

Fish Protection and Downstream Migration – Actual Topics (partly) solved in Germany

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- Introduction and Current Status
- The „Forum Fish Protection and Downstream Migration“
- Example for fish protection by modern screen
- Concepts and examples for bypassing of the fish
- Conclusions

Status Upstream Migration

- In Germany the technology of upstream migration is commonly regarded as well developed, because the guideline DWA-M 509 was just issued in May (after a draft period of 4 years!).
- But this guideline is already outdated, because the state-of-the-art documented in this brochure is several years old.
- This guideline makes planners prefer the vertical slot fish pass. So, at many sites vertical-slot fishpasses are build despite of the high cost.



New Developments

- So, the process of developments to solve the problem of upstream migration with less cost and to avoid disadvantages of the „standard“ is still going on.
- Newer solutions and developments, like the superactive baffle (Larinier) fish pass or the combined baffle-brush-fishpass or the latest developments of fish locks are not specified in this guideline.

Baffle-brush-fishway



Forum Fish Protection and Downstream Migration

Forum Fischschutz und Fischabstieg *www.forum-fischschutz.de*

In Germany, a centrally moderated process on fish protection and downstream bypassing was started 2 years ago and will be finished in November. The goal of this forum is the discussion of the state-of-the-art, the exchange of knowledge and the establishing of a common understanding of the problems and solutions available for this issue.

The results up to now are:

- The mortality or risk of damage when passing the turbines can be very different between a few percent and 100 percent depending on the type of turbine (hydrodynamic screw turbines vs. Pelton turbines).
- The mortality rate can only be estimated when defining a design fish species and size.
- Discussions are going on, whether the fish individual is important or the fish population.

Results of the „Forum Fish Protection and Downstream Migration (2)

- Behavioural screens (louvers, electric curtains, subsonic devices, stroboscope light, etc.) expose also a selective efficiency, i.e. the efficiency depends on the fish species and the local conditions.
- A high efficiency can only be expected for fine screens (10 mm).
- Fine screens are available, but only for small and medium-size hydropower plants.
- Currently the design of fish protection means has to be based on a target species.
- There is a big lack of knowledge on the behaviour of fishes in front of screens and bypass intakes.

