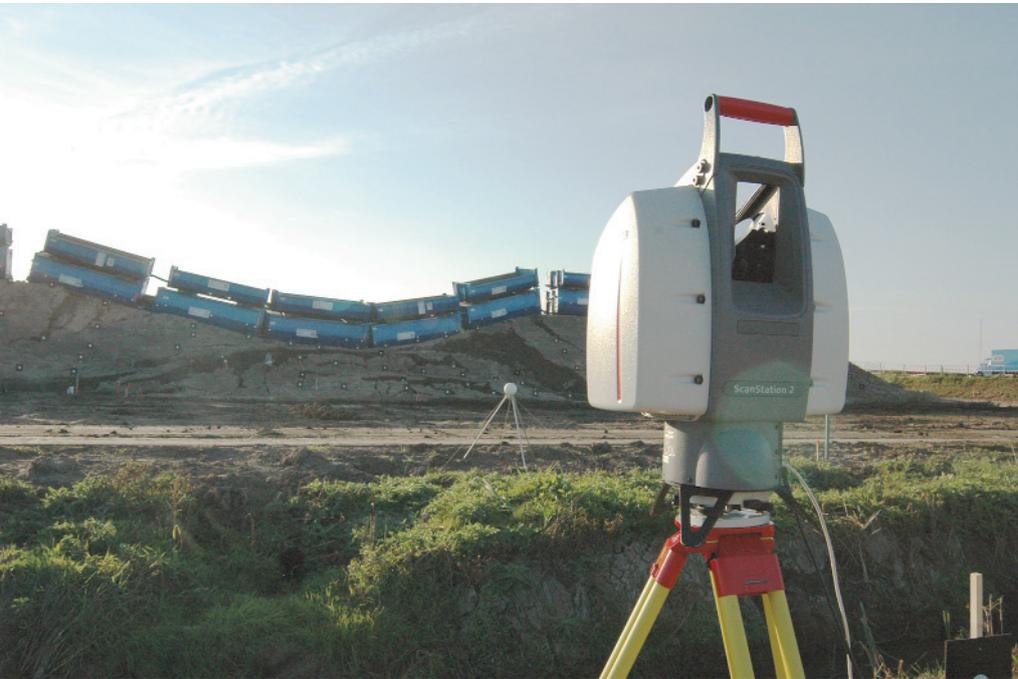


Leica Geosystems **TruStory**

Deformation Monitoring of Dikes with 3D Laser Scanning



A dike being continuously monitored with a Leica ScanStation 2.

Climate change and the ground subsidence in the Netherlands are facts that increase the risk of dike failures. Measures should be taken to reduce this risk. These measures can lead to stronger, but also to 'smarter' dikes, which have various sensors installed to better understand the reasons dikes fail. The 'Ijkdijk' project was established to be able to realize such a smart dike in the future. Hansje Brinker participated in this project and achieved valuable deformation results with the Leica ScanStation 2.

Macro stability experiment

The macro stability experiment is one of the experiments executed within the Ijkdijk project. The aim of the experiment was to examine whether measurement devices, such as a variety of sensor techniques, can be a useful addition to the regular visual inspection for the detection of stability problems in water defense structures. To be able to execute this experiment, an artificial dike 100 meters long and 6 meters high was built in the north of the Netherlands. At the end of September 2008 the dike was subjected to strong forces (performed under controlled circumstances) until it collapsed.

