

Bentofix®

A new fish ladder in Freiburg

Project name
Fish ladder in Freiburg

Designer:
UNGER ingenieure, Freiburg

Main contractor:
Walther Keune-Bau GmbH & Co. KG, Freiburg

Product:
Bentofix® BZ 13-B



 Naue



Fig. 1: Sealing of the riverbed with Bentofix®

Challenge

The historic Schwabentorwehr (Swabian Gate Weir) on the Dreisam River in Freiburg/Breisgau was a listed building for monument protection. However, the 1873 constructed building was not only in disrepair but was an obstacle to the migration of fish, including salmon, which were being reintroduced to the river ecosystem. To improve the site while preserving its historical character, a natural fish ladder was added.

One of the things that makes the site so unique is that a special geosynthetic clay liner (GCL) was installed under the revetment to act as a water barrier and seal the protected structure. Several of the GCL panels even had to be installed under flowing water.

The EU Water Framework Directive stipulates ecological continuity, but the old 2.5m high and 42m long Swabian Weir Ramp with its 10 steps could not be surmounted by fish. While fish bypasses were used in other locations along the river, the layout of the Swabian Gate Weir in the middle of Freiburg prevented this. There was a public footpath, a cycle path, the federal road B31 on both sides of the site, and residential buildings. Planners had no other choice but to re-build the structure.

Solution

A 115m long and approx. 19.5 to 23.8m wide near-natural sole structure was erected as a river-wide drainage channel with a basin structure. The revetment of the new weir consists of hydraulic armour stones in setstone and transom construction. The actual channel is 98m long and has 21 basins with a height difference of 15cm each. This allows fish and invertebrates to overcome the height difference of 3.3m upstream.

It was important for the designers to seal the building downwards in order to reduce surface water losses (exfiltration from surface water or infiltration into groundwater). This was especially critical at low water

levels in the river Dreisam and in groundwater. Bentofix® was installed between the existing subsoil and the revetment. It was the only GCL able to meet the conditions specified in the tender, including the main requirements of exhibiting a very high puncture resistance and having the ability to be installed underwater.

The installed Bentofix® type is a needle-punched GCL. It is a combination of a GCL with an additional sand protection and ballast layer. The additionally integrated sand layer acts as a ballast for underwater installation and protection layer for rock placement.

The GCLs were installed under the revetment from the middle of the second basin to the upper end of the sole structure. Towards the side slopes, the panels were led directly under the upper edges of the crossbars and the foot protection. They were laid directly on the subgrade with an overlap of 1m in flow direction. Due to the firmly bonded nonwoven layers, no additional protection measurements were necessary.

The GCL panels were covered with a 10cm gravel-sand layer 0/32mm, followed by a 30cm gravel-scrap mixture 0/120mm to 0/150mm and the revetment.

The entire bottom structure was constructed in two sections, half on one side and half on the other, as the river Dreisam could not be diverted outside the water cross-section due to the lack of space. The dam was laid approx. 2.50m off-centre and then converted to the finished revetment for the second construction phase. The GCLs are therefore located in the flow direction approximately in the middle of the river with an overlap of approx. 2m. The panels were then installed in the middle of the river.

One challenge was the narrowness on the construction site. There was no storage space, so every Bentofix® GCL roll was only taken from the storage yard to the construction site just prior to installation.



Fig. 2: Installation of Bentofix®

Bentofix® is a registered trademark of Naue GmbH & Co. KG in various countries.

The information contained herein is, to the best of our knowledge, true and accurate. There is no implied or expressed warranty.

© 2022 Naue GmbH & Co. KG, Espelkamp, Germany · All rights reserved · No. 00577 · Status 21.01.2022

naue.com