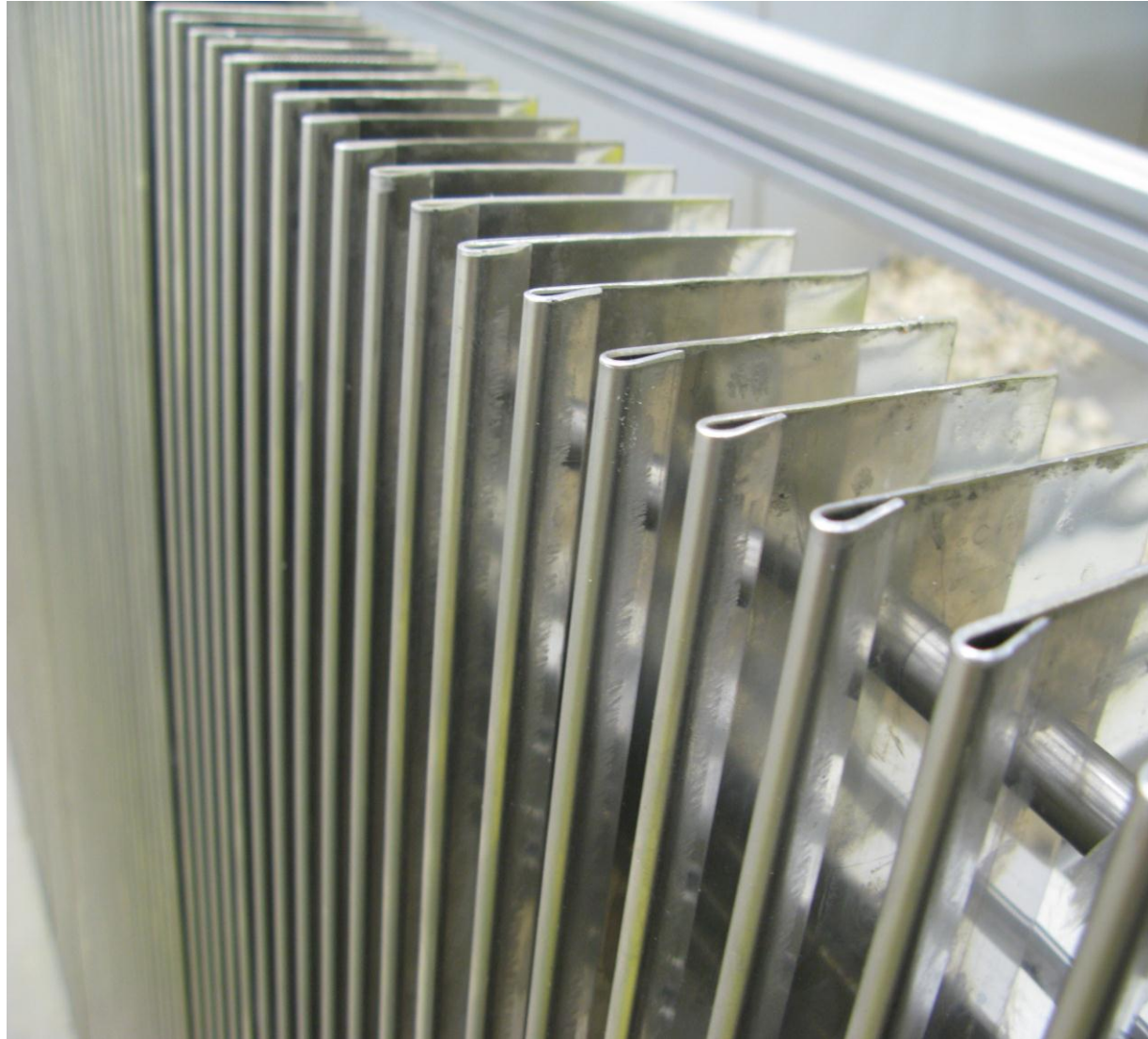
Downstream Migration

- Concerning the fish protection and downstream migration there is no comparable guideline available.
- Due to the lack of knowledge one book (Ebel, 2013) is regarded as a kind of standard.
- But: there is a severe bug in this book, which has to be addressed later.

Ebel, Guntram: Fischschutz und Fischabstieg an Wasserkraftanlagen. Halle/Saale 2013 (ISBN 978-3-00-039686-1)

