

BSc/MSc-thesis topic - Crack estimation in levees based on soil moisture and deformation
A case study in Flood Proof Holland

Clay and peat soils respond to natural hydrological cycles of precipitation and evaporation with reversible deformations, or swelling and shrinking of the soil. This swelling and shrinking is a result of variations in water content in the soil (Stewart et al, 2016; Camporese et al., 2006). During dry periods, cracks can form in the soil. Cracks can lead to increasing the infiltration rate and hydraulic conductivity of the soil (Zhan, Ng & Fredlund, 2007). From a flood risk perspective this phenomenon is interesting, as cracking of soil could undermine the structural integrity of earthen levees (Vardon, 2015).

Located on the south direction of TU Delft, there is an area equipped as a small scale testing-polder, so field tests can be performed. This area, called Flood Proof Holland (FPH), consists of basins in which water can be discharged by opening a sluice. Several innovations have been tested here, like the TubebARRIER (Figure 1).

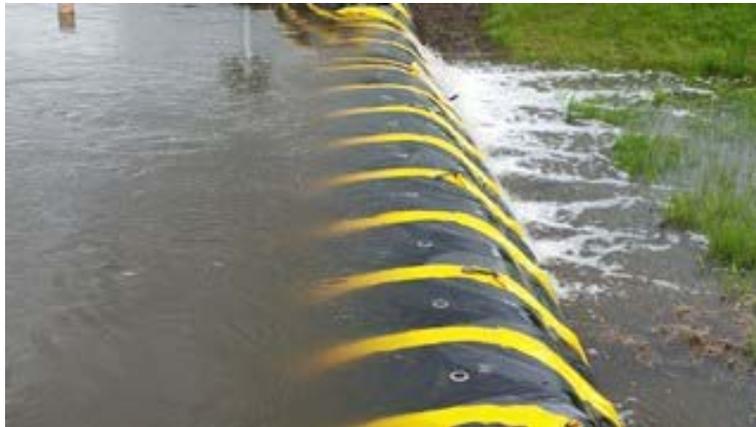


Figure 1. TubebARRIER (source: <http://www.tubebARRIER.nl>)

It appears that in the levees present in FPH cracks start to occur (Figure 2). This creates an interesting opportunity to investigate crack behaviour in levees in the field. Stewart et al (2016) present a promising model that predicts soil shrinkage, subsidence and cracking (in clayey soils) based on soil moisture conditions. This model can be tested on the levee in FPH to assess its applicability on levees.

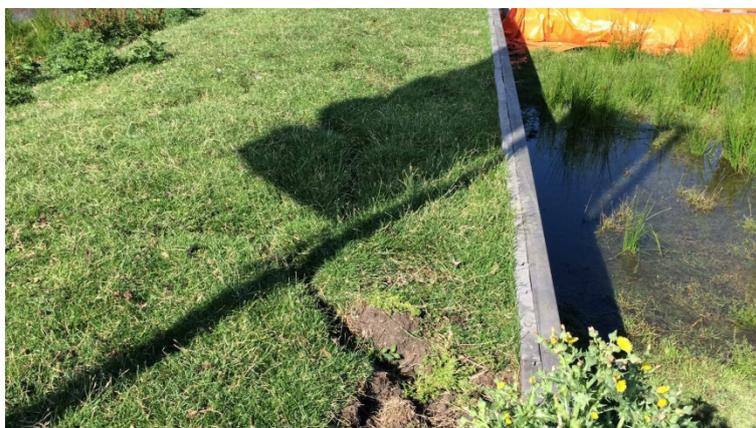


Figure 2. Cracked soil in a levee at FPH, Delft.

For further analysis field observations are needed on soil moisture conditions, vertical deformation (subsidence) and crack development in time. Furthermore, lab tests of the soil in FPH that measure

the void ratio of the soil sample as a function of the volumetric water content. This so-called 'soil shrinkage curve' is important input for this model.

The aim of this thesis is to investigate the applicability of various models (such as the model by Stewart et al. 2016) and techniques to predict cracking in levees. The use of field observations in FPH in combination with deformation observed from inSAR satellite images and a hydrological model can be used to verify different models.

Finally, it will be investigated (and modelled) how cracking affects the safety of levees. The case of the observed cracking in Flood Proof Holland will be used as a reference / validation case.

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Literature

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