# Forensic analyses and hindcasting of the Breitenhagen levee failure

Kool, Job; Kanning, Wim; Jommi, Cristina; Jonkman, Bas

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**93. Forensic analyses and hindcasting of the Breitenhagen levee failure**

*Kool, J.J.[1]*, Kanning, W.* , Jommi, C.*, Jonkman, S.N.**

** Delft University of Technology*

*1 j.j.kool@TUdelft.nl, Delft University of Technology, Faculty of Civil Engineering and Geosciences, Stevinweg 1, 2628 CN Delft, the Netherlands*

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ABSTRACT

The hindcasting of levee failures can provide valuable information about levee strength, strength models and dominant factors that contribute to failure. It is however not always clear how and why a levee failed as evidence (such as detail subsoil composition) is not present anymore.

This paper discusses a levee that failed in 2013 near Breitenhagen in Germany, which is called “the Breitenhagen case”(Grubert, 2013). The Breitenhagen levee failed due to long lasting high water level causing an inner slope instability slide. The resulting flood caused severe damage in the hinterland.

In order to investigate the failure, both visual analysis and sensitivity analysis is used to identify the most likely failure modes and most likely contributions to failure. The visual analysis is based on photo and video footage which makes it possible to provide markers that help to understand the whole system and reveal all possible causes of this particular levee. With the help of different sensitivity analyses a comparison is made between several different models, failure models(e.g. Bishop, 1954) in which mean values and upper and lower bounds are considered in order to determine which modelling choices would lead to (modelled) failure. The analyses contain next to the soil parameter variations, the influence of the roots of a nearby tree, the influence of long term high water and the influence of an old levee reparations which disturbed the soil structures.

The results show that best estimated of parameters do not necessarily explain the failures of the levee. It is likely that the main factors that help explain failure are transient effects and roots.

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How do our flood defences perform during floods? Ten years of lessons learned and putting them into practice

*Flikweert, J.*[1], Hollingsworth, C.**, Burdett, S.*** and Simm, J.*****

* Royal HaskoningDHV

** Environment Agency

***Royal HaskoningDHV

****HR Wallingford

[1] Rightwell House, Bretton, Peterborough, PE38DW, +44 7887 632814, jaap.flikweert@rhdhv.com

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- Asset management
- Lessons learned and continuous improvement
- Flood defence performance

ABSTRACT

Flood defences are only called into action a few times in their life, so if a large flood does occur, it is important to learn from their performance. The Environment Agency have carried out a structured review of defence performance after each of the major events since the 2007 Summer floods, up to and including the winter 2015/16 floods. These reviews have focused on lessons learned for asset management, at both local and national scale. This presentation will look back over the six reviews carried out in that period, drawing out overarching conclusions about how English flood defences perform during floods based on real life experience, and how this has driven and is driving improvements to asset management and design, supported by research.

The six reviews covered all major breaches or near-breaches, but also assessed assets that survived against the odds. Each review typically started with site visits to collate factual information but also to understand the local asset managers' point of view and collect anecdotal evidence, essential to establish the story of the flood event. This was used to determine the failure modes that occurred, supported by hydraulic/geotechnical modelling as required.