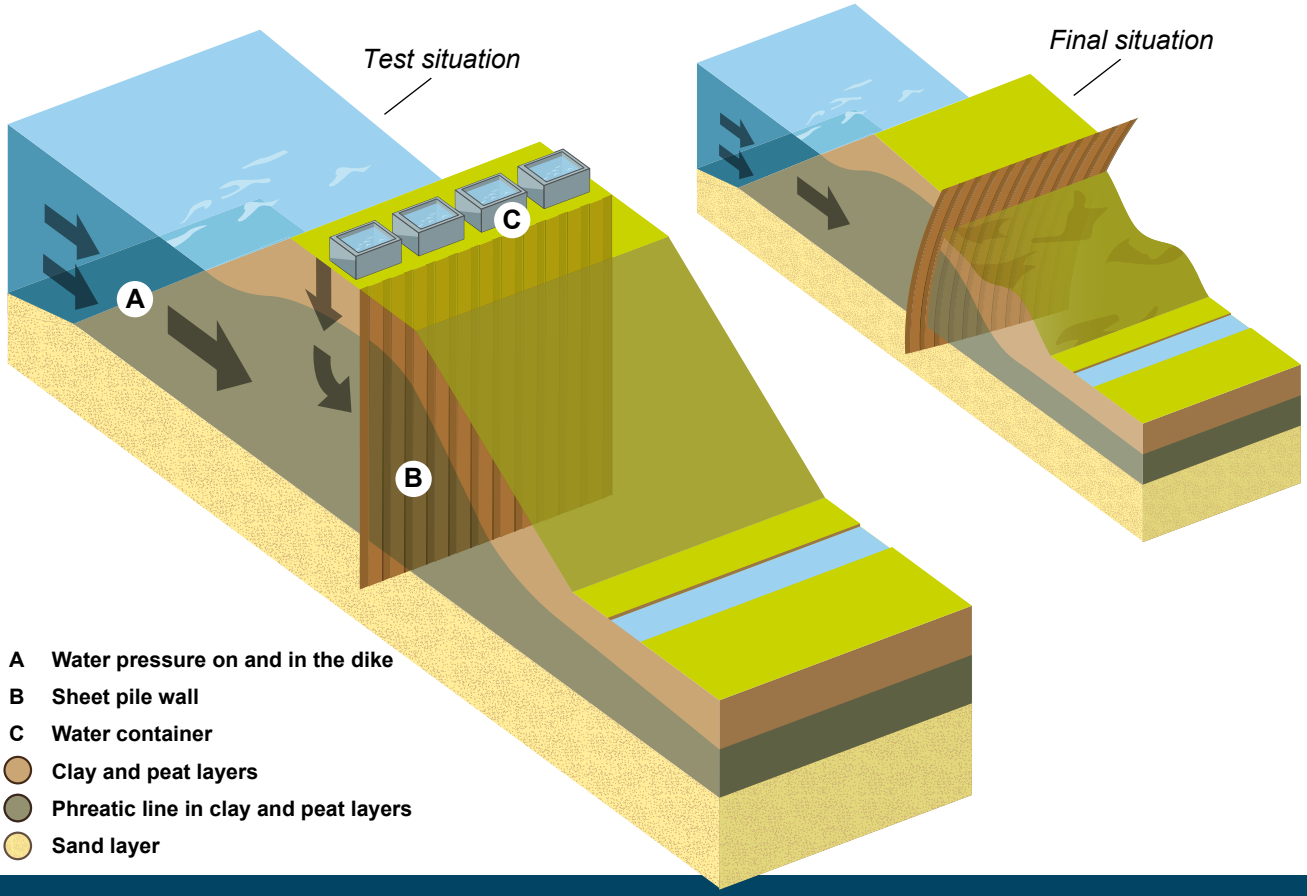
The sheet pile wall test: ‘Eemdijk test’

To innovate sheet pile walls in dikes



In the sheet pile wall test we will load a test dike with a sheet pile wall until faillure. This gives us a clear insight into actual deformation behaviour and the strength of a structure of this kind in a dike during extreme conditions. In addition, we are also going to induce failure in a dike without a sheet pile wall in order to learn more about the differences between dikes with sheet pile walls and dikes without sheet pile walls. The data from continuous monitoring during the test will be used to establish a case that can be used to validate present and future dike assessment methods. In addition to the full scale tests, there will also be a number of smaller experiments at the same location focusing on the strength of specific parts of the sheet pile wall.

