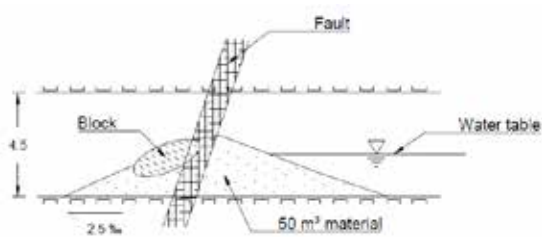
Background

Unlined high pressure tunnels and shafts are regarded as a Norwegian specialty in the hydropower industry. This cost saving solution has been possible due to the Norwegian support philosophy that accepts some rock fall during operation. Over the last years, the production pattern of many Norwegian hydropower plants has changed from supply driven to demand driven, which involve higher frequencies of start-and-stop cycles of the turbines. This production pattern is in use at Brattset Hydropower Project, where there has been experienced an increase in rock falls and other stability problems in the recent years.

During the project work prior to the MSc thesis, a study on the engineering geological conditions along the unlined headrace tunnel of Brattset was carried out. Four different types of instabilities were identified, relating to weakness zones, jointing and stresses in the rock mass.



The MSc thesis aims to further analyze and discuss these stability issues, and investigate the influence of hydraulic mechanisms caused by start-and-stop cycles. Stability assessment of the identified issues will be carried out, using both analytical and numerical modelling. Results from field mapping, laboratory testing of the rock mass and evaluation on gouge swelling potential will be important input data in the models. Finally the findings will be used in a discussion on the long-term stability of Norwegian unlined hydropower tunnels.

Block fall in the headrace tunnel in 2015, caused by joints and stress induced micro-cracking

Illustration of collapse of weakness zone in the headrace tunnel in 2008. The failure was caused by swelling material in the zone.

MASTER THESIS

Ragna Halseth

Department of Geoscience and Petroleum

Spring 2018

Stability assessment of headrace tunnel system of Brattset hydropower project

Supervisor:
Krishna K. Panthi
Co-supervisor:
Bibek Neupane

NTNU