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Hybrid model approach for designing fish ways - example fish lift system at Baldeney/Ruhr and fish way at Geesthacht /Elbe

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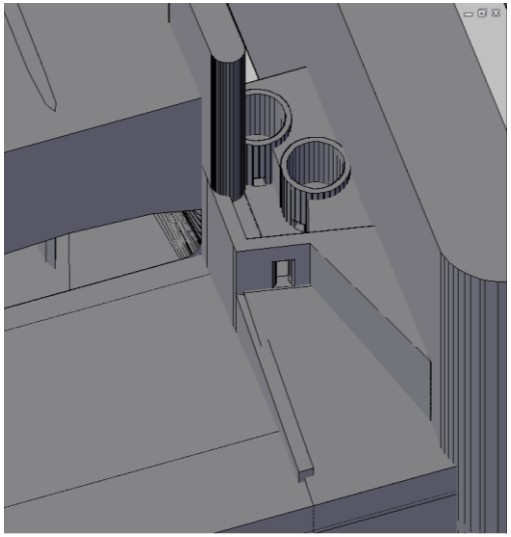
Hybrid model approach for designing fish ways - example fish lift system at Baldeney/Ruhr and fish way at Geesthacht /Elbe

F. Seidel, P. Oberle, M. Musall, P. Schultz, T. Grafmüller, F. Nestmann

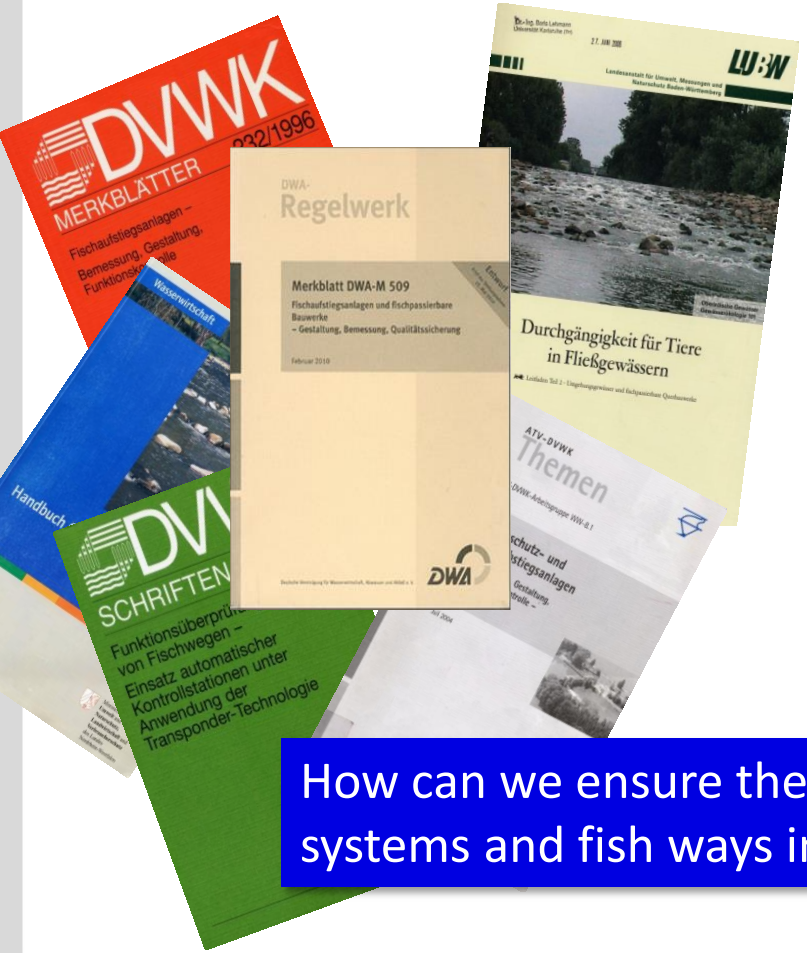
Fishpassage 2015, Groningen

Institut für Wasser und Gewässerentwicklung – Bereich Wasserwirtschaft und Kulturtechnik –
Prof. Dr.-Ing. Dr. h.c. mult. Franz Nestmann

