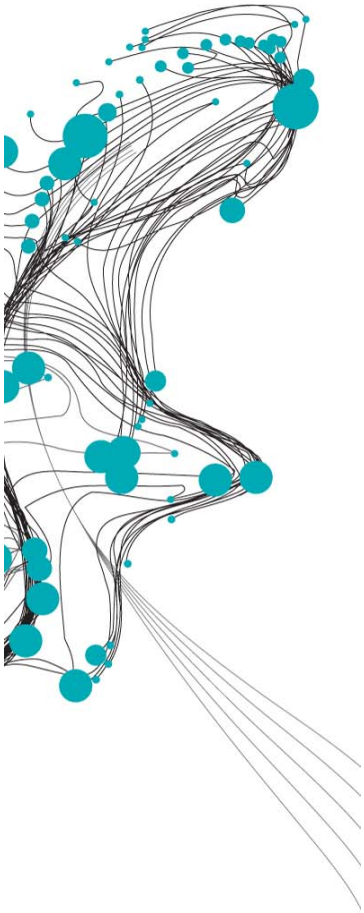
MACRO-STABILITY SAFETY ASSESSMENT FOR FLOOD DEFENSES WITH BURRIED PIPES



A growing demand for multifunctional flood defenses causes the direct need for more knowledge and understanding of the effects of a structure located inside a flood defense, called transition, to the physical condition of this flood defense (van Loon-Steensma & Vellinga, 2014). Constructors and policy makers do at the moment not have a complete understanding of the direct implications on safety caused by transitions (Morris et al., 2012). This leads to the situation concepts of multifunctional flood defenses will not be approved or executed. Therefore the goal is to deliver geotechnical information which predicts the safety of a flood defense under influence of a transition during an extreme loading situation. Focus of this research is mainly on making a model which predicts the effect of a buried pipe on the development of macro-stability failure mechanism since the structure element pipeline is in present-day one of the mostly applied structures within dikes (Finsbury, Steven L. Stockton, & Loudiere, 2013).

The geotechnical conditions, which provide information about the effect of a pipeline on macro-stability, are simulated with a 2D coupled model build in the finite element software COMSOL 4.4. This model applies a coupled combination of a Darcy model for modelling the flow of water in the porous media and a Drucker-Prager linear elastic perfectly plastic model for modelling the soil displacements in the soil skeleton. Validation of the model is performed using the data of the Southdike, an IJkdijk real scale experiment.

The model predicts the characteristic of the pipe such as location, size, material and the content of the pipe influence the development of the macro-stability failure mechanism. The change in safety condition of the macro-stability failure mechanism cannot be addressed solely to a single characteristic of the pipe. The soil conditions and the loading conditions also have a significant influence to the effect of the pipe on the safety condition of the macro-stability failure mechanism.

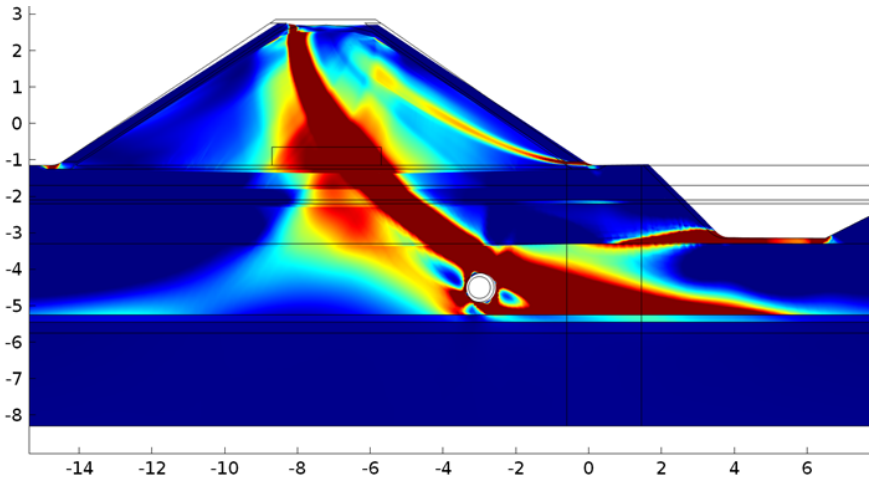


Figure 1: Calculated potential slip circle of the Southdike with the inclusion of a pipe in COMSOL

The general conclusion is that for certain conditions, the characteristic of the pipe has a positive influence on the development of macro-instability.

Finsbury, R. H. L. S. of, Steven L. Stockton, P. E., & Loudiere, D. (2013). *The International Levee Handbook*. (U. A. C. of Engineers, Ed.). London: CIRIA.

Morris, M., Benahmed, N., Phillippe, P., Royet, P., Tourment, R., Ham, G. van den, & Beek, V. van. (2012). *WP 3 : Reliability of Urban Flood Defences*. Brussel.

Van Loon-Steensma, J. M., & Vellinga, P. (2014). Robust, multifunctional flood defenses in the Dutch rural riverine area. Natural Hazards and Earth System Science, 14(5), 1085–1098.

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