



DAM

Dike strength Analysis Module

Automated, autonomous evaluation of the strength of dikes, levees and dams

With increasing economical investments in flood prone areas, flood risk management is a hot topic in many deltas and lowlying areas around the world. With ever changing climate, public acceptance of risk, changes to the built environment or to the levees themselves, dike and levee managers face the challenge of continuously evaluating their levees for different scenarios. However, for most extensive levee systems this evaluation can be costly and time consuming.

Deltares has developed the DAM (Dike strength Analysis Module) software that allow for **automated, autonomous evaluation** of dike strength, for use with:

1. operational forecasting in real-time
2. periodic safety evaluation
3. preliminary designs for new levees and improvement of existing levees
4. large-scale scenario analyses for policy makers

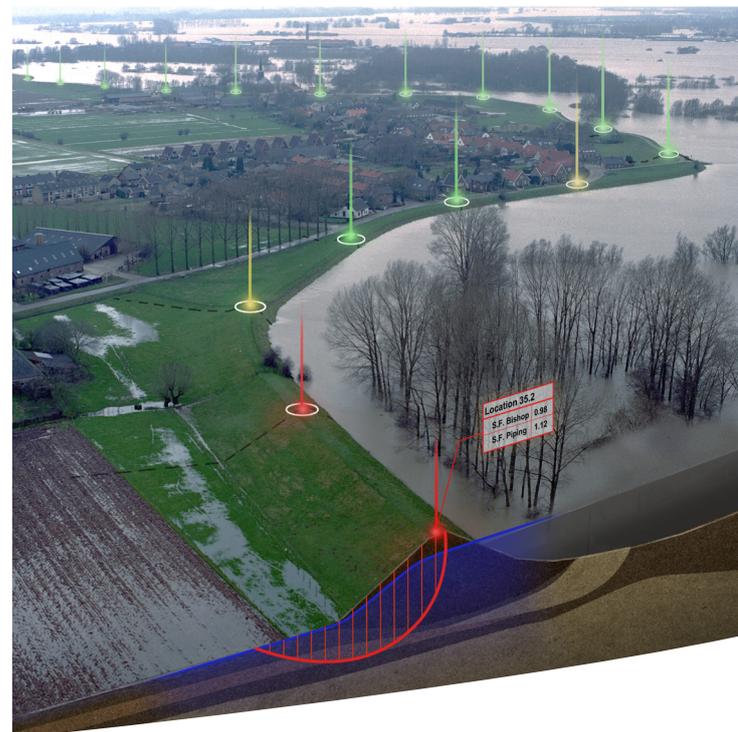
The philosophy of our approach is to allow dike managers to focus their efforts on maintenance, dike safety and data management of the levees, not on endless calculations each time there is an additional question or change in the system. Through automation and modular software, new (climate) scenarios or new knowledge on dike failure mechanisms do not lead to completely re-evaluating the dikes. Effects of changes to either can be re-evaluated with the press of a button.

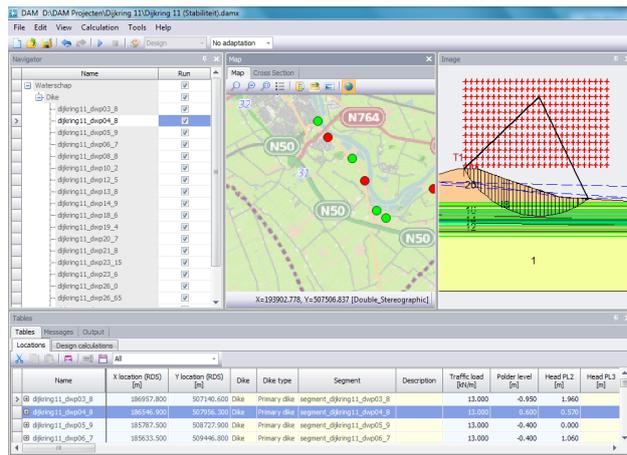
Automation and high-speed computing

The unique opportunities of DAM are derived from advances in automation of numerical modeling of dikes and in greatly reducing run times for these models. We have developed tools that use the basic

information of dikes, including digital representations of dike surface geometry, subsoil structures and soil properties (allowing for various scenarios for the subsoil composition), and automatically create numerical models for any scenario you wish to investigate. During the course of multiple projects in which over 5,000 kilometers (over 3000 miles) of dike stretches in the Netherlands, Belgium, China and the USA (Mississippi) were evaluated, these algorithms have been tuned to obtain a good balance between autonomy, repeatability