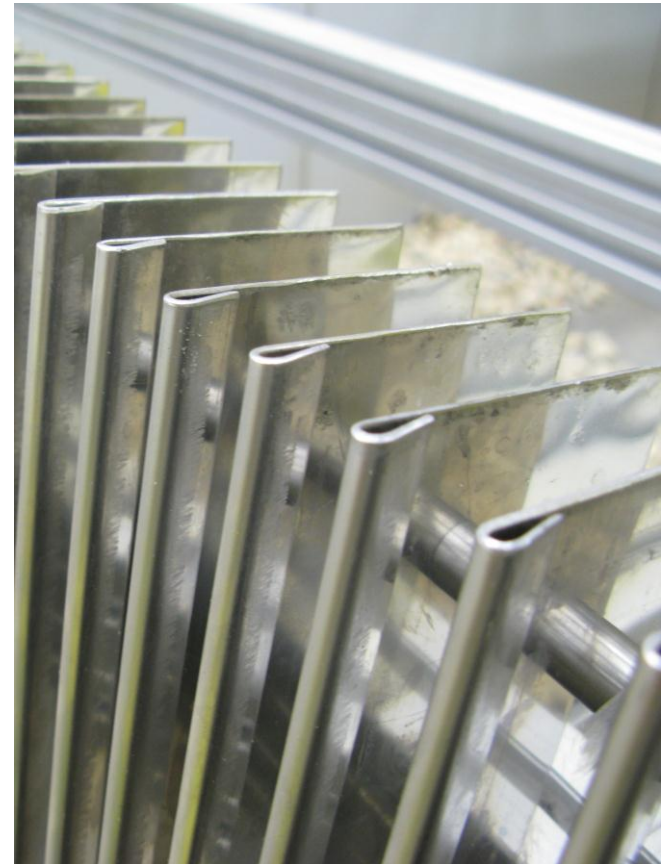


Best Fish-friendly Screen available



Fish-friendly Screen – Advantages and Features

- Optimum profile
- Spacing from 6 to 15 mm
- Very little head loss: 25 mm with 1 m/s and 10 mm spacing
- Round and smooth nose
- Easy to clean, because all debris stays on the screen surface and can be wiped off.
- Little material demand – stainless steel
- Good protection of fish because force is distributed over more rods
- Protection against overload
- Coarse trash rack necessary



Functional Principles of Fish Bypassing

Function	Guide the fish to a bypass		Fish-lifting trough
