

## Bristled Fish Pass – the Au-Schönenberg Hydroelectric Dam

Pilot project, fish migration assistance, hydropower, biological permeability



(1) The fish passage

With the construction of the Au on the Thur hydroelectric dam in Switzerland, the **ability for fish to migrate** had to be insured. At the research institute for Environmental and Hydraulic Engineering at the University of Kassel, a new model of **fish passage** was designed for this purpose. The opportunity was taken to develop a passage that could serve the dual purpose of being both a passage for aquatic life and as a path for recreational sports such as canoeing. Resultant of this effort is a bristled passage. Flow velocities between the bristle elements are about 1 m/s and thus within the benchmarks of the **NRW Dam Manual**. Tests show that this type of fish passage does not have selective effects on fish stocks.

### Area

The Au-Schönenberg plant is located on the Thur River, in Switzerland. Additional to measures to improve biological permeability on the lower Thur River, projects on widening of the river bed and improvement of the water structure and the hydraulic connectivity of the floodplain exist.

### Reason / Cause

Lorze AG operates a power plant in a channel on the site of the former Bürglen spinning mill. Therefore a maximum discharge of 17.5 m<sup>3</sup>/s is conducted to the channel at the Au weir. With the **construction of the new plant**, the excess water at the weir can be used approximately 250 days per year. But with the construction of the Au power plant, the ability of fish to migrate up the dammed Au must be ensured.

In sections of waters disturbed by the above named constructions migration of aquatic fauna can be difficult. The WFD requires that this fragmentation of aquatic habitats must be removed. Accordingly, fish and benthic organisms must be able to move from one water section to another. For this purpose a series of devices are available, which all have more or less distinct disadvantages in terms of flow conditions, tendency to back up, suitability for the migration of benthic organisms, selectivity, cover, etc.

### Objective

A fish passage will only serve its purpose if it provides favourable hydraulic conditions and is located at sites where fish look for entry. For this reason, the following design criteria are of importance:

- Directional flow field without excessive turbulence
- Sufficient water depth
- Sufficiently large and well distributed tranquilize sections
- Moderate velocities
- Adequate escape and shelter opportunities within the device

To avoid the selectivity, the flow inside the passage device should not vary extremely from the characteristics of the river. For the migration of benthic organisms, large soles with a distinct gap system that also remains in case of the entry of fine sediment are particularly useful. In addition, bottlenecks with high flow velocities and a discontinuous channel transition between the streambed and fish passage should be avoided.

### Actors / Procedure

With these criteria as a guideline, a novel fish pass was developed at the Research Institute for Environmental and Hydraulic Engineering at the **University of Kassel**. The development also aimed creating a **new fish passage design** which would serve the combined use of a fish and aquatic fauna passage also of a canoe passage. The elastic and permeable **bristle elements** of the new fish pass replaced the previously used fault and deflector elements. The new elements consist of individual bristle bundles, anchored to a base plate. The broom-like elements are mounted on the concrete floor of the fish passage and distributed on the passage as to prevent a strong flow.



(2) Fish pass ramp

In order to give fish sufficient places to rest, the bristles are interspersed with gaps and interstices. The channel bed of the passage is backfilled with coarse-grained substrate. This prevents bed load discharge in steeper sections of the channel.

## Costs / Financing

9 million francs (approximately 6 million euros) were invested by the private sector in the construction of the Au-Schönenberg plant. The commissioning took place in December 2002. 7 million kWh of electricity per year are generated and feed in the local power grid. The project was compensated according to the legal provisions to promote renewable energies.

## Results / Assessment

The velocities which are approximately between the bristle elements are around 1.0 m/s and are hence within the appropriate standards set by the NRW Dam manual. In addition, the areas in the sub-stream of the bristle elements are quiet zones with flow velocities of 0.3 m/s. Therefore, a lengthening of the passage is possible. Separate tranquilize sections, as found in conventional passages, are not needed. The water demand is medium, i.e. below 200 l/s.

Exceeding risk caused by driftwood does not exist. It is stopped by the bristle caused eddies, where small organic solids and algae are broken down, and carried away. Driftwood and other debris can also easily be removed from the bristle elements with a comb-like rake. In addition, the bristle elements are easily interchangeable.

The bristles themselves pose no danger of injury to the fish. Studies confirm that the fish passage is not selective on smaller species of fish appearing in the Thur. Observations through the window integrated into the passage also show a stress-free, quiet, but well oriented passage of the fish. Likewise, long lasting rests in the gaps could be seen.

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## Bristled fish pass in Germany

An example of a bristled fish pass in Germany is located on the Saale in Thuringia, south of Camburg, close the border to Saxony-Anhalt. The Schleusingen Hydro-Laboratory, a branch of the Bauhaus University Weimar, designed a fish-canoe pass for the hydroelectric plant in Döbritschen. This bristled fish pass has been set up under a DBU-funded project and is adjusted to the expected fish species with a low gradient of 1: 18. Function control carried out over several weeks proved to be very persuasive. Even the „weakest swimmers“ managed to swim up easily. A second fish migrant assistance is planned, since the current-loving species tend to swim to the turbine house to search for passage.



(3) Bristled fish pass by Camburg/Döbritschen (Thüringen)

## Literature

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## Links

<http://www.hydro-solar.ch/fischaufstiegshilfen.asp>

<http://www.iwk.uni-karlsruhe.de/index.php>

Picture sources: HYDRO-SOLAR Energie AG (1)/(2); Wolfgang Schmalz, Hydrolabor Schleusingen (3)

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