The test method

The first step is to build a circular test dike and then test the dike without the sheet pile wall to failure. After repairs have been made to the dike, the sheet pile wall will be installed on one side of the dike and the water level on the inside of the dike will be raised again. We will then determine how long it will take before this version of the dike fails. We monitor that process in detail so that we will have an exact idea of how, and where, the sheet pile wall fails.

The goals

A sheet pile wall is an expensive way of strengthening dikes that is already being used regularly in the rivers area of the Netherlands. We also expect it to be used frequently in the future. Currently, there is no validated design approach for sheet pile walls used to strengthen a dike. The design method in use at present was established for a small number of project locations. The sheet pile wall test will allow us to check whether the system being used at the moment can also be applied to other locations and whether the present computer models match the field situation. We will be able to improve those models in the future on the basis of the results of this test.

Never before has the Netherlands been faced with the need for such a major programme of dike upgrades. Standards have been made stricter and so one third of the primary Dutch dikes now fail to meet safety requirements. A total of no less than 1,100 km will require strengthening between now and 2028. That can only be achieved within budget, and with the minimum impact for people living on and near the dikes, by using smart, innovative solutions.

Field testing like this sheet pile wall test helps us to learn how a dike behaves in extreme conditions such as high water levels. There are many benefits to reinforcing dikes with sheet pile walls. Where there is no room to widen a dike, a sheet pile wall can be the solution. Houses nearby can be preserved. That is ideal in a densely populated country like the Netherlands. But there are also drawbacks. A sheet pile wall as a reinforcement method is relatively expensive. Houses can also be damaged when sheet pile walls are driven into the ground. The sheet pile wall test will hopefully show that the pile wall we use is stronger than was assumed in the past. This will allow us to optimise the thickness of the sheet pile wall and the type used on individual projects, generating major savings in the future.

The location

The location of this special sheet pile wall test is Eemdijk in the Netherlands, near the river Eem.

Collaboration

The test involves intensive collaboration between the Vallei en Veluwe regional water authority, the research institute Deltares and the Macrostability Research Project (in Dutch: POV Macrostabiliteit), part of the Dutch Flood Protection Programme.

Working together to make the Netherlands safer

The sheet pile wall test is being executed for the Macrostability Research Project. Experts from all over the country, private bodies, research institutes and government authorities are working in that project on ways to make dike upgrades better, faster and cheaper.

To provide the Netherlands with adequate protection from flooding, we have strict safety standards for our dikes. The climate is changing and the sea level is rising. At the same time, the land is subsiding. Our dikes must be able to withstand high water and waves to reduce the risk of flooding. They therefore require strengthening. There are many options, with the most widely used being the traditional approach of strengthening using more soil. But that is not always possible, for example in places where features in the dike such as houses or industries limit the available space. One of the solutions here is to use sheet pile walls, the focus of the research in this project.

They are challenged to produce innovative solutions for the failure mechanism of macrostability. To maximise the practical applicability of the solutions, the solutions are tested immediately in projects. The Rivierenland regional water authority is the leading partner in the Macrostability Research Project.

Dutch Flood Protection Programme

The Macrostability Research Project is part of the Dutch Flood Protection Programme in which Rijkswaterstaat collaborates with the regional water authorities. In the years to come, the Dutch Flood Protection Programme will be facing the challenge of completing the largest dike upgrade operation ever. More than 1100 km of dikes, and 256 locks and pumping stations will have to be tackled before 2028 in 300 projects throughout the Netherlands: along the coast, the major rivers and lakes. The Dutch Flood Protection Programme has earmarked € 7.4 billion for this operation.

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