

香港岩土及岩土環境工程專業協會 ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS (HONG KONG)

Website: www.ags-hk.org

GROUND INVESTIGATION GUIDELINES 04.4 - ROCK TUNNELS

What do we need to know?

General Information Needed

- · Tunnel Alignment
- · Geological Model
- · Hydrogeological profile
- · Presence of hydrothemal alteration. weak layers or planes & their orientation (faults, shear zones)
- · Underground water flow (sub-surface streams etc.)
- · Overlying water (rivers, lakes, sea)
- Structures sensitive to settlement (i.e. groundwater drawdown) or vibration (i.e. from blasting).
- · Existing tunnels or utilities (location in relation to tunnel)
- Mineworkings

Scheme plans

Field Mapping of all relevant exposures Aerial photographic interpretation

Investigation Drillholes (vertical & inclined to pick up faults & rock structure). Horizontál drilling at portals) Directional drilling **Piezometers**

Geological maps & available GI records

Utility records and plans, topographic maps etc. Tunnel face logs, support system records, stabilisation measures

Sampling

Cohesive Soils: U100/U76/Mazier

(transported soils or saprolites)

Piston

(v.soft-soft soils)

Granular soils:

Bulk samples, SPT split spoon U100/U76 & disturbed samples

Rock:

Double tube coring to prove rock. Air foam/mud flush (& triple tube drilling) through fault gouge or hydrothermally altered rock.

Detailed fracture logging of rock core over tunnel horizon for rock mass assessment

Groundwater

Typical Properties to be Determined

- · Geological profile (rockhead level, rock type, overburden thickness & type)
- · Rock mass characterisation (RMR, Q values, Hoek & Bray strength criteria, RQD and fracture index)
- · Rock mass properties (Joints, microfracturing, faults & shear zones; fracture condition, orientation and infill, mineralisation, presence of hydrothermal alteration and weak layers.)
- Rock and discontinuity strength
- Rock abrasiveness & cuttability (for TBM design)
- · Stability at Portals
- · Rock mass and overburden permeability
- · Water tables (perched, transient and artesian)
- · Settlement characteristics of overburden due to groundwater drawdown
- · Presence and type of gas

SO₃, pH, CI

Instrumentation:

Inclinometers, Extensometers, settlement markers, crack tell tales

Groundwater chemistry:

Typical Required Design Parameters

In situ tests:

SPT, impression packer/BH televiewer, water absorption, packer tests, lugeon tests

Geophysical surveys (seismic, resistivity, micro-gravity, magnetic) In situ modulus (High Pressure Dilatometer or Goodman Jack) In situ stress tests (hydrofracture, pressuremeters) & high pressure dilatometer

Laboratory Tests:

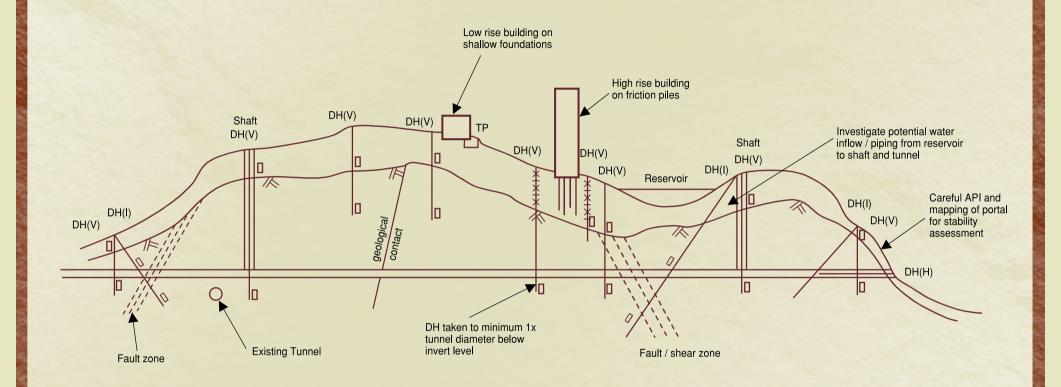
Index tests, triaxial shear strength and oedometer for overburden.

Point load, UCS, Young's Modulus, Poissons Ratio, rock shear tests on joints and saw cuts for rock

TBM related test:

Thin section petrography, Punch test, Rock abrasivity test, Brazilian test, Machine Excavation Performance tests

Tunnel Drawing



Note

Movement monitoring required for all affected structures. Surface geophysics can be used to locate faults, shear zones geological contacts etc. Lugeon Tests to be done in all drillholes at, above and below tunnel level and throughout drillhole at shaft locations. Borehole televiewer and packer test for tunnel alignment and shaft location.

Legend

/	Rockhead	TP	Trial pit
DH(V)	Drillhole (Vertical)		Piezometer
DH(I)	Drillhole (Inclined)	*	Extensometer / Inclinometer
DH(H)	Drillhole (Horizontal)	*	(In separate drillholes)

