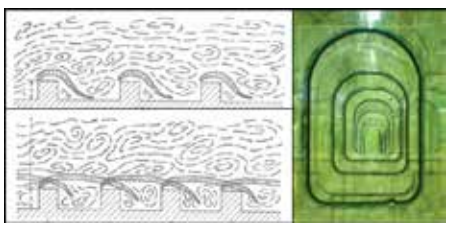
Background

The estimation of the hydraulic resistance in rough (rock-blasted) tunnels is critical in hydropower engineering. To investigate the tunnel conveyance capacity in hydropower systems, the so-called Birkeland method* has been derived at the Norwegian Hydraulic Laboratory (NTNU) to simulate the tunnel wall roughness by an equivalent strip roughness glued inside smooth tunnel models.

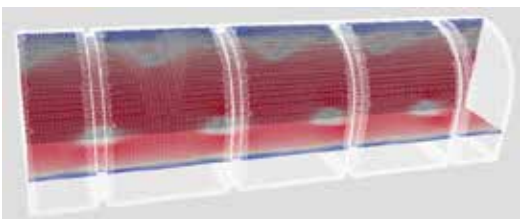
Whilst widely used in the hydraulic laboratory at NTNU, some aspects of the method are yet to be tested; such as its validity for a wider range of discharges and roughnesses, as well as the impact of the inflow conditions on the head losses and flow field between the strips of the physical model.

As a part of the investigations conducted within the Tunnel Roughness project, the validity of the Birkeland approach is tested numericaly within the OpenFOAM CFD package (RANS and RANSTT simulations), and compared to an experimental dataset acquired in 2017.

The Tunnel Roughness project is a Knowledge-building Project for Industry funded by the Norwegian Research Council and a consortium including NVE, TronderEnergi, BKK and NVKS. More information and updates can be found at www.ntnu.edu/nvks/tunnelroughness



Sketch of vortex generation as described by Chow (McGraw-Hill - 1959) and example of strip roughness in a tunnel model (*Birkeland, Master thesis NTNU - 2008)



Velocity field estimations in a strip roughness tunnel model – E. Mølmann

MASTER THESIS

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Numerical simulation of water flow in a laboratory tunnel

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