Principle description	Fish is guided by tangent component to the side of the bypass	Fish is guided by tangent component to a bypass channel	Fish is taken by rising trough behind a protection comb and released into a channel to tailrace
Principle sketch	<p><i>Angled horizontal screen</i></p> <p>Plan view</p>	<p><i>Inclined screen</i></p> <p>Longitudinal section</p>	

Angled Horizontally Guiding Screen Halle-Planena river Saale



Hydropower Site Planena, river Saale from upstream

Foto: Kehl (www.wkw-halle.de)



Hydropower Site Planena, river Saale Guiding Screen

Foto: Kehl (www.wkw-halle.de)



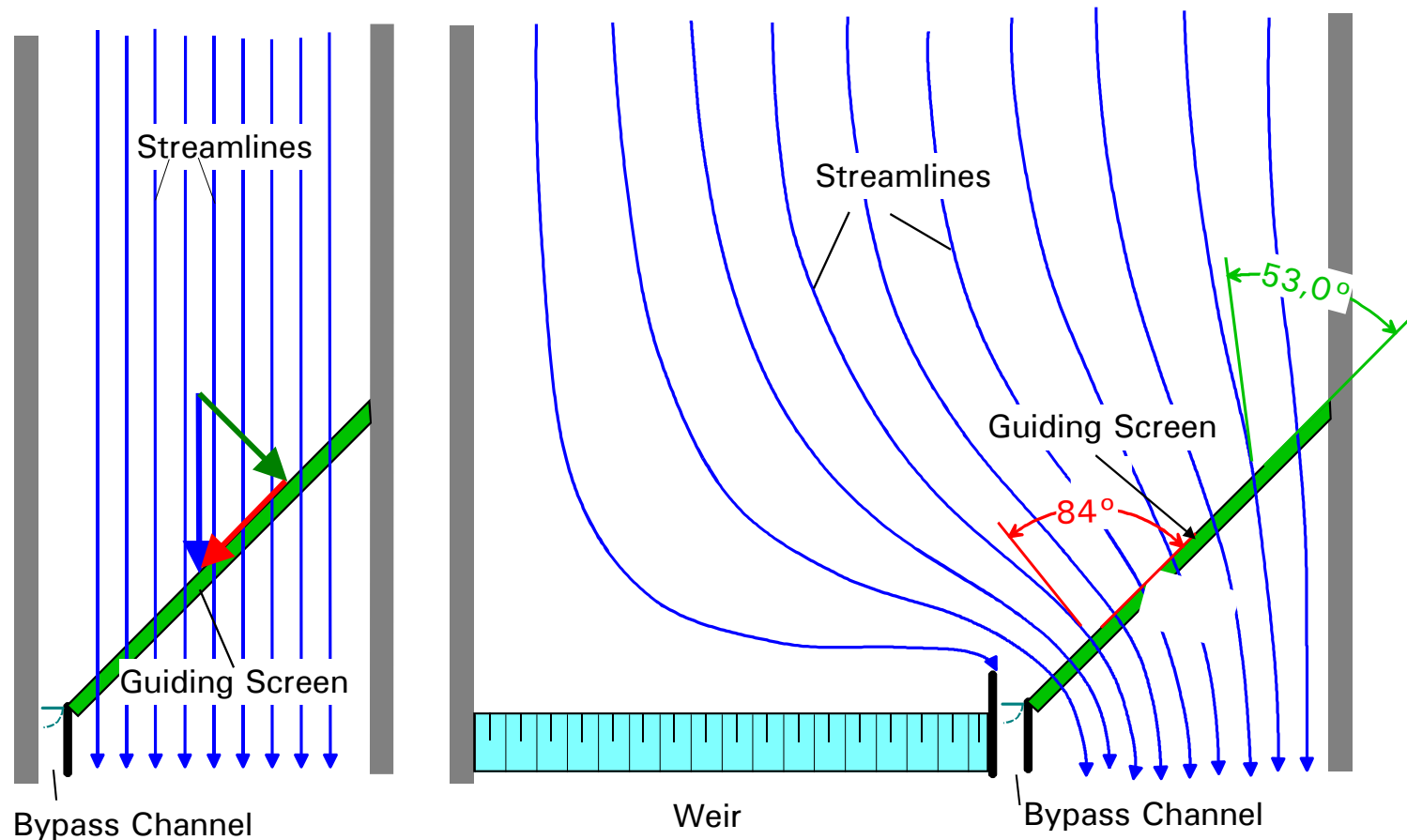
Hydropower Site Planena,
river Saale
Door in Fish Bypass



