Reliability analysis of flood defence structures
Software Tool

FLOODsite Task 7 has developed:

■ RELIABLE – A software tool that calculates the annual probability of defence failure and fragility curves for specific coastal and fluvial flood defence structures.

The tool is intended for:

■ Engineers, scientists, researchers and specialist planners involved with the assessment and management of risks associated with flood defence structures.

Where to find the tool:

■ The tool and user manual are available for download via the Task 7 area of the FLOODsite website under www.floodsite.net.
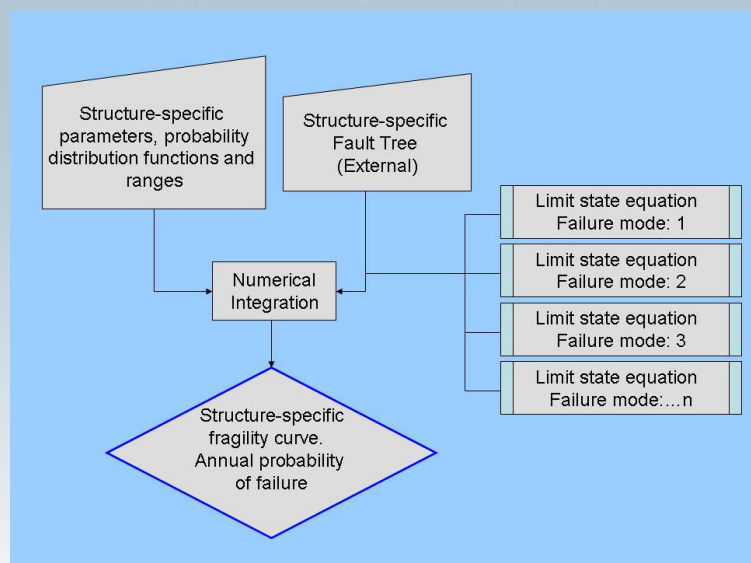
In Brief

Decision-making for flood risk management relies on an understanding of the likelihood of existing or proposed flood defences failing under given hydraulic loadings. This is often referred to as 'fragility'. For probabilistic risk assessment methods, a probabilistic measure of the structural performance is required. This is typically expressed as a *fragility curve* relating 'loading' to 'probability of failure' (Fig. 2). Combined with descriptors of decay or deterioration, fragility curves can be generated that enable the likely future performance of the structure to be described.
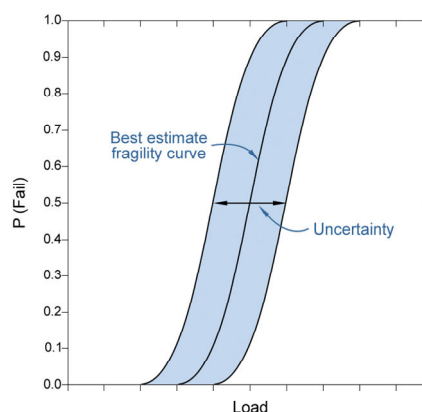

Fig 2. An example fragility curve

The RELIABLE software (Fig 1.) demands information on the flood defence relating to geometry, material properties, the potential failure mechanisms, fault tree and uncertainties, and calculates:

■ The annual probability of failure of any flood defence structure;

■ Fragility curves for specific coastal and flood defence structures.

