Floodprotection Rhesi – Detailmodell 1:35
Optimization of dam toe protection and groynes

In its current state, the international river reach of the Alpine Rhine (km 65 to 91) is characterized by a straight course with a predominantly plane bed. In the frame of the flood protection project “Rhesi” (www.rhesi.org), the discharge capacity of the Rhine will be increased by widening the river channel from approx. 70 m today to more than 200 m in the future.
Due to the river widening, the morphology of the Alpine Rhine will change from a straight channel to alternating bars and, in its widest sections, to a braided channel. The new and more dynamic morphological structures will induce transversal currents and so-called "morphological scours", which can lead to increased shear stress on the river banks. The location and depth of the scours are significantly influenced by local morphological processes and are, therefore, difficult to predict.

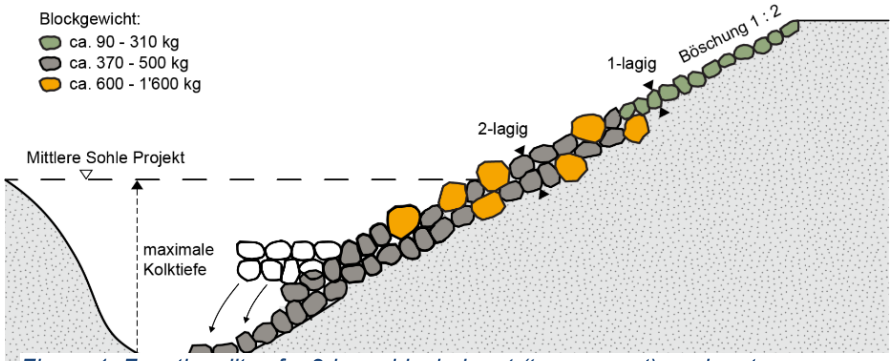

Figure 1: Functionality of a 2-layer block depot (transparent) as dam toe protection with optimized block sizes of the bank protection

This requires a highly flexible design of the bank protection measures. As a result, dam toe protections with “block depots” are planned on both riversides in the entire project area (Fig. 1).
The functionality of this block depot was investigated for plausibility in the model scale of 1:35. The tests showed that the block depot can be placed directly below the middle bed in the project state.
The simulation showed that a 2-layer block depot with a length of 4 m secures the bank down to a depth of 6 m. The tests made it possible to significantly reduce the block sizes of the bank protection: instead of the planned blocks of 0.6 - 1.6 tons, blocks of 370 - 500 kg are sufficient.

As additional measures, groynes are to be installed at various places along the bank protection to repeatedly divert the current away from the banks. For this purpose, high and low groynes were optimized and examined in the Detailmodel with regard to their geometry and block sizes. The integration into the flood plain and the bank protection between the groynes were also tested.
The experiments let to a decrease of the block size on the back of the groyne by the factor 0.5x. It was also shown that the block depot between the groynes is not necessary. However, the bank protection must remain.

The model tests for the detailed construction of the bank protection and the groynes provided important foundations that were adopted for further project planning. The planned block sizes and the number of blocks were reduced for both issues. Due to the project length of 26 km and the construction of the measures on both sides, such optimizations are highly scalable, and cost savings of several dozen million CHF were achieved in the project. Further results of the tests, such as the verification of the slippage of the block depots and proof of the suitability of the tested groynes, significantly increased planning reliability.

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