Modeling of asphaltic dike revetments under wave loading (Experimental tests and DEM modeling)

B.Sc or M.Sc. Thesis Project

Goal: To study the mechanical behavior of a dike made of an asphalt plate and subsoil, experimentally and numerically by using Discrete element method.

Motivation: In the Netherlands, 600 km of the sea dikes are protected by an asphaltic revetment that has to resist considerable wave loads with a significant wave height of up to 4.5 m. The subsoil is normally sandy, and the asphalt layer acts as a protection against erosion. The asphalt layer can fail as a result of fatigue due to repeated loading under storm conditions. In case of very high wave loads, the asphalt can fail after a few large waves. Ageing of the asphalt has a large effect on the resistance against fatigue. Therefore, periodic monitoring is prescribed by law. This monitoring consists of: falling weight deflection measurements, lab testing, radar measurements, visual inspection and calculations with the software program 'Wave impact' ('Golfklap') in order to determine the strength under storm conditions. An important aspect in the assessment of the safety of the asphalt revetment under wave attack is the mechanical model of the asphalt plate lying on the subsoil, generally consisting of sand. It has been understood that neither FEM (Finite Element Method) nor DEM (Discrete Element Method) would be sufficient to express the asphalt behavior.

In this study, numerical discrete element simulations are conducted to estimate the mechanical behavior of dikes made of asphalt. To calibrate and validate numerical models, experimental samples are prepared for some element tests for asphalt and subsoil separately and together. The numerically observed mechanical response of asphalt together with subsoil is then further studied through an other numerical modeling approach (FEM).
This research is in collaboration between UTwente, TU Delft and Deltares.

Figure 1: Dikes along a sea side

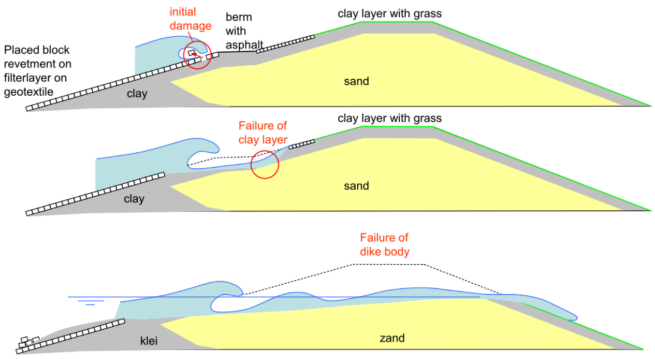

Figure 2: Failure of a sea dike under wave attack

Agenda:

- Literature review, research plan and questions
- Introduction to Discrete Element Method
- Modeling of dike surface and subsoil using Discrete Element Method
- Discussions, presentations and writing thesis (i.e, a scientific paper)

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