



# Centre for environmental design of renewable energy - CEDREN



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# SafePASS

Efficient and safe two-way migration  
for salmonids and European eel pass  
hydropower structures

**CEDREN**

Centre for Environmental Design of Renewable Energy



# The project itself

SafePASS aims to find the best solutions for fish migration in regulated rivers, from the perspectives of both the fish and the hydropower industry. Includes:

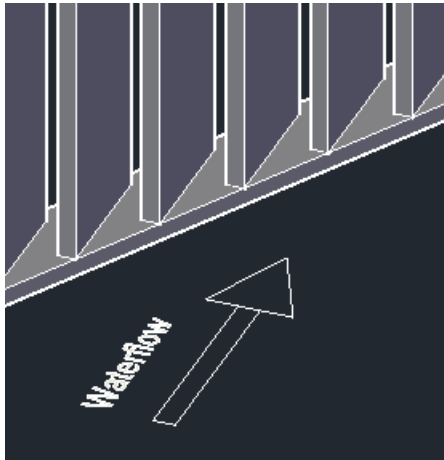
- Trash-rack experiments in hydraulic laboratory
- Analysis of the impact of hydraulics on the behaviour of eels at the vicinity and passing spillways
- Smolts tracking by using telemetry on river Orkla
- Numerical modelling of the reservoir and intake at Svorkmo HPP

# Background

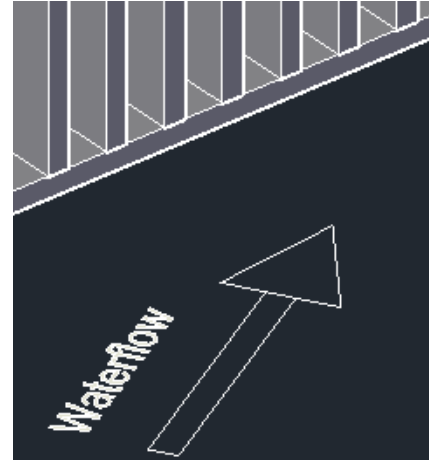
- During downstream movement some fish pass through the intake towards to the turbine
- The crossing has high mortality for the fish
- What is the main aim goal of this work?
- Help to prevent fish to enter into the intake/tunnel during their downstream migration with minimum of head-loss associated

# Fish-friendly trashracks

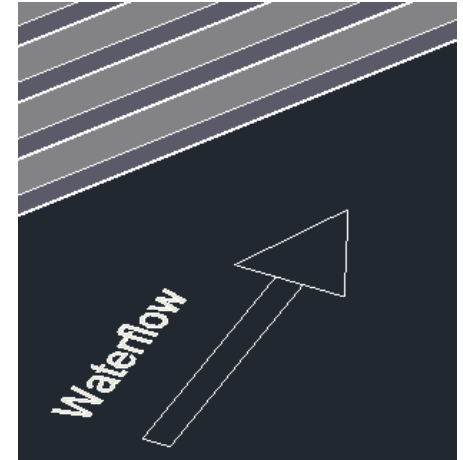
Rack I.



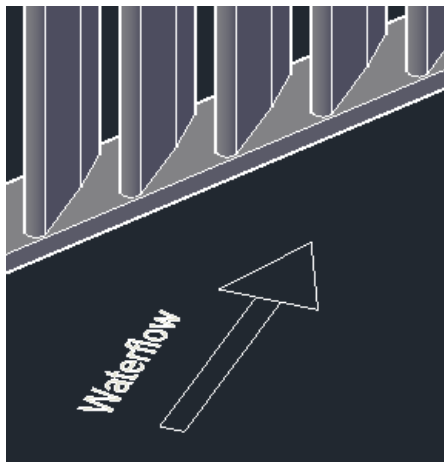
Rack III.