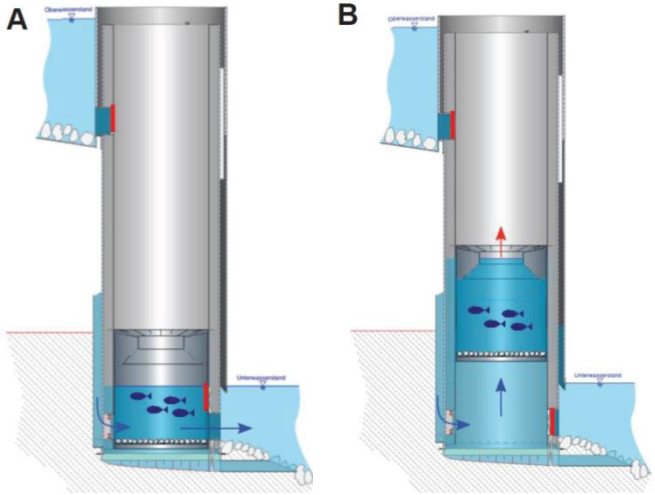


Passability: Design and design criteria

- Manuals, engineer standards



- Special design, e.g. Fisch Lift

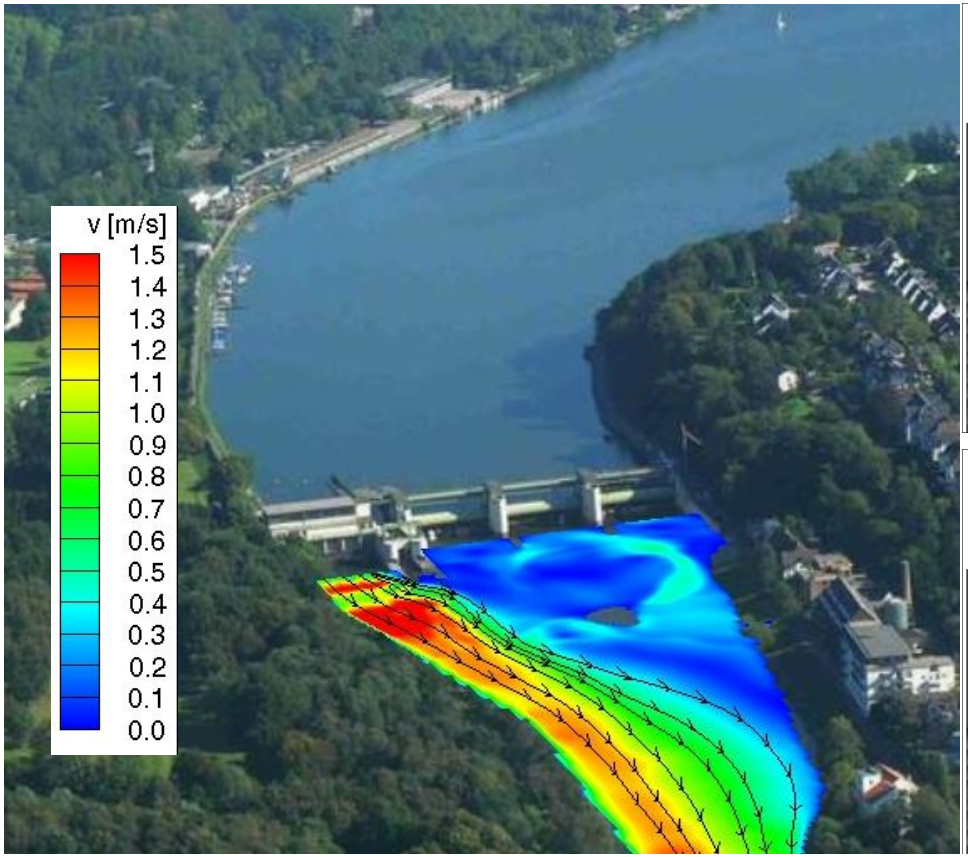


How can we ensure the functionality of new and innovative systems and fish ways in the design phase?

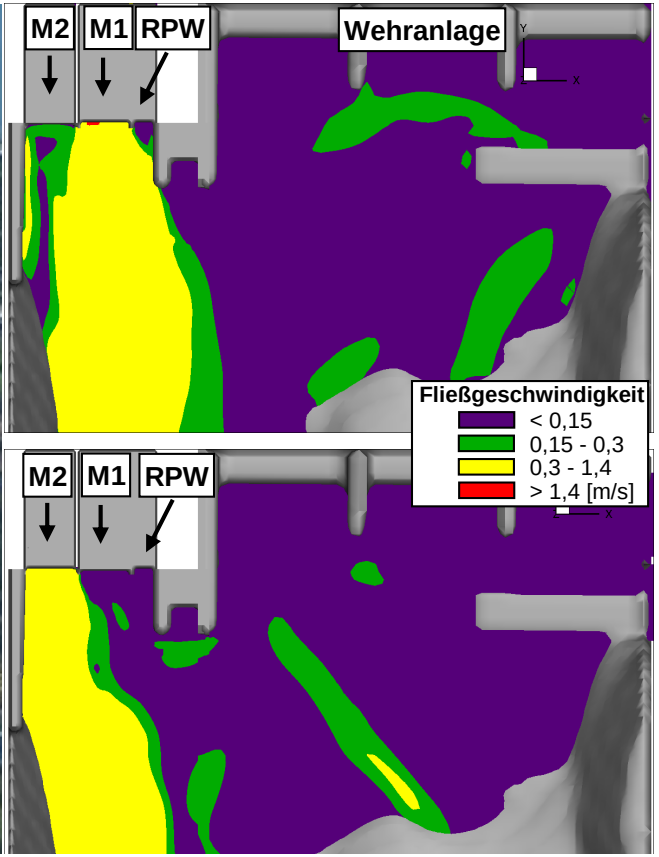
Case study 1: Baldeney

- 3D-hydrodynamic numerical model for evaluating the attractiveness

numerical



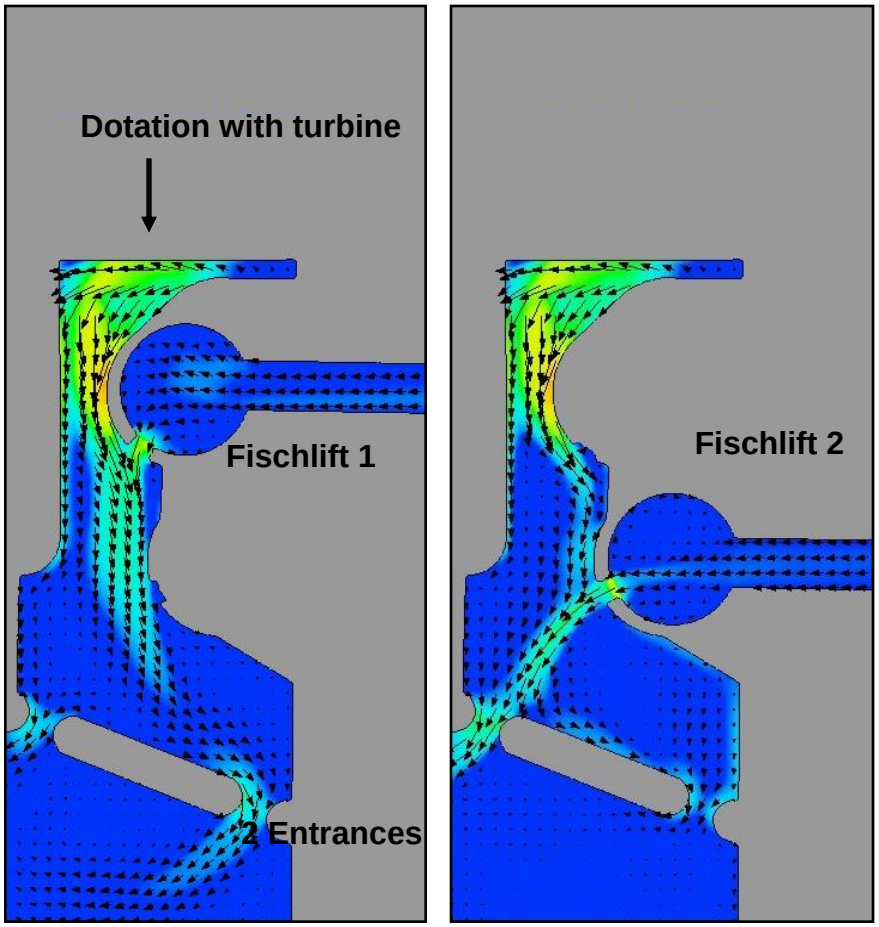
Velocities: hydraulic colour scheme, Flow 3D, RANS