■ **Scope**

Monitoring of a dike subjected to in-creasing forces

■ **Organization**

Delft University of Technology
Rijkswa-terstaat
Hansje Brinker

■ **Date**

September 2008

■ **Project Summary**

4 days, 2-person surveying,
184 scans, Leica ScanStation 2

■ **Office**

Leica Cyclone Software, other

■ **Deliverable**

Deformation animation of the dike

■ **Benefits**

- Non-invasive technique
- High-resolution
- Near real-time monitoring

Detection of weak spots by continuous monitoring

In association with Leica Geosystems, the Delft University of Technology and 'Rijkswaterstaat' Hansje Brinker has used the Leica ScanStation 2 to measure the geometry of the dike during the experiment. Comparing the different geometries of the dike during the experiment

¹ The Ijkdijk project is a collaboration between TNO, STOWA, Deltares, N.V. NOM en IDL Sensor Solutions. www.ijkdijk.nl

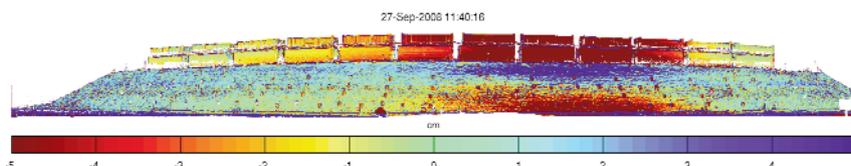
enables the deformation modeling of the dike structure. In the future this valuable knowledge can be used to detect weak spots on existing dikes and hence prevent dike failures before they happen. The laser scanner stored the geometry of the "Ijkdijk" from a fixed location over three days. The scanner was positioned at a safe distance of 50 meters at half the dike length. Additionally a number of HDS targets were placed randomly at the dike slope. A shelter, built from construction out of wood and light plastic, provided extra protection against possible severe weather circumstances and strong sunlight. During the macro stability test 184 scans of the dike were completed continuously. A spatial resolution of 5 cm between the pulses on the dike was chosen, so that the scanning time remained limited and a high resolution in time could be obtained. The ScanStation 2 endured the three-day experiment very well.

On 27 September 2008 at 16:02 the dike was successfully collapsed. In the office the point clouds were processed with Leica Cyclone

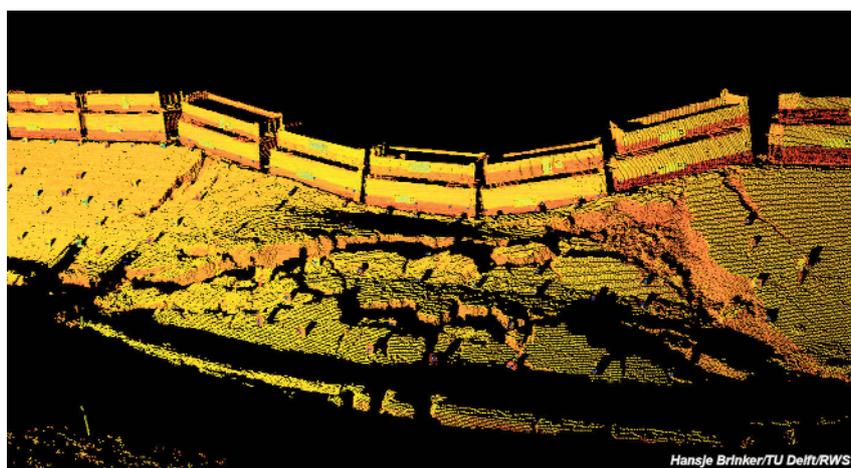
Software and compared with each other, enabling the determination of the deformation at different times. The deformation of the dike was described very well by the scans. First indications of deformation at the weak points of failure could be observed 42 hours in advance. An animation of the deformation was created, showing the deformation pattern starting on 25 September 2008 to the dike failure on 27 September 2008².

Deformation as a vital parameter

Based on the results of this test it was determined that deformation is a crucial and significant parameter of a dike. It appears that deformation monitoring with 3D laser scanning can indicate weak spots in a dike far ahead of a failure occurring. This experiment also showed that the deformation pattern of a dike can be monitored closely with non-invasive techniques by using a 3D laser scanner.



The graph shows the weak spots of the dike that was intentionally subjected to strong forces. The colored bar below shows the amount of deformation.



The dike was scanned again directly after its collapse.

² The animation is available at www.hansjebrinker.net