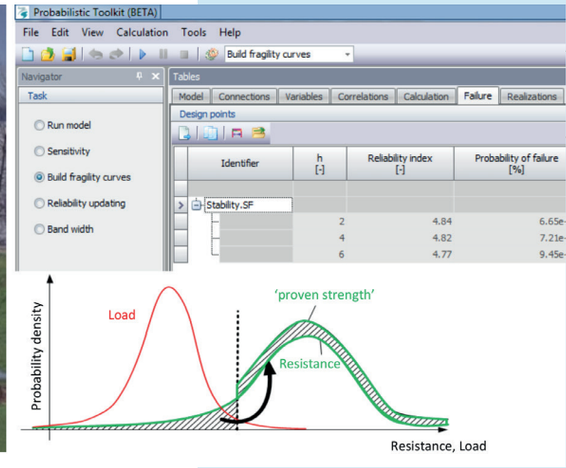
Contact

timo.schweckendiek@deltares.nl
T +31(0)6 1328 5445

Using past performance for updates of dike reliability

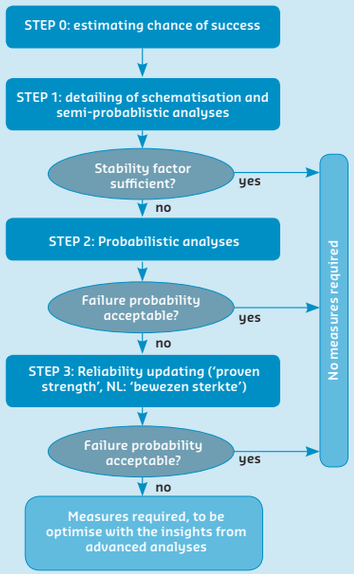


Reliability updates for dikes involve including observations of past performance in estimates of a dike's present reliability. In this project, reliability updates were made operational by developing the method, applying it to specific cases, building software and drafting manuals. As Dutch dikes have already typically endured significant load conditions, the reliability updating method is expected to have a major impact.

Dike-slope stability is a relatively important failure mechanism in the Dutch assessment framework for primary flood defences. The last round of assessments in 2011 identified many dikes that failed to meet the safety requirements for slopes.

In a dike assessment, the estimated probability of failure based on a slope stability analysis can be compared directly with the target probability of failure for a specific dike section as defined in the statutory assessment of Dutch primary flood defences (the Statutory Assessment Instrument, WBI-2017). The assessment involves a semi-probabilistic approach or a fully probabilistic approach (in Dutch: gedetailleerde toets).

As in most geotechnical problems, the assessment of slope stability is typically dominated by major uncertainties relating to soil properties, often resulting in rather high estimated probabilities of failure by comparison with the actual failure rates observed in the field. If a dike section does not comply with the target failure probability using semi-probabilistic and fully probabilistic approaches, observations of past performance, such as non-failure after significant loading, can be incorporated to improve the probability estimates. The analyses for reliability updates are advanced assessments (in Dutch: toets op maat).



The R&D projects for reliability updating in 2016 included both the development and documentation of the method, the accompanying software (Probabilistic Toolkit) and the demonstration of applicability in realistic test cases. A secondary objective was to generate insights that can help to assess the potential effect on the updated reliability estimates for typical conditions. The test cases included dike sections along the Markermeer dike and the Krachtige IJssel dikes Krimpenerwaard (KIJK), and they used a level of detail and complexity which was representative for real-life conditions. A simplified approach with fragility curves (reliability as a function of outside water level) was introduced so that practitioners can match slope failure probabilities to field observations. All the cases confirmed that the results obtained with the simplified approach are a reasonable match with the results obtained using conventional reliability methods such as Monte Carlo simulation.

The method was developed and applied in test cases in 2016. Its success and positive international peer-review comments mean that it is on the verge of being applied in real projects with water authorities in the Netherlands in 2017.

Further reading:
Schweckendiek & Kanning (2016). Reliability updating for slope stability of dikes. Approach with fragility curves (background report). Deltares report 1230090-033-GEO-0001.