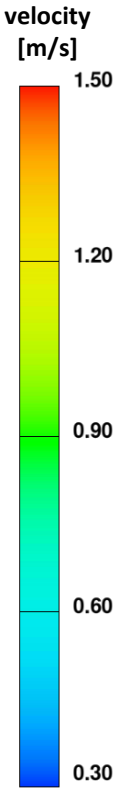


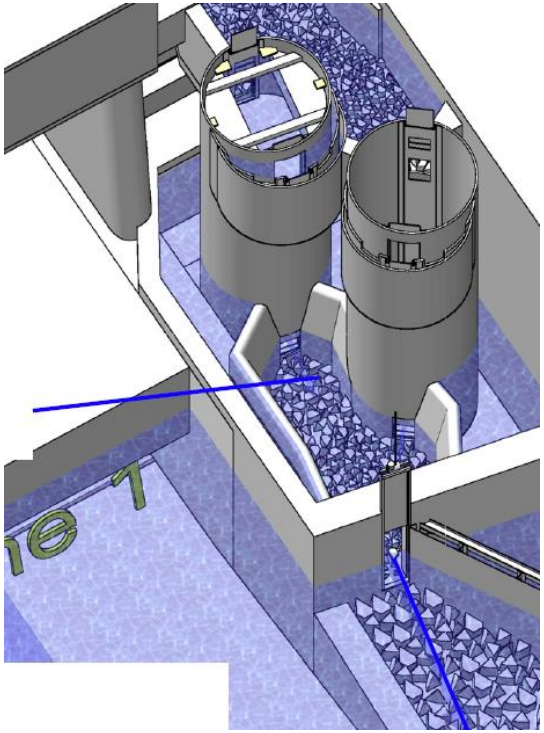
Velocities: etohydraulic colour scheme

Example: Prechamber design

- 3D-hydrodynamic numerical model







numerical

> 50 simulations

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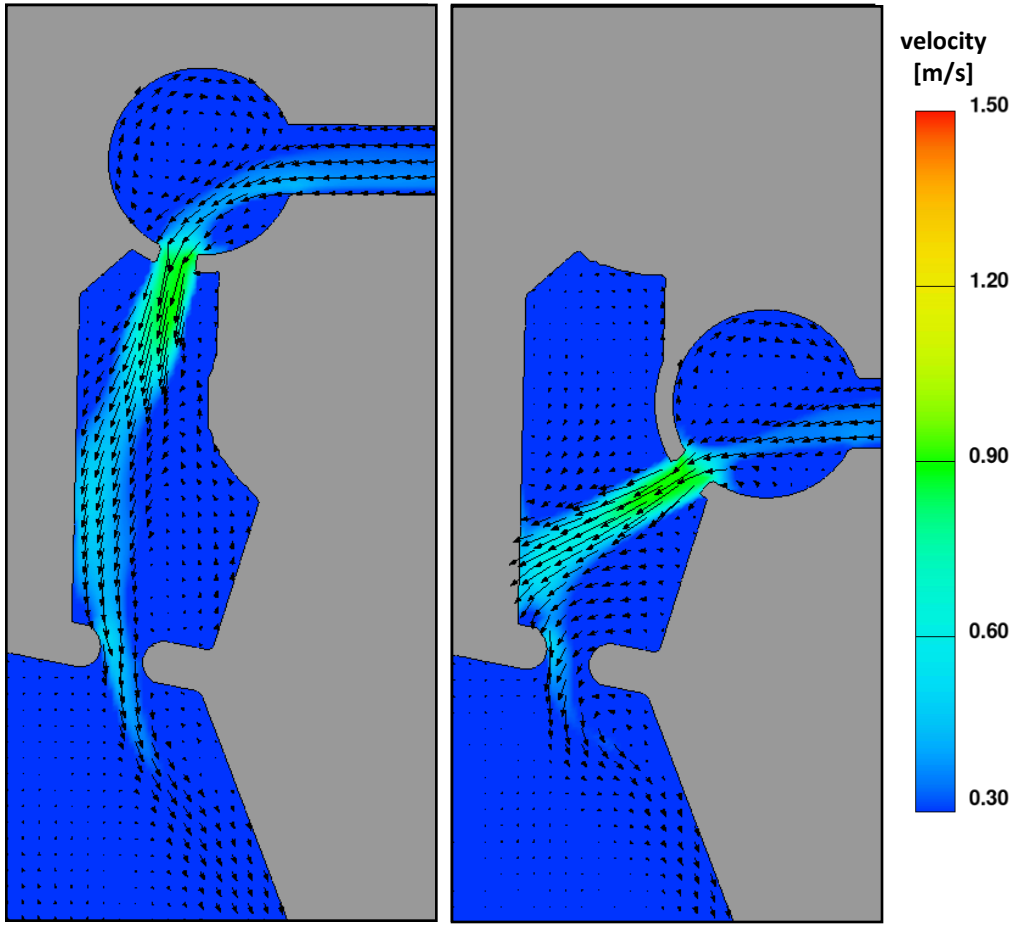
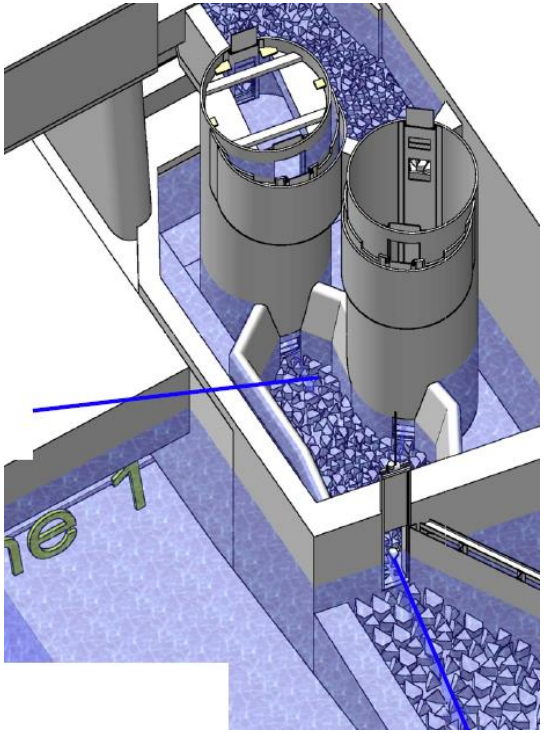
Example: Prechamber design

