Compensation grouting in coarse-grained soils - Model tests and numerical calculations

Name: Martin Sailer
E-Mail: m.sailer@tum.de
Supervisor: Prof. Dr.-Ing. Roberto Cudmani
Chair of Soil Mechanics and Foundation Engineering, Rock Mechanics and Tunneling
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Introduction – The technique of compensation grouting
Compensation grouting is a special civil engineering method used to compensate settlements under existing buildings (Fig. 1). Grouting is carried out through a layer of manchette tubes (TAMs) which are drilled horizontally in the subsoil beneath the building (e. g. from a shaft). A slowly hardening grout is injected into the subsoil via the TAMs. The injected grout displaces the soil. As a result the surface is lifting. Occurring deformations of the building are measured in real time by water level monitoring. Repeatedly injecting small amounts of grout can compensate settlements on the building [1].

Problem definition
In building practice, compensation grouting in coarse-grained soils (sand and gravel) lead to high material consumption, long execution times and high costs. Problems, among others [2], are:
- Grout can flow into the pore space, as a result no deformation of the soil occurs
- Filtering of the grout leads to a Reduction of the effective grout volume

Fig. 1: Mode of action of compensation grouting.
Research content:
The development of new experimental and numerical tools should enable a more reliable and economic planning and execution of compensation grouting in coarse-grained soils.

1. Development and execution of small-scale model tests:
   - Suitability test of the grout mixture (Fig. 2a)
   - Development / shape of the resulting grout body (Fig. 2b)
   - Influence of different grouting concepts (grouting of several times small grout quantities compared to less frequently large amounts of grout)

2. Large-scale grouting trials in a test pit:
   - Compensation grouting as on site, but under known boundary conditions
   - Spatial measurement of the liftings by using special measuring systems
   - Effects on the efficiency of different grouting concepts

3. Numerical calculations (Fig. 2c):
   - Calibration and validation of the calculations based on small and large-scale grouting tests
   - Recalculation of completed construction measures
   - Derivation of generally valid recommendations for interaction between compensation grouting and buildings
   - Improvement of the existing predictions based on numerical calculations of compensation grouting in coarse-grained soils

Fig. 2: Small-scale model tests (a, b) and numerical calculations (c).

References