

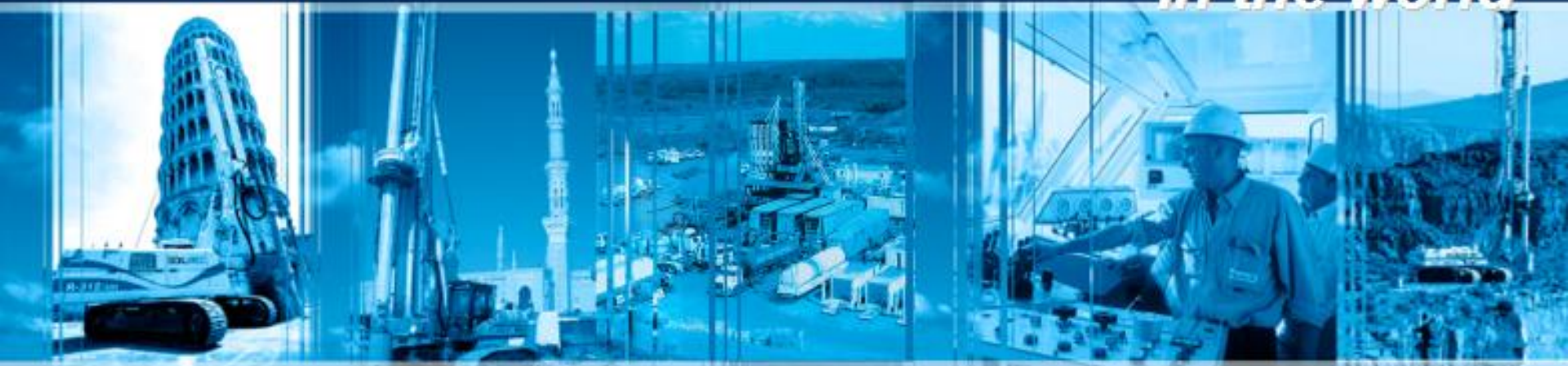
GROUND IMPROVEMENT



APPLICATIONS OF JET GROUTING TECHNOLOGY IN HONG KONG

SEMINAR ON GROUTING AND DEEP MIXING

**TREVII Group ... a qualified presence
*in the world***



Trevi Construction Co., Ltd., Tsim Sha Tsui, Hong Kong

