THE EFFECT OF INFILTRATION BY WAVE OVERTOPPING ON THE MACRO-STABILITY OF A DIKE

Water in the dike has an effect on the macro-stability of a dike, but it is not known what the contribution of infiltration by wave overtopping is to the phreatic conditions of the dike and how these conditions affect the macro-stability. A better understanding of this topic may save both space and costs in dike design.

The research is conducted based on a case study; a dike cross-section along dike trajectory 48-1, which leads from Spijk to Westervoort. The case location provides the dike geometry and hydraulic boundary conditions for the research.

A sensitivity analysis on different important parameters is performed using GeoStudio: Seep/W. This model simulates groundwater flows in the dike as a result of both high water levels and infiltration by wave overtopping. As a result of infiltration by wave overtopping, the phreatic line takes on an oval shape, within which the soil is unsaturated (see Figure 1). This unsaturated zone shrinks over time. The rate of decrease of the unsaturated area is used as a representative value for the sensitivity analysis. Important parameters to take into account in the assessment of infiltration by wave overtopping are the saturated hydraulic conductivity, the saturated water content and α from the van Genuchten equations. Also, the time during which the inner slope is wet is important. While the rate of infiltration is an unknown in this model, it is not important, as it can be set equal to the saturated hydraulic conductivity of the soil. Finally, cover layer characteristics are very important to take into account.

Using D-Stability, a relation is found between the area of the unsaturated zone and the safety factor for macro-stability for four material types. However, because the number of scenarios considered is limited, the found relation cannot be assumed to always be valid. Instead, it is recommended to perform macro-stability analysis manually.

Following from this research, a method is proposed to include infiltration by wave overtopping in the assessment of the macro-stability of a dike. In this method, the time until full saturation is estimated based on input parameters as listed above. A comparison between this duration and the normative duration of wave overtopping yields an indication on whether or not to take wave overtopping into account in the assessment of macro-stability. The macro-stability assessment can then be performed as usual.

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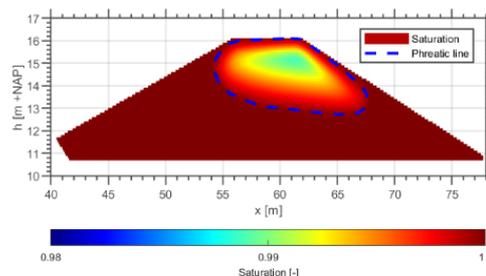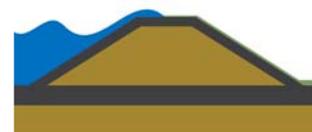dr. H. Cheng

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Figure 1: Example of oval shaped unsaturated zone

Figure 2: Schematisation of a dike

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