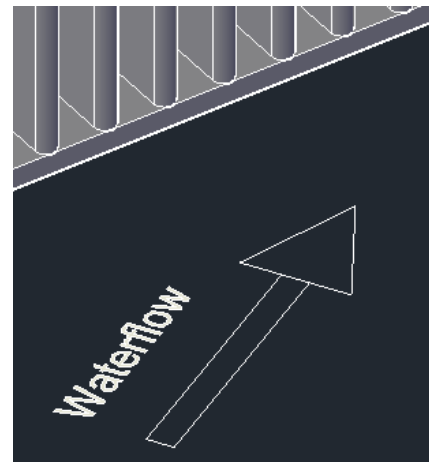
Rack V.



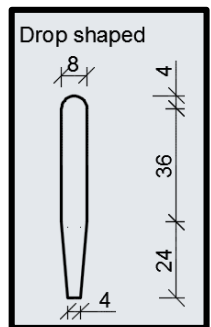
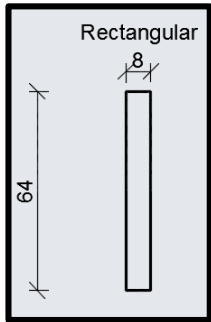
Rack II.



Rack IV.

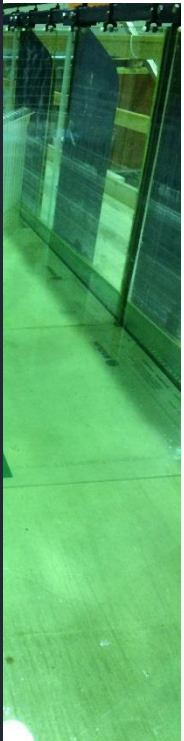
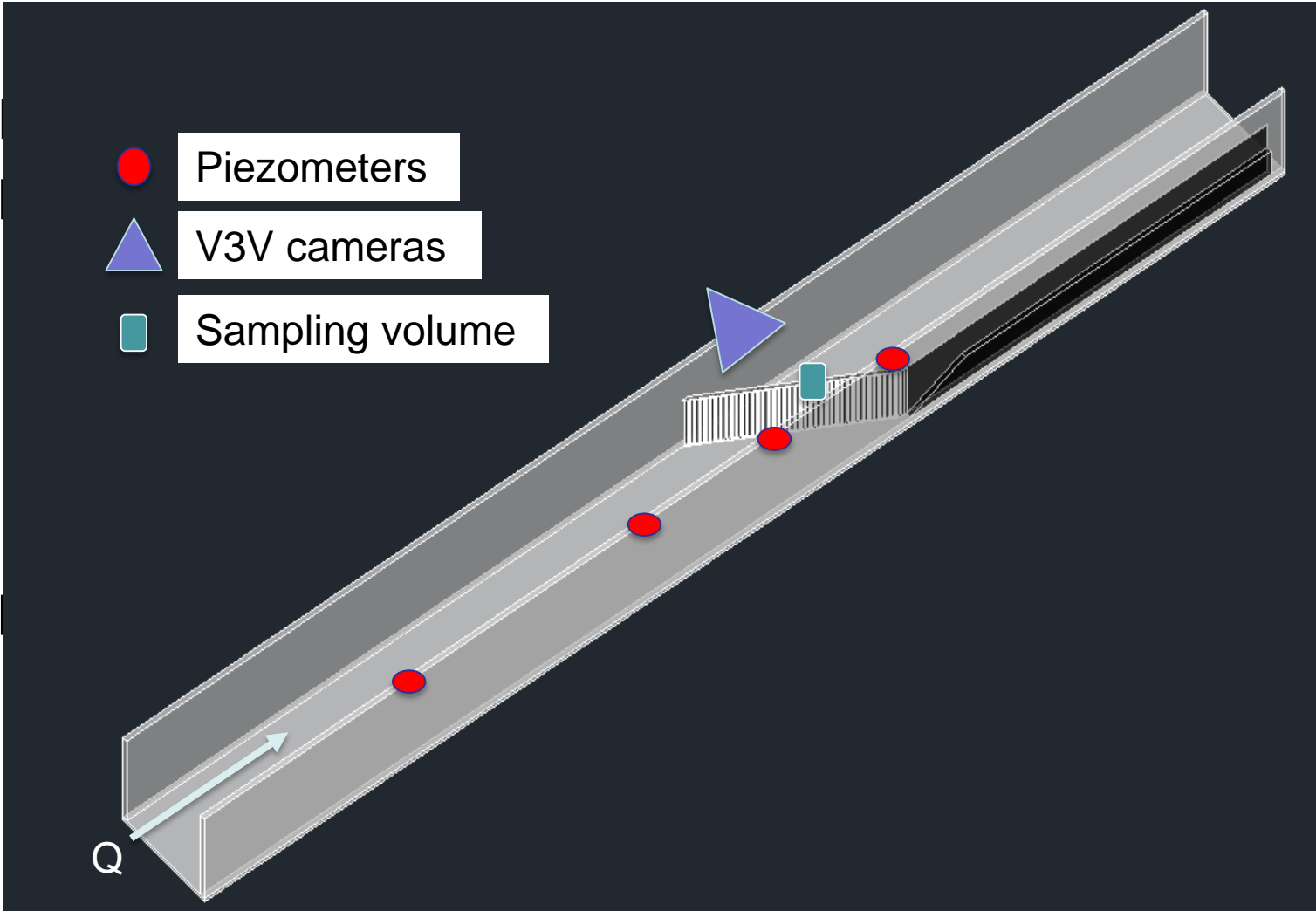