Foto: Kehl (www.wkw-halle.de)

Angled Horizontally Guiding Screen - Discussion

There is one main critical attribute which is currently neglected, but very important – the dependency of the flow characteristics on the headrace geometry:



Angled Horizontally Guiding Screen - Conclusion

- Important for guiding effect is the angle between the **streamlines** and the **screen surface** – not the angle to a river axis!
- There is only a continuous guiding component to the bypass, if the headrace **is not** significantly wider than the screen aspect (from upstream).
- Guiding screens (angled in plan view) are effective in **channels with parallel banks**, not in rivers with a large headwater area.

Inclined Screen - Example



Draufsicht M, 1:100

10 mm - Rechen

FAA-Neubau

Monitoring

Graphics: Dumont - Floecksmuehle

Unkelmuehle, river Sieg – 10 mm Inclined Screen 30 deg



Foto:
Floecksmuehle

Unkelmuehle – Bypass Channel and Gate



Fotos:
Floecks-
muehle

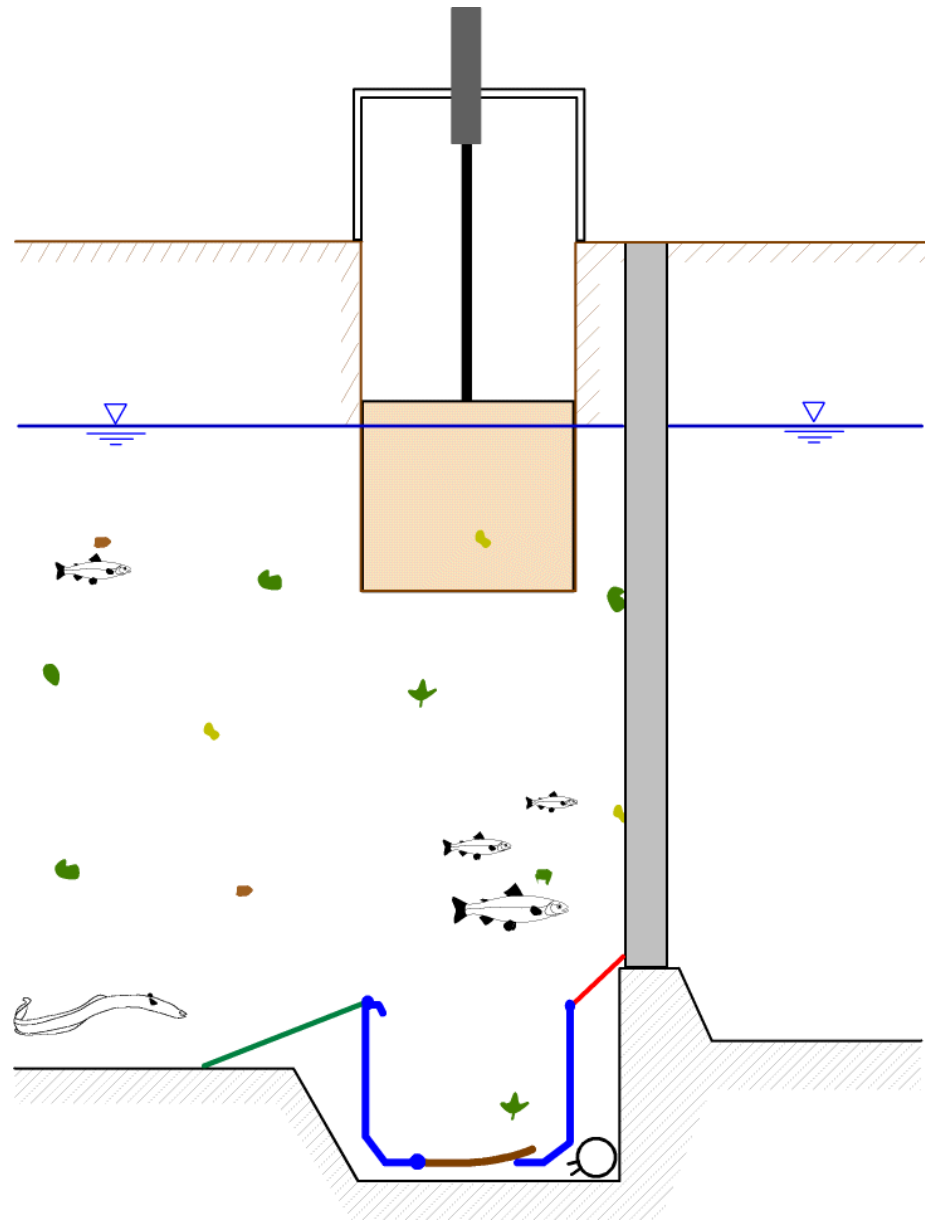


Inclined Screen - Discussion

- There is a **lack of knowledge** on the efficiency of inclined screens with bypass entrance close to the surface, because many fish species do **not like to change the swimming level**.
- The hydraulic conditions at transition channels (from headrace to bypass channel) are complicated and correlated to strong acceleration.
- There is a strong evidence, that acceleration is not easily accepted by the fish.
- Some species, especially eels, try to escape in upstream direction. So, they need a special bypass system

The Fish-lifting Trough

- Vertical fine trash screen
- Bottom gutter
- Trough of stainless steel with vertical movement
 - fish protecting comb and
 - wiping strip
- Lowering type gate in the side wall with bypass channel to tailrace



Conclusions

- The fish guiding concept causes high cost due big screen area.
- Horizontal angled screens show hydraulic performance only if the headrace width is not bigger than the screen aspect width.
- There are no efficiency results available up to now, which prove, that the fish migration system exhibits a high efficiency in a short time.
- The fish-lifting trough shows a high efficiency in the laboratory tests.
- 2 Pilot projects are prepared right now (river Fulda, Interlaken)

THANK YOU!