GEOFROST

Dealing with challenging ground conditions

Dr. Anne-Lise Berggren, senior specialist



We freeze the challenging ground, making "rock" out of soil.

Drill and blast through frost blocks. Excavate soil inside frost cylinders.



APPLICATIONS



Ground freezing to reach sufficient rock overburden.

- Arch, cylinder or block.
- Alternative to cut and cover portal.
- Reduce mass movement.
- Avoid demolishing buildings in infrastructure alignment.
- Eliminate slope stability.
- Enable alignments that earlier was impossible.





Ground freezing through weak and waterbearing ground

- Norwegian way of tunneling: Investigation drilling to be aware of what is coming.
- Stop before running into trouble.
- Drilling chamber to allow freezing pipes parallel to the tunnel.
- Drill through blow out preventors if high water pressure.
- Freeze the week/water bearing zone.
- Continue tunneling by D&B or TBM.

Freezing to deal with challenging ground conditions





Ground freezing compensate insufficient rock overburden.

- Access from surface.
- Freezing ready when tunnel arrives.
- Tunneling continues as if nothing special.

Freezing to deal with challenging ground conditions





Ground freezing was invented in mining industry

- Europe 19th century.
- Ground becomes impermeable and hard when freezing.
- Originally trial and error.
- Geo-knowledge developed.
- Today a predictable and controllable method.
- Instrumentation verifies that temperature criteria are reached before excavation.





WHAT WE OFFER



Geofrost deliver:

- Design
- Installation
- Freezing
- Maintenance
- Instrumentation

A complete temporary waterproof stabilization



Market areas:

- Tunnels and shafts
- Hydropower tunnels
- Construction pits
- Water and sewerage
- Environmental mitigation
- Ground investigation
- Consulting



REFERENCES



The Oslofjord tunnel, permeable soil 120 m below sea

Glaciofluvial material of sand, gravel and blocks was impossible to grout to achieve impermeability and sufficient stability.

Ground freezing stabilized and sealed the zone before drill and blast 120 m below the fjord.







Three lane subsea road tunnel



Festningstunnelen (Fjellinjen) urban area





ALLIM SHALE

CLAY

5 m above tunnel crown, in urban area with weakness zone of fissured alum shale and completely disintegrated rock (clay):

- permeable moraine
- sand and gravel
- marine soft clay

Ground freezing stabilization and water proofing.

Three lane road tunnel, double tube





The Hallandsås tunnels through disintegrated rock

Ground freezing stabilized the difficult Möllebäck zone before TBM drilled through. The 300 m long zone consisted partly of deeply physical and chemical weathered rock (residual soil) and partly of rock with highly permeable fissures.



Single track double tube railway tunnel



The Eidsvoll tunnel through clay and silt

NATM with steel arches and sprayed concrete, through clay and silt. Excavation through silt below groundwater needs stabilization! Ground freezing stabilizes and makes the ground impermeable (rightmost picture).



High-speed railway tunnel



The Global Seed Vault, water control in tallus

Frozen retaining walls prevent meltwater and rainwater to enter the tunnel entrance/excavation pit.



Nearly 30 meter deep excavation for cut and cover tunnel





100+ projects

Selected References

Contracting

- Festningstunnelen, Oslo, Norway,Road tunnel, crushing zone, The Norwegian Public Road Administration
- The Oslofjord tunnel, Norway, Road tunnel, leaking weakness zone, Scandinavian Rock Group
- Södra länken SL01, Stockholm, Sweden, Road tunnel, mixed face, NCC
- Eidsvolltunnelen, Norway, Railway, soil tunnel, AF/Hochtief JV
- Älvsjö, Stockholm, Sweden, Sewerage tunnel, mixed face, Skanska
- HATS1, Hong Kong, Sewerage tunnel, start block for TBM, Skanska/Shui On/Balfour Beatty JV
- Skoddeberg, Norway, Ice plug, Hålogaland Kraft

Consulting

- Shaft, Dounreay, Great Britain, Shaft refurbishment, nuclear waste, The United Kingdom Atom Energy Authority
- E18 Månejordet, Norway, Road tunnel, mixed face with quick clay, The Norwegian Public Road Administration
- Ambuklao Hydro Power, The Philippines Ice plug, Statkraft
- Hallandsås, Sweden, Railroad tunnel, Skanska/Vinci
- E16 Wøyen-Bjørum sag, Norway, Soil tunnel feasibility study, The Norwegian Public Road Administration
- Södra Länken SL04, Stockholm, Sweden, Road tunnel with lack of rock overburden, The Swedish Public Road Administration
- Fellesprosjektet, E6 Dovrebanen, Norway, Road and railway, geotechnical engineering, Norwegian National Railway Administration





Statens vegvesen











BANE NOR





Oslo kommune



AF GRUPPEN

VINCI



UK Atomic Energy Authority





BETONMAST





Thank you for your attention

www.geofrost.no/en