Rack VI.



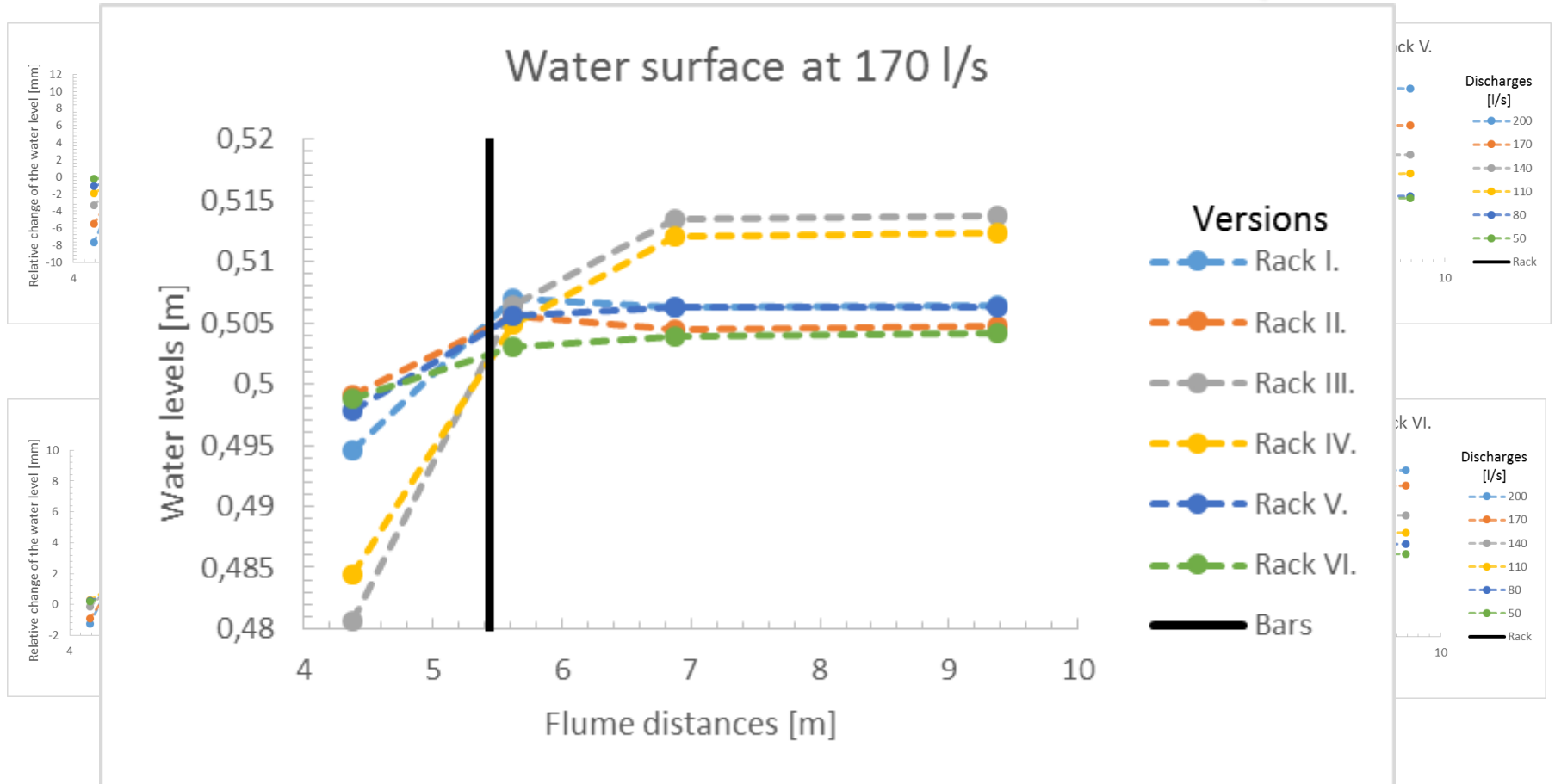
# Laboratory setup

- - 
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- Piezometers
  - ▲ V3V cameras
  - Sampling volume