- 3D-hydrodynamic numerical model





numerical

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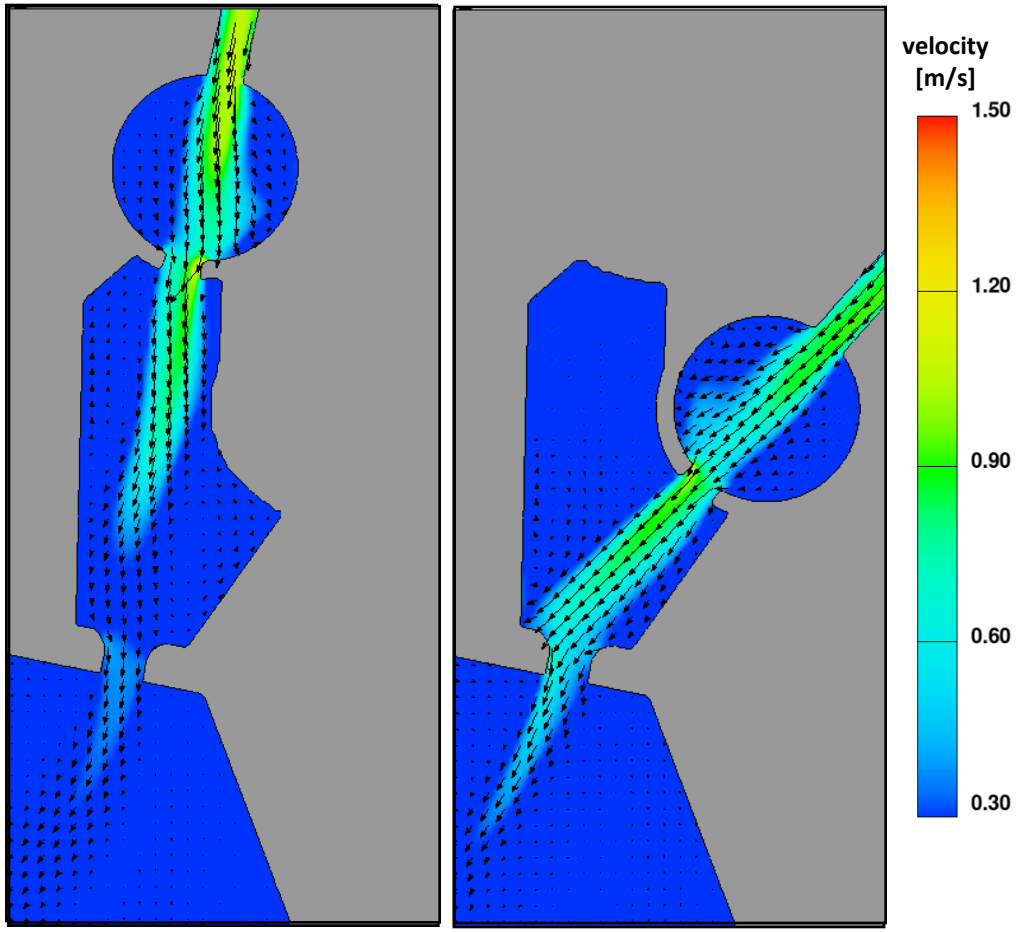
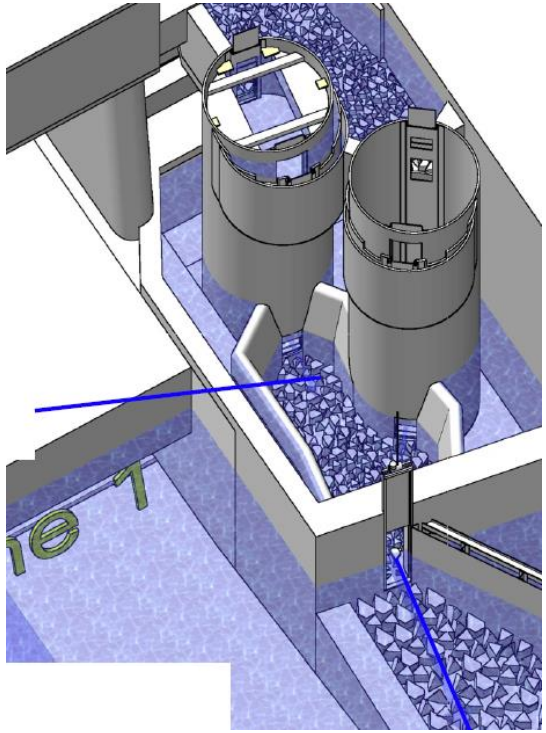
Example: Prechamber design