Purpose of DAM: a quick overview of dike strength





User interface of DAM

and transparency of the numerical modeling versus the control that manual modeling by experts yields. Furthermore, these algorithms are continuously improved and the automation allows the re-evaluation of the dike system with the press of a button.

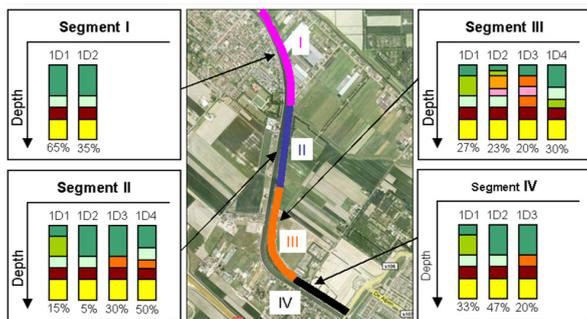
This automation has been partnered with advances in high-speed computing. Several numerical models for e.g. sliding and piping have been greatly sped up by use of techniques such as neural networks and genetic search algorithms. In this way, we have routinely performed over 100,000 slope stability calculations per day, while the piping evaluations are so fast they can be considered as 'instantly'. This speed allows

quick evaluations of different scenarios, for example to evaluate the consequences of climate change on the levee systems.

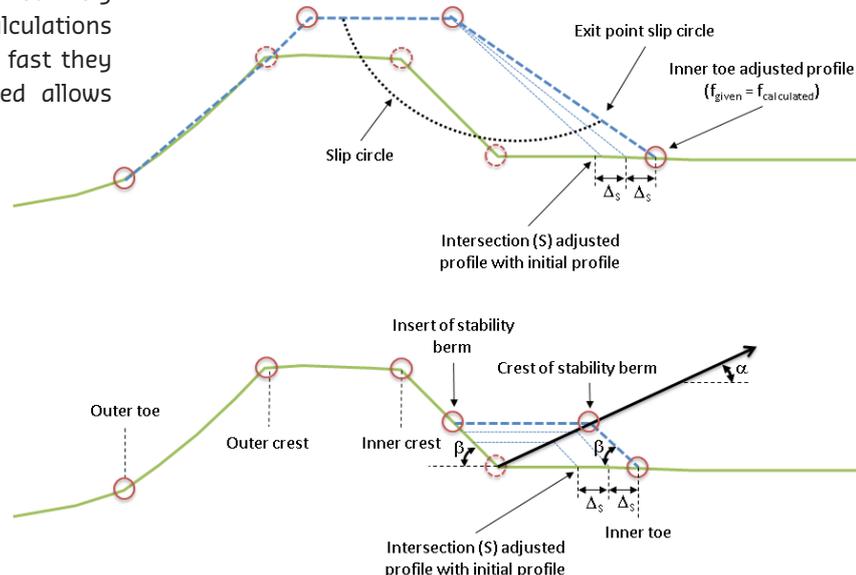
Easy integration with other systems including GIS and Delft-FEWS. Our software has been built to operate as a service. That means that it's easy for other applications to use the software without any user intervention. This allows for new applications of dike strength analysis which were hitherto impossible, such as operational (real-time) forecasting or scenario analysis. As an example, a plug-in has been created for the popular Delft-FEWS water level forecasting system.

As a default, DAM uses the D-Series for calculation models, but links to other software can readily be made. A basic connection to e.g. SLOPE/W is already available.

For the underlying data management of the dike strength analysis, the software can either use a dedicated database or it can interface with external databases (including GIS) in various methods. The forecasting results of our dike analysis module can also be exported to external databases or GIS systems for results management or visualisation.



Stochastic modelling: different chances of various subsoil



Determination of required levee improvement to reach a certain safety level

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