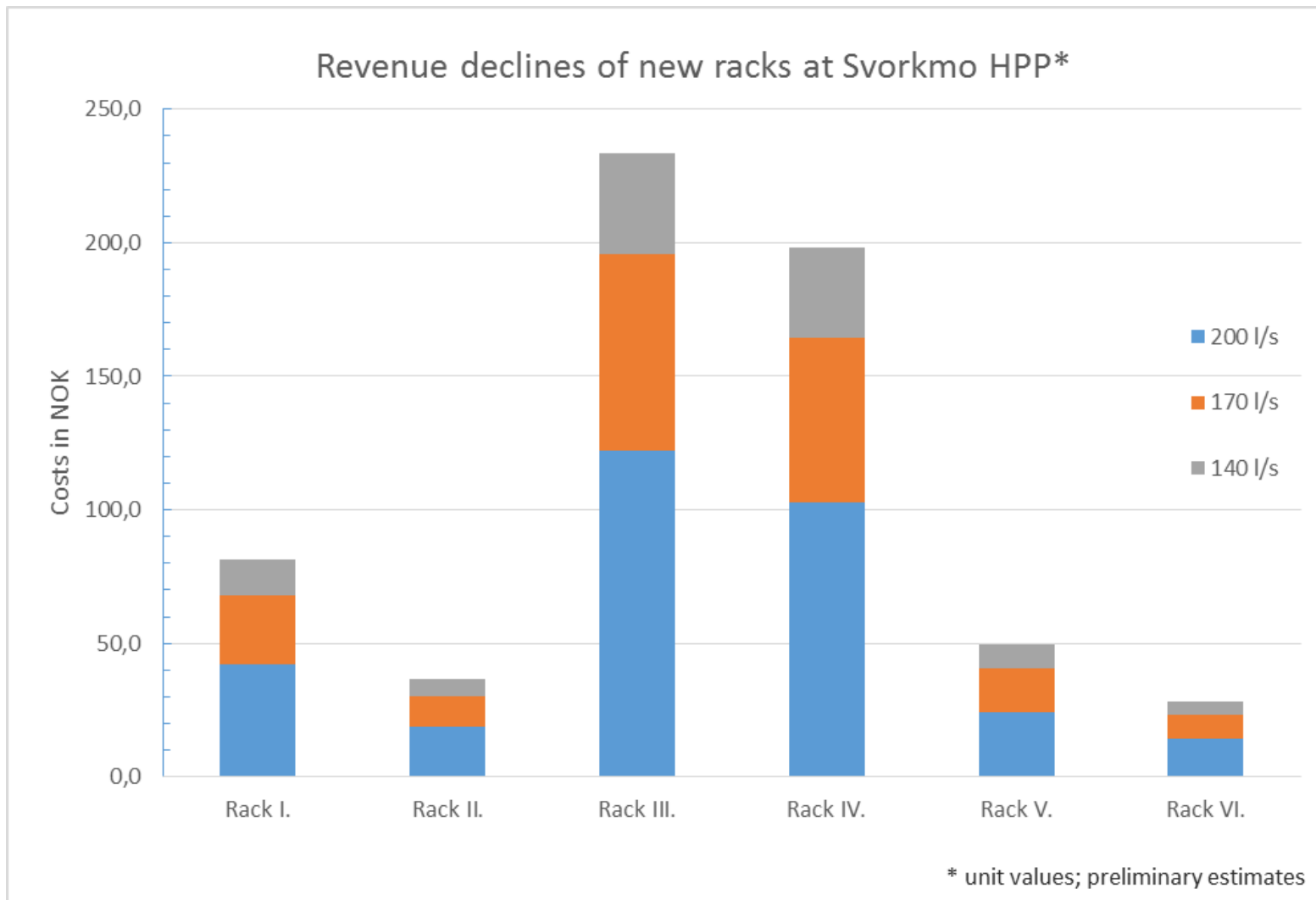


# Head-losses

Flow direction  
←



# Head-losses





# About the V3V system

- Volumetric 3-Component Velocimetry (V3V)
  - Based on the method of Particle Image Velocimetry (PIV)
  - 140x140x100 mm measured volume
  - Gives high resolution of 3D velocities
- Conditions:
  - Installed laser and camera system (3 high speed cameras)
  - 55  $\mu\text{m}$  particles were mixed into the water
- Method:
  - Calibration in calm water
  - Capturing when firing the laser