- 3D-hydrodynamic numerical model



> 50 simulations



numerical

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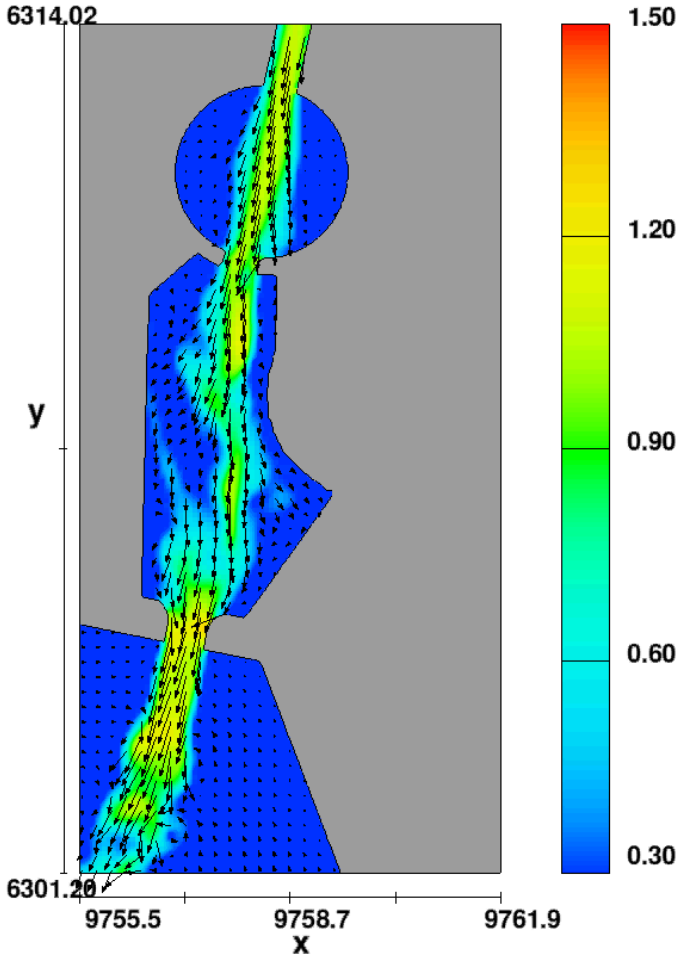
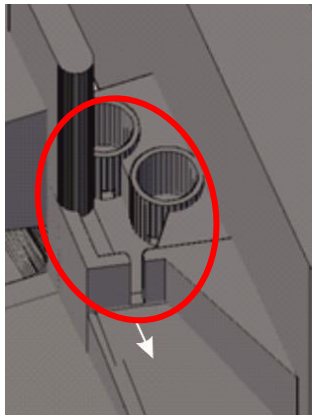
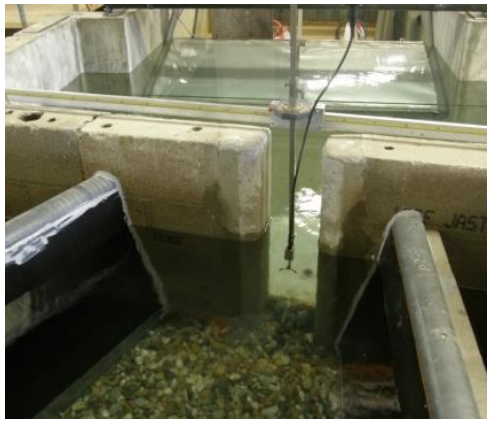
Example: Prechamber design

- 3D- numerical model, LES



- Physical model, scale 1:3





numerical

physical

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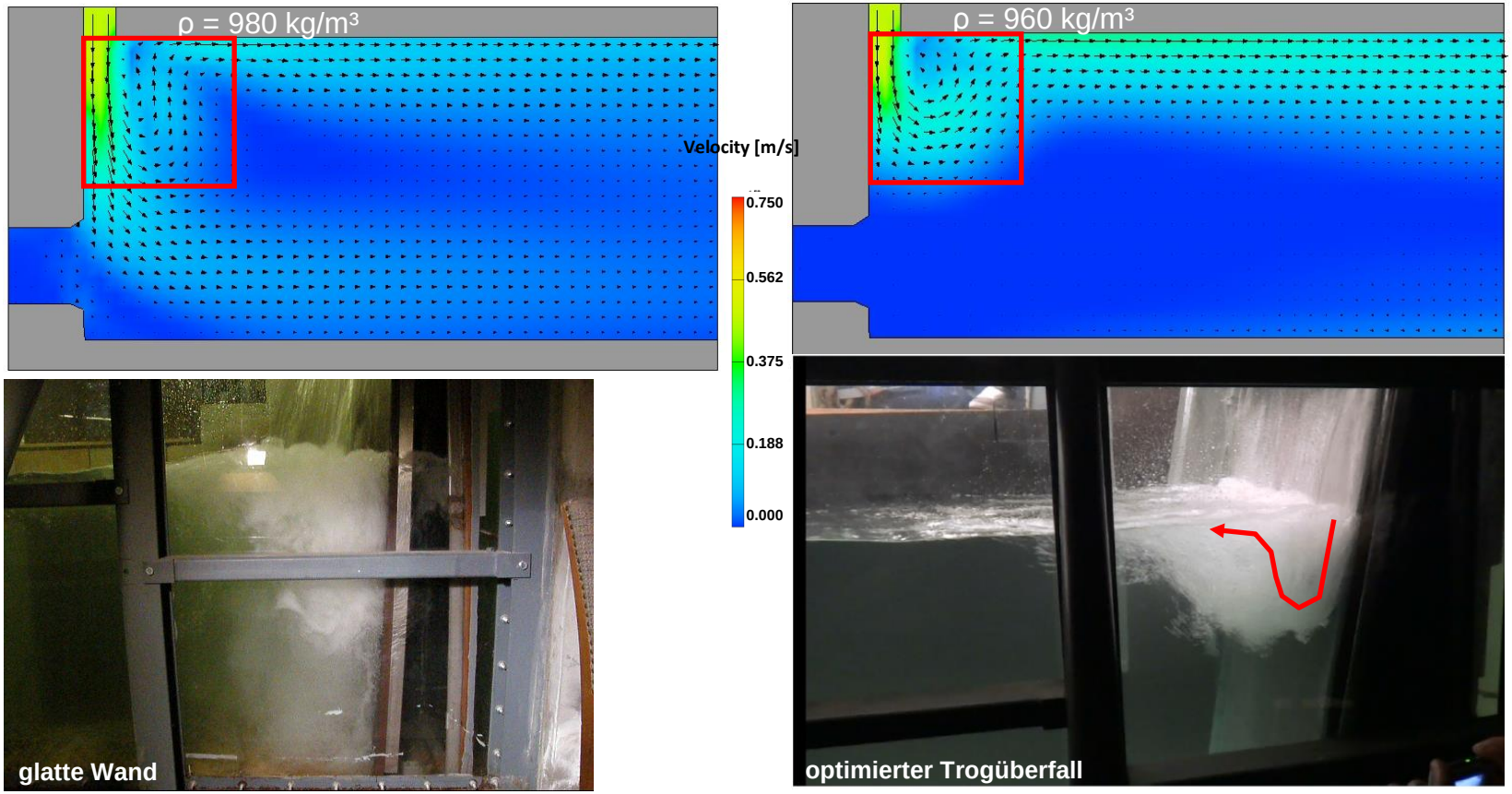
Example: Prechamber design, additional dotation

- 3D- numerical model and physical model scale 1:1,7



numerical

physical

ethohyd.