Fig 1. Components of the RELIABLE software

Fault Trees

Fault trees are a common method to analyse failure probabilities of complex systems. The fault tree is a tool for linking various failure mechanisms leading to an expression of the probability of system failure (e.g. breach of a sheet pile wall as shown in Fig. 3).
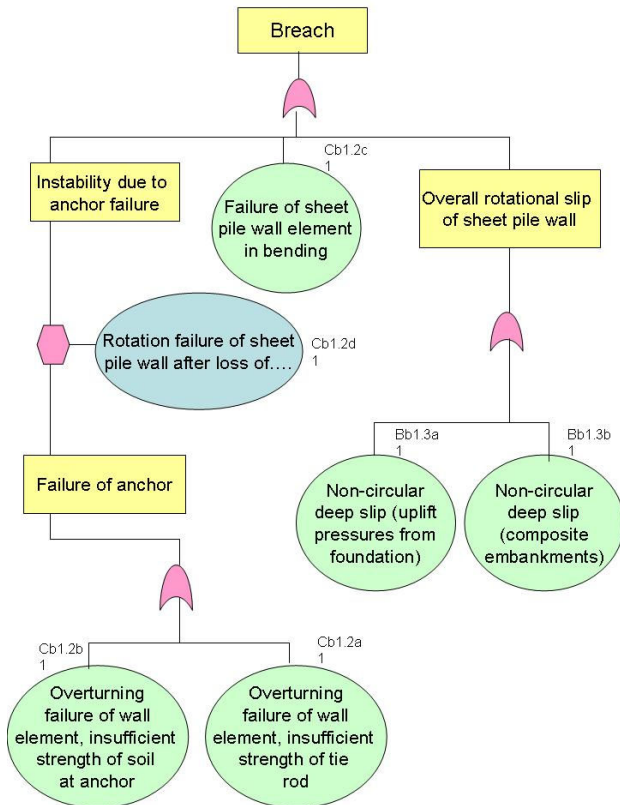

Fig 3. Example fault tree for sheet pile wall analysis

The fault trees included within the RELIABLE software contain components that consist of equations that describe the potential failure mechanisms of defences. It is also possible for users to link in external models that describe failure mechanisms that are not included within the RELIABLE suite. For example, these may include finite element geotechnical models.

The Software

The interface (Fig.4) enables the user to specify distributions and parameters for each failure mechanism in a straightforward manner. A large range of distribution types are available in the software tool (including extreme value distributions).
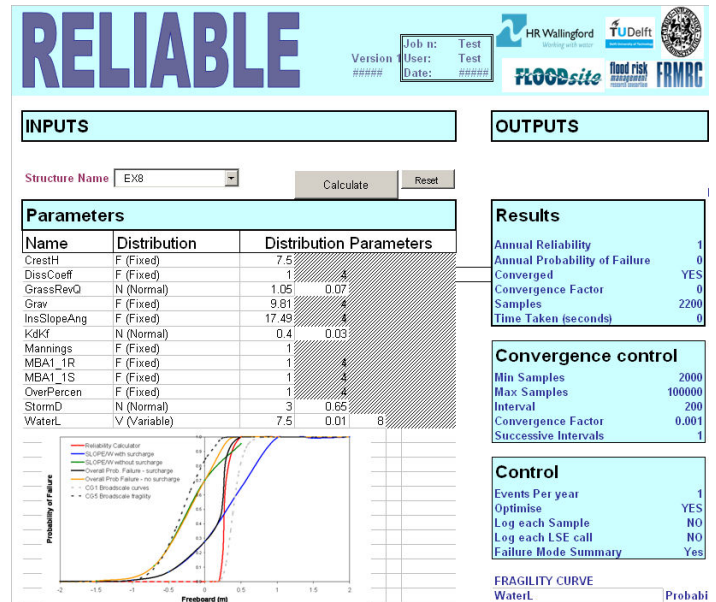

Fig 4. Screenshot of the RELIABLE interface

The outputs from the software can be used to help understand the performance of an entire flood defence system and its components.

Related Work

The development of RELIABLE has also been supported by the FRMRC research programme (www.floodrisk.org.uk).

FLOODsite Task 4 describes the failure mechanisms that underpin the equations used in the suite of RELIABLE subroutines. The software has been applied to pilot sites relating to the Thames (Task 24), Scheldt (Task 25) and German Bight (Task 27).

The FLOODsite project

FLOODsite is an interdisciplinary project integrating expertise from physical, environmental and social sciences, as well as spatial planning and management. The project has over 30 research tasks across seven themes, including pilot applications in Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Spain and the UK. The EC has identified FLOODsite as one of its contributions to the European Flood Action Programme.

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