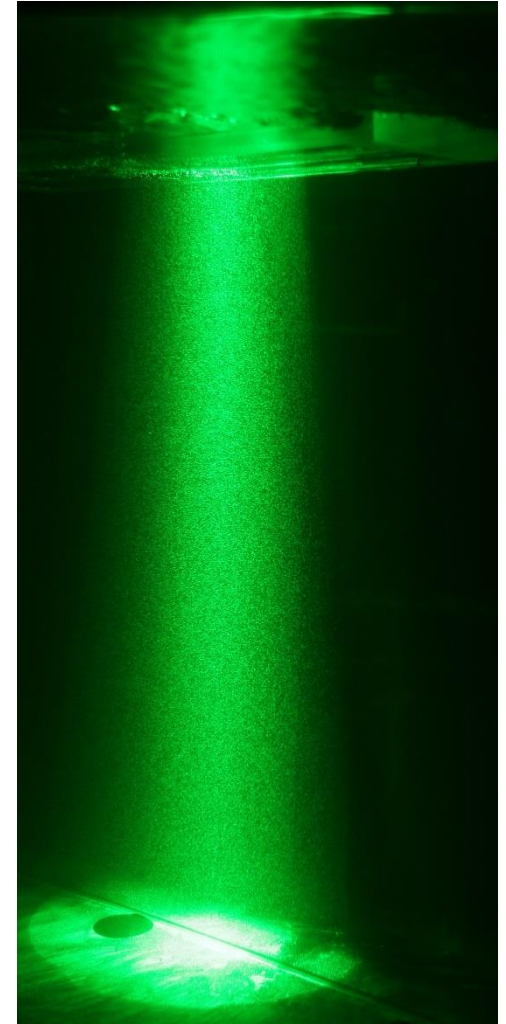
