



Geotechnical Risk and Reliability

GR-2

In geotechnical engineering large uncertainties in soil properties and other design parameters are encountered, which makes it highly amenable to probabilistic analysis. Risk- and reliability-based design approaches are increasingly popular. The GR2 group within Deltares is specialized in uncertainty, reliability and risk analysis in geotechnical engineering. We provide a wide range of services including contract research, specialized consultancy and professional training with particular focus on practical applications.

Core expertise

- Geotechnical risk assessment and risk-based design.
- Probabilistic tools and software.
- Design codes, code calibration and best practices.
- Random field analysis.
- Data assimilation and reliability updating.

Services

- Specialized consultancy for practical reliability applications.
- Contract research.
- Professional training courses.

Application areas

Flood risk and flood defences:

- Reliability-based assessment and design of dikes and other flood defenses.
- Design codes and code calibration.
- Bayesian reliability updating with past performance data.
- Asset management strategies.

Foundations and geotechnical structures:

- Foundation piles (e.g. reliability-based quality prediction with Bayesian belief networks).
- Soil-structure interaction (e.g. reliability analysis with FEM).
- Uncertainty-based settlement predictions.

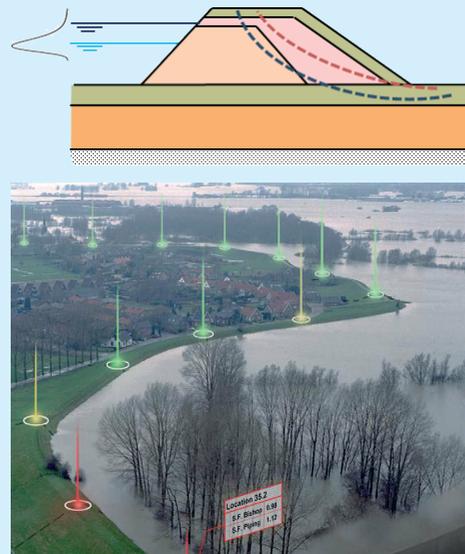
Infrastructures in delta areas:

- Subsidence analysis based on satellite data and inverse modelling.
- Pipeline networks.

Project highlights

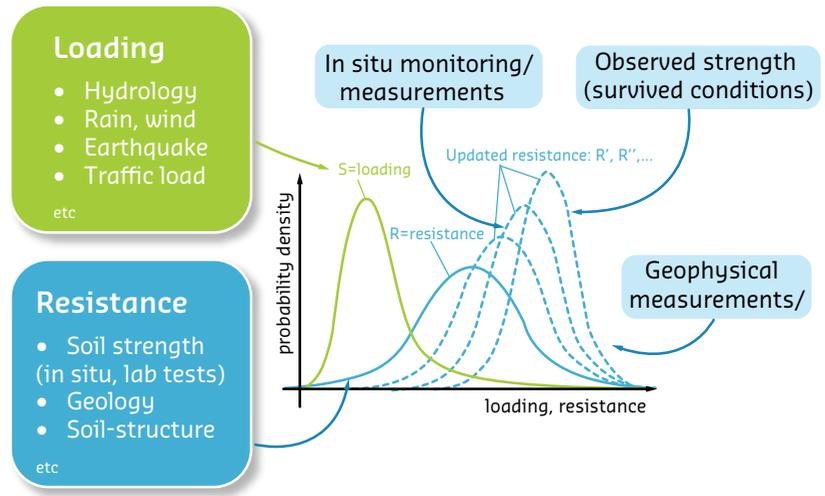
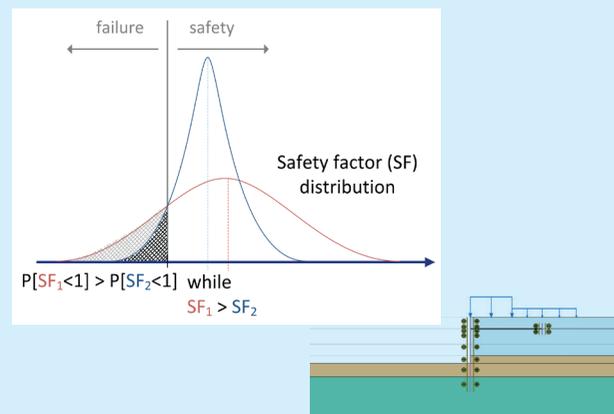
Safety assessment of flood defences

In the Netherlands, all primary flood defences are periodically assessed using statutory safety standards. Calibration of partial factors can ensure an acceptable level of reliability and flood risk. Besides establishing the target reliability values for Dutch flood defences, the GR2 group elaborated and calibrated semi-probabilistic assessment rules for the failure modes slope instability and internal erosion / piping, to ensure consistency of the assessment rules used in practice with the underlying risk acceptance criteria.



Reliability analysis with FEM

Soil-structure interaction problems typically require the use of numerical analysis. In this project reliability analysis tools were coupled with commercial FEM software (Plaxis) in order to analyse the reliability of retaining structures. A case study of a quay wall showed that reliability-based design optimization is attainable. Having established the connection, the application to other types of structures will be investigated. A similar study has also been used to derive assessment criteria for dike reinforced with anchors.



Reliability updating for dikes with past performance data

Many dikes have endured significant load conditions. Using this type of performance data in safety assessments can significantly impact reliability estimates. Within this project, reliability updating is made accessible to practitioners by developing the method, demonstrating its use in real case studies, building software and developing best-practices.



Other:

- Gate Terminal Port of Rotterdam: reliability analysis for liquefaction and flow slides.
- Reliability framework for the Dutch NPR approach for shallow foundations subject to seismic loading.
- More @ <https://publicwiki.deltares.nl/display/GR2>.



If you are looking for...

- applied reliability- or risk-based optimization of geotechnical designs.
- consultancy and tools for applied reliability and risk assessment.
- natural hazard analysis, including risk-based design of flood defence systems.
- practice-oriented professional training.

Please contact us!



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Establishing reliability analysis in geotechnical engineering practice

<https://tinyurl.com/RG-RAGEP>