Additional ethohydraulic test for the dotation, scale 1 : 1,7

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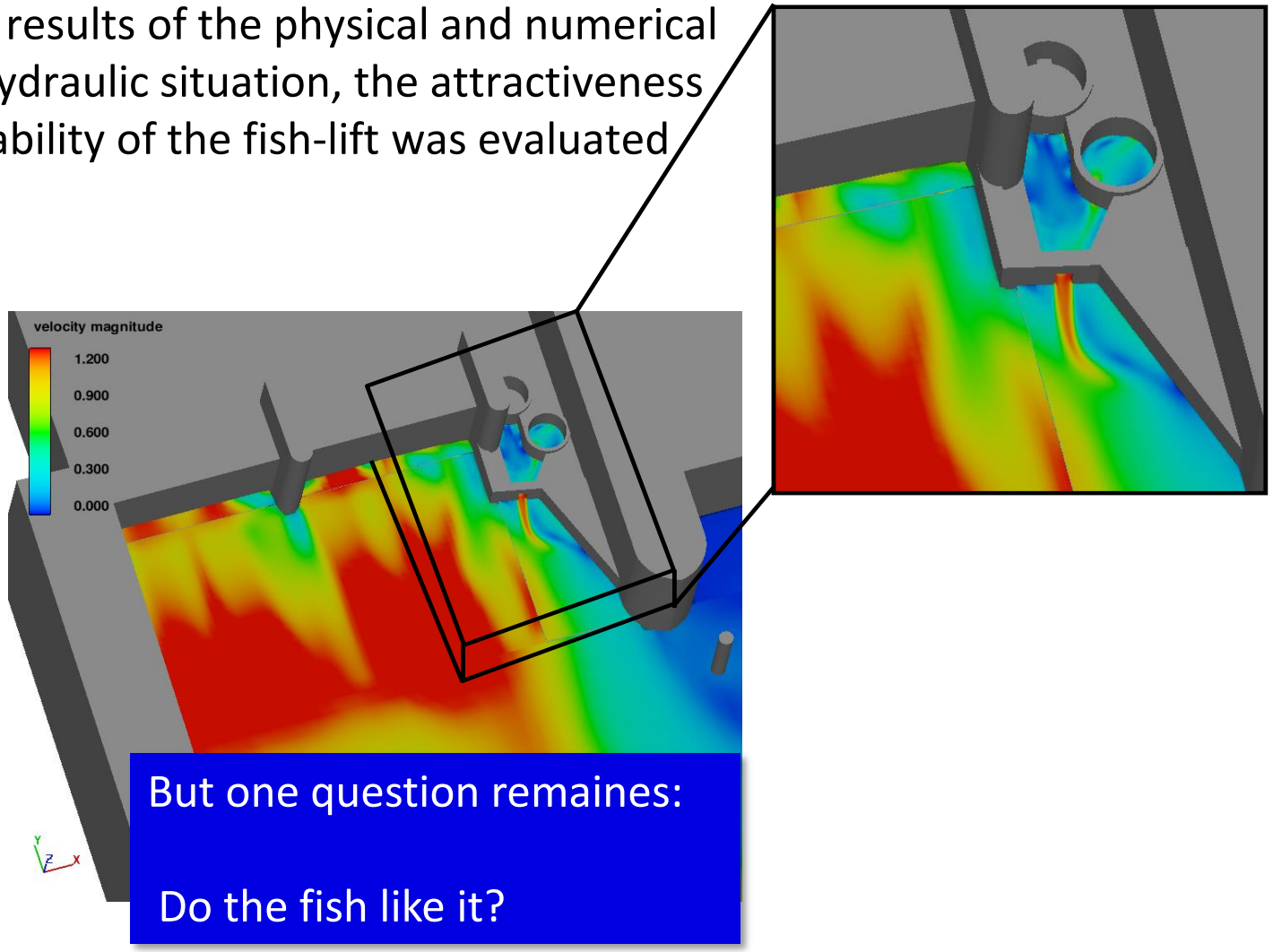
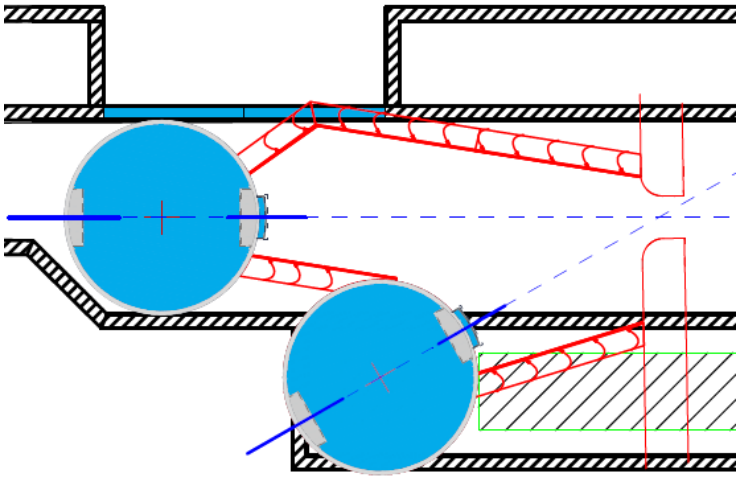
Result of the model study