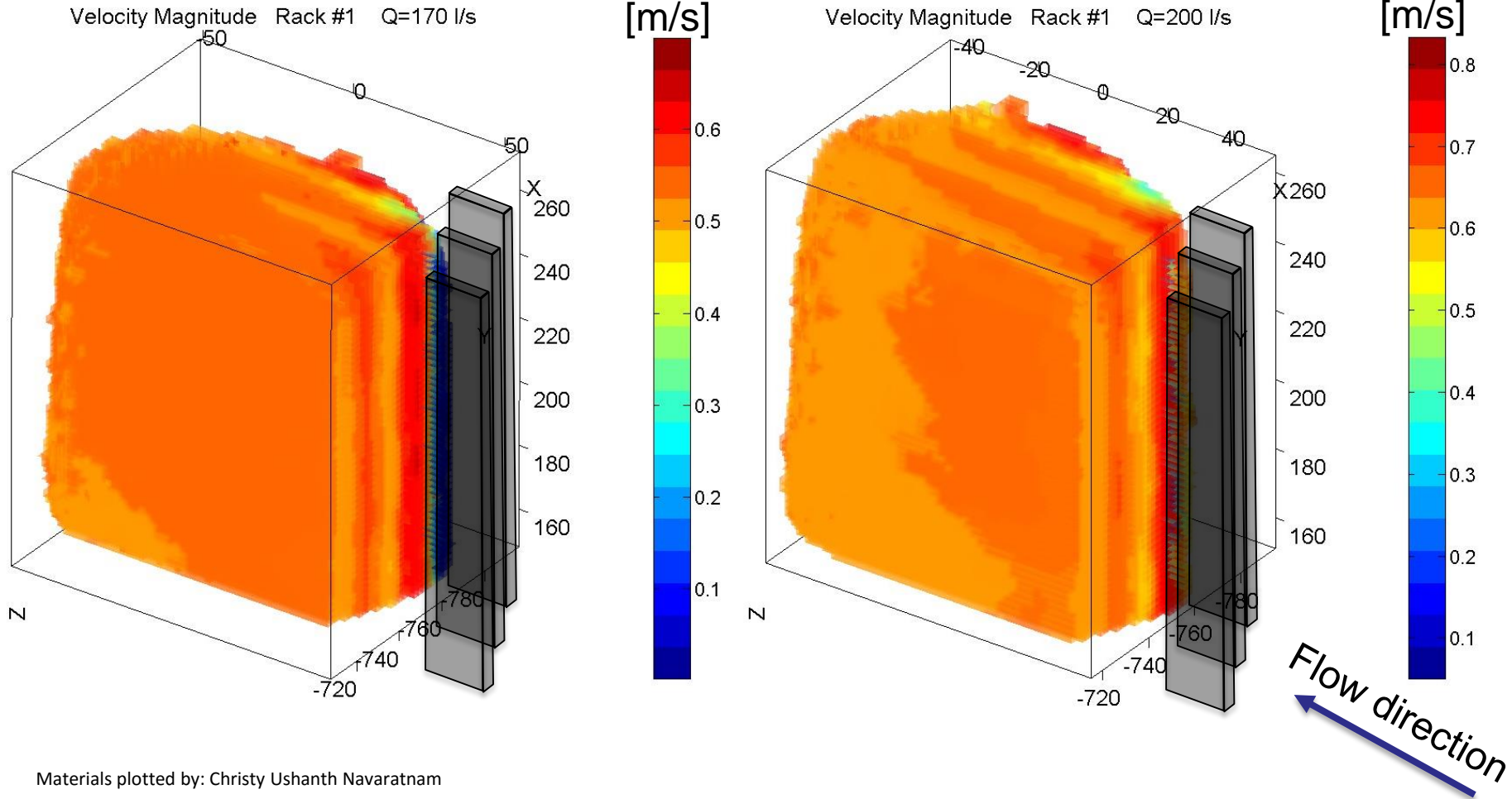


