Processing of ERT data from Stabilised Columns

Inversion of cylindrical ERT data of jet grouting stabilised columns by using AarhusInv

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Modern construction sites are associated with high demands on suitable soil conditions, resulting in geotechnical challenges that can be solved using soil stabilisation techniques. The reliability of these techniques is tested using different quality assurance methods. One of the most common ground stabilisation methods is jet injection and installation of jet grouted columns. Quality control (QC) methods are necessary to ensure that the jet grouted columns meet requirements. One critical geometric property to be controlled is the radius. Traditional QC methods are expensive and invasive. An alternative quality assurance method, electrical resistivity tomography (ERT), has been tested as part of this study. The results show that ERT has good potential as a QC method of jet grouted columns. However, the handling of measured ERT data from jet grouted columns need to be improved and handled in a software that takes the cylindrical geometry to account.

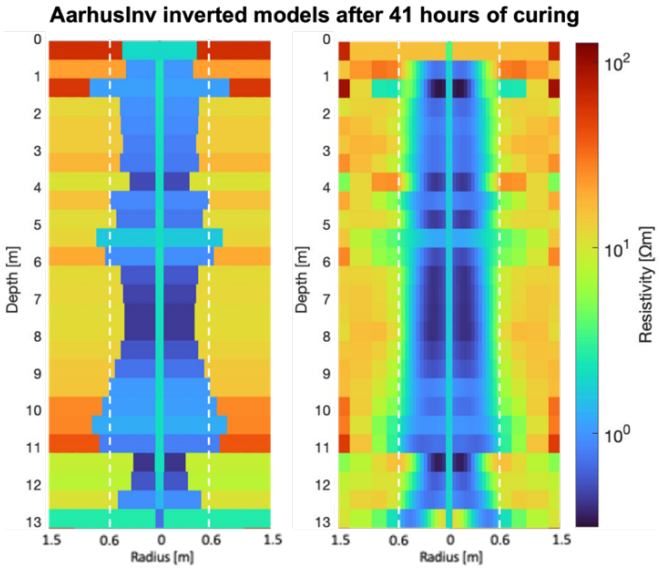
The installation of the jet grouted columns involves mixing the in-situ soil with cement slurry, which is then injected with a high-pressure jet to create a ground stabilising column. The high-pressure injection can lead to significant variations of radius across column depth. The aim of the thesis is to test how well the quality of the columns are reflected by the measured data and inverted models in the alternative software (AarhusInv)?

The ERT method is a geophysical method used to image the subsurface via measuring the subsurface resistivity. By inducing electrical current into the ground and measuring the potential differences the resistivity can be calculated. The method could be used on jet stabilised columns as a QC by measuring the resistivity contrast between the stabilised column and the surrounding soil. The result of this potential QC could indicate the column radius.

The data, synthetic ERT data was generated and processed using forward modelling. Different kinds of jet grouted column geometries were simulated to test the accuracy of the software. The synthetic data sets were subjected to different levels of noise, and inversions were performed on the models with and without noise. Furthermore, ERT field data from a test site in Moss, Norway was also inverted and analysed.

The inversion was performed with AarhusInv, a software that supports cylindrical geometry input. The inversion of the synthetic and measured data was carried out using two different models: a few-ring model and a multi-ring model. The results from the inversion of the field data were compared with inversions performed on the same data using the programs Res2DInv and pyGIMLi. The goal was to examine whether AarhusInv is better at detecting variations in resistivity on cylindrical objects and connect that to the jet grouted column radius.

The results show a clear contrast in resistivity between the jet column and the surrounding subsurface. This suggest that the ERT method is valid for QC method purposes. In contrast, the results from the control method are significantly impacted by the introduction of noise. It is also shown that it is possible to invert cylindrical objects



with varying radii in AarhusInv. Although there are some deviations between the designed geometry of the synthetic models and their inverted models.

The inversions on the measured data show a subsurface cylindrical construction with a deviant resistivity compared to the surrounding subsurface. The subsurface column has an expected radius that is higher than the radius of the inverted models. However, both a few-ring and a multi-ring inversion model work and give similar results.

Despite promising results, the ERT method needs further validation to be considered as a common quality assurance practice. A possible way to establish the accuracy of ERT is to perform the measurements on a jet grouted column and then excavate the column. This would allow one to compare the inversion result of the ERT data and column quality established through excavation. The application of AarhusInv and few-ring model is recommended for the inversion, due to the simple setup and clear results. The method can then be compared to other QC's.