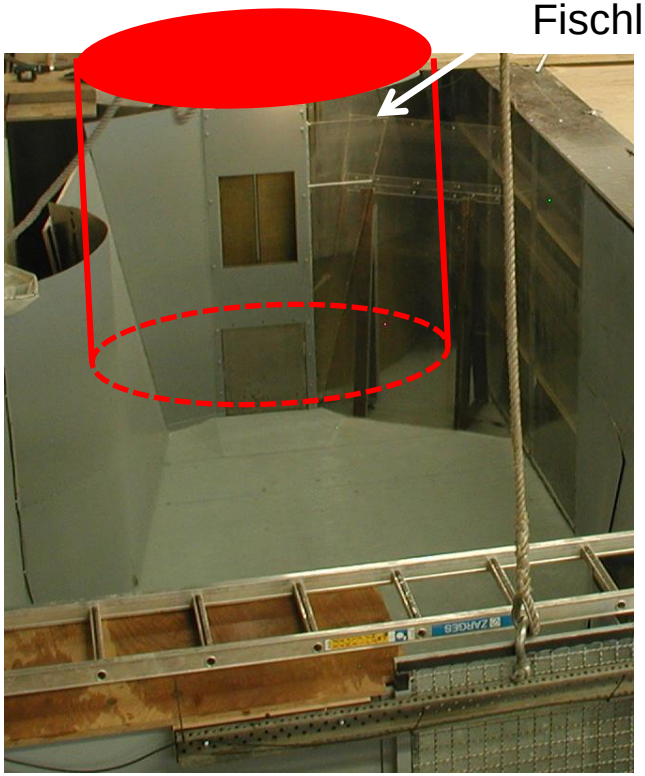
- Based on the results of the physical and numerical models the hydraulic situation, the attractiveness and the passability of the fish-lift was evaluated positive!



Let´s ask the fish: Ethohydraulic test

- Setup scale 1:1





- Ethohdraulic flume at KIT
  - Lenght: 20 m
  - Width: 2,7 m
  - Depth: 2,0 m

ethohyd.

Ethohydraulic test

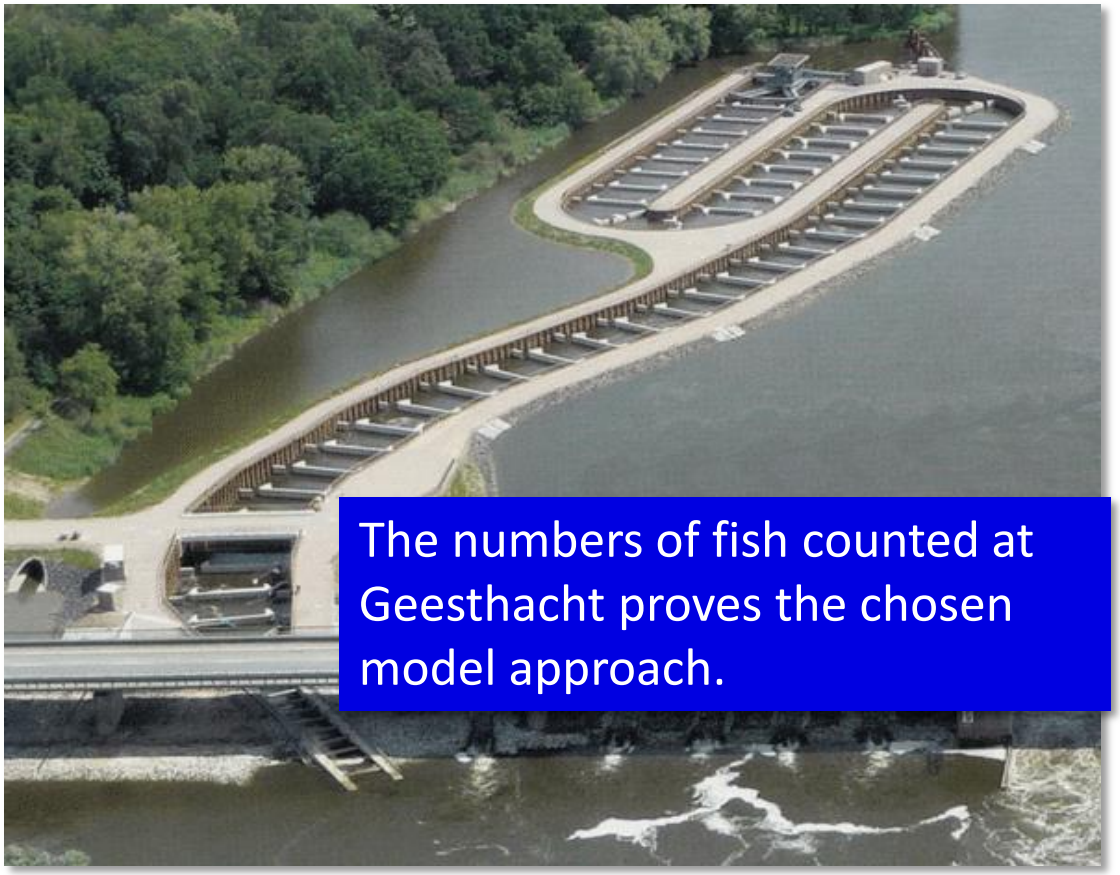
Art	Einstieg	Ausstieg
Aal (inkl.Steigaal)	+	+
Barbe	+	+
Barsch	+	+
Brassen	+	+
Döbel	+	+
Elritze	+	+
Forelle (Bach-/Seeforellen)	+	+
Gründling	+	+
Hasel	+	+
Hecht	+	+
Karpfen	+	+
Quappe	+	+
Rotauge	+	+
Ukelei	+	+
Zander	+	+
Anzahl Versuche	35	40

- > 800 individuals from 15 fish species
- > 80 setups

In addition to the model study, the functionality of the fish lift was proven within the etohydraulic test.

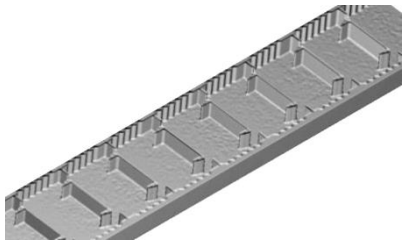
- 2015: Test for downstream passage
- 2016: Construction

Case Study 2: Fischway Weir Geesthacht



The numbers of fish counted at Geesthacht proves the chosen model approach.