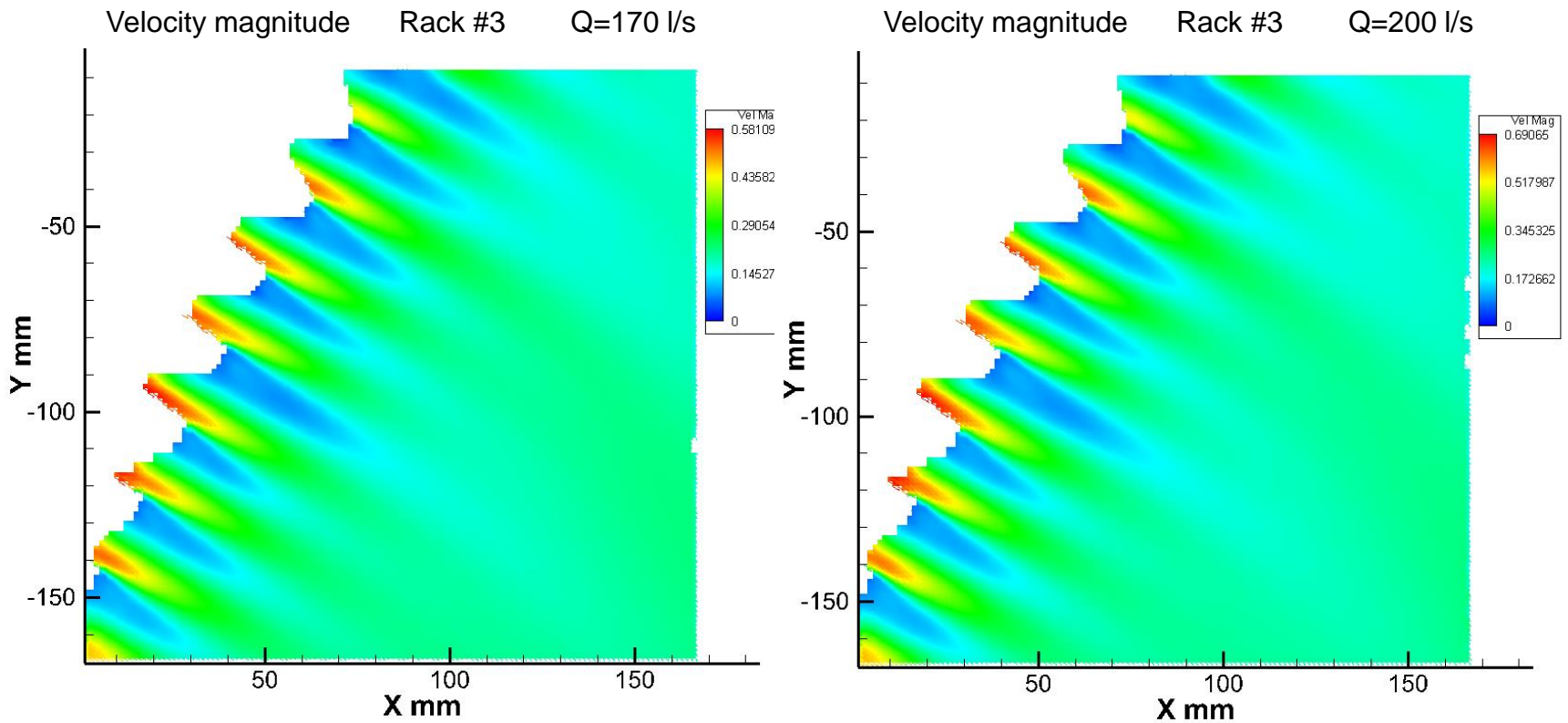
Photo: Knut Alfredsen

# Results of V3V



Materials plotted by: Christy Ushanth Navaratnam

# Results of PIV



Materials plotted by: Christy Ushanth Navaratnam

Thank you for your attention!



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