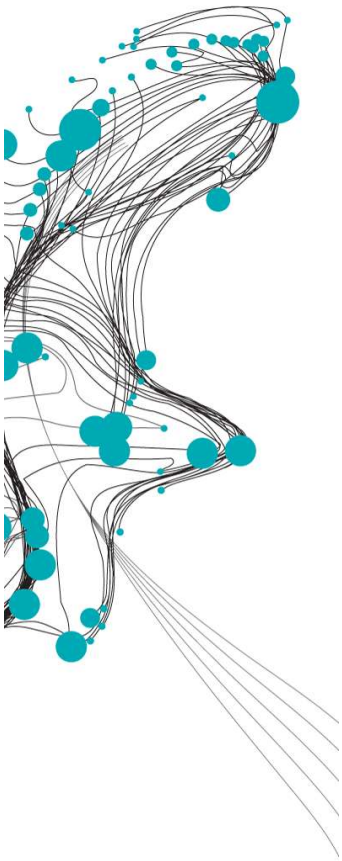
Feasibility assessment of a grass cover dike in a coastal wetland setting

Towards a design tool



Recently new Dutch flood safety standards came into effect. These new safety standards require dike reinforcements for a large part of the Netherlands. Therefore, high investments and the urge for innovative, sustainable solutions are needed. Accordingly, flood protection projects in the Netherlands have shown interest in adopting nature, biodiversity and climate change into their design solutions. Within these solutions, coastal wetlands are considered to have high potential to reduce wave loads on conventional coastal structures such as dikes and dams. Additionally, dikes that are entirely covered in grass on the waterside slope add to the biodiversity, compared to conventional hard revetments. The aim of this study is to assess the feasibility of a grass cover dike in combination with a coastal wetland in front of it. Herein, the feasibility depends on two factors, namely the erosion depth of the grass and clay layers as well as the required costs for construction and maintenance.

The research is divided into two parts. The first part is a numerical analysis (OpenFOAM) extending the current knowledge on the effect of the slope angle on the wave impact load. The second part combines the gained knowledge on the erosion of grass and clay with an assessment on geometric wetland configurations, presented in a design tool. Using this tool, the following three dike design scenarios for the Koehool-Lauwersmeer dike trajectory at the Wadden sea are tested on their feasibility as a case study: (i) gentle grass cover dike with a large vegetated foreshore, (ii) traditional dike versus a grass cover dike with a small vegetated foreshore and (iii) traditional dike versus a grass cover dike with foreshore construction by brushwood dams.

The result of the first part of the study confirms a linear trend between the slope angle and the wave impact load. The second part shows the potential of a grass cover dike with a wetland in front of it, whereby important wetland conditions appear to be the inundation depth and critical orbital velocity for stem breaking. The results of the first scenario in the case study do not reject the grass cover dike, considering a gentle dike slope of 1/8 with a vegetated foreshore. For the second scenario, a grass cover dike solution is more cost-effective than the traditional dike design. Considering foreshore construction for the last scenario, a minimal vegetated foreshore width of 350m would have evident impact on the wave height reduction allowing for a grass cover dike. However, continuous maintenance costs make the brushwood construction relatively expensive compared to the traditional dike design.

To conclude, the feasibility assessment in the form of a design tool, demonstrates for the Koehool-Lauwersmeer dikes that a grass cover dike in a wetland setting is possible and more cost-effective than conventional hard solutions. It is recommended to consider the design tool in the preliminary design phase of a dike. Furthermore, a first step was taken towards the practical implementation of coastal wetland research in the form of a design tool. Reducing the uncertainty in the long-term morphological development together with integrating plant specific stability will extend and improve the design tool.

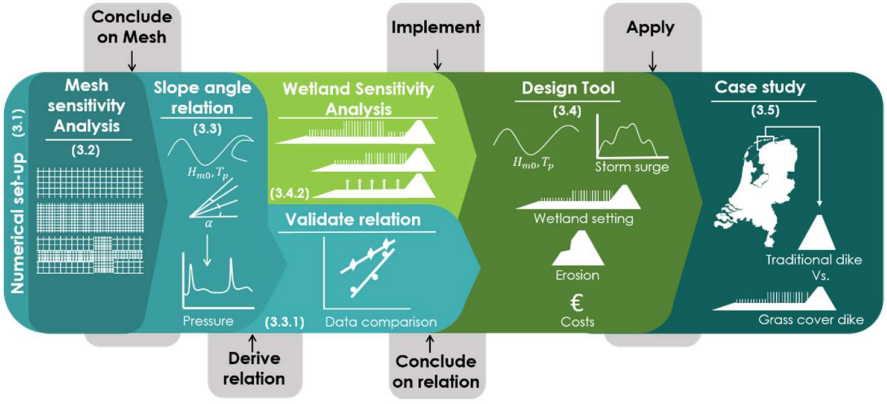


Figure 1: Methodology

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18 September 2020

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