- Study at KIT: 2008-2009
- Construction 2010

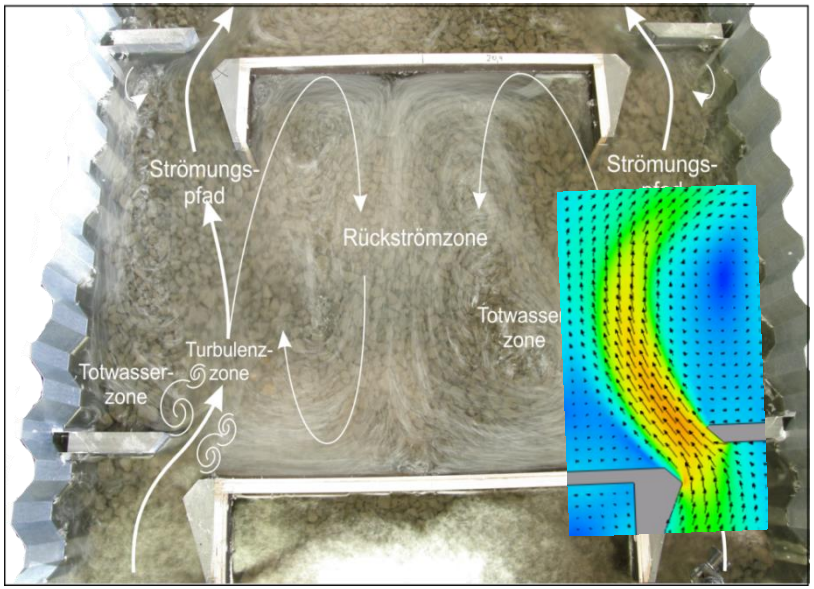


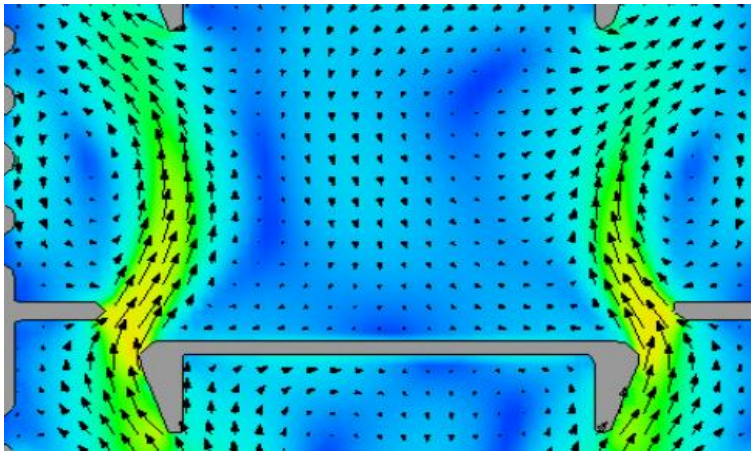
numerical

physical

ethohyd.

Flow field of the fish way Geesthacht

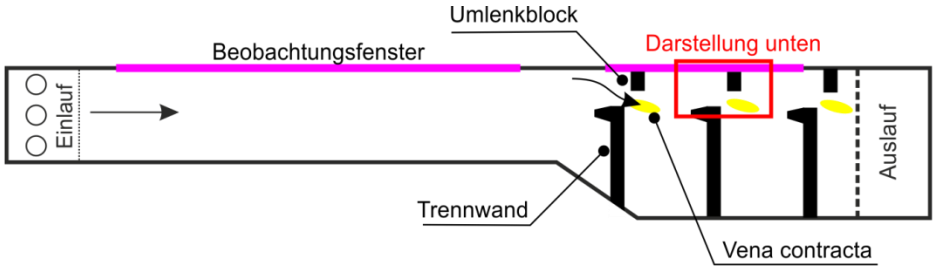


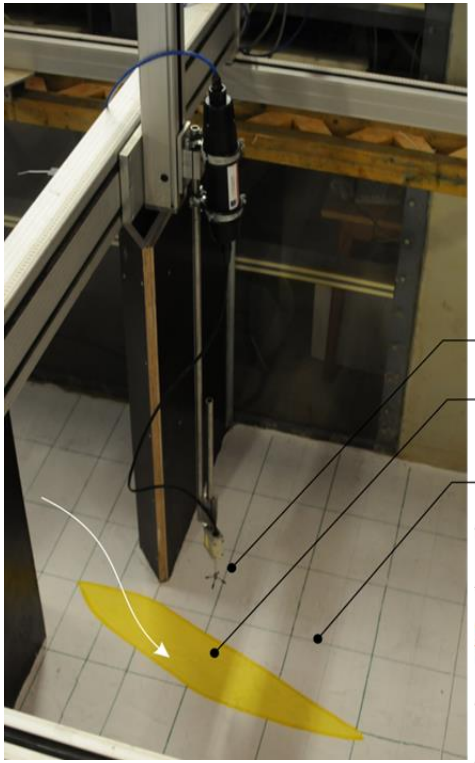


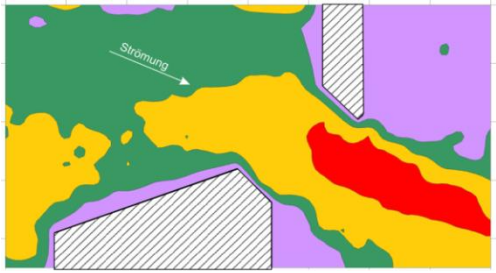
numerical

physical

Example: Ethohydraulic test for the slot passage







ethohyd.

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Conclusions

- Today, it is possible to utilize available tools in the planning phase to increase the quality of fish passages.
- This is of particular importance for special designs and non-standard solutions.
- We can extract way more than just the mean velocity out of the numerical and physical models, therefore we need to know more about the interaction between the fish and the hydraulics and fish-relevant hydraulic parameters e.g. turbulence, eddy size etc.
- Ethohydraulics is a good way to support engineerical problems and to learn more about the interaction between the flow field and fish behavior.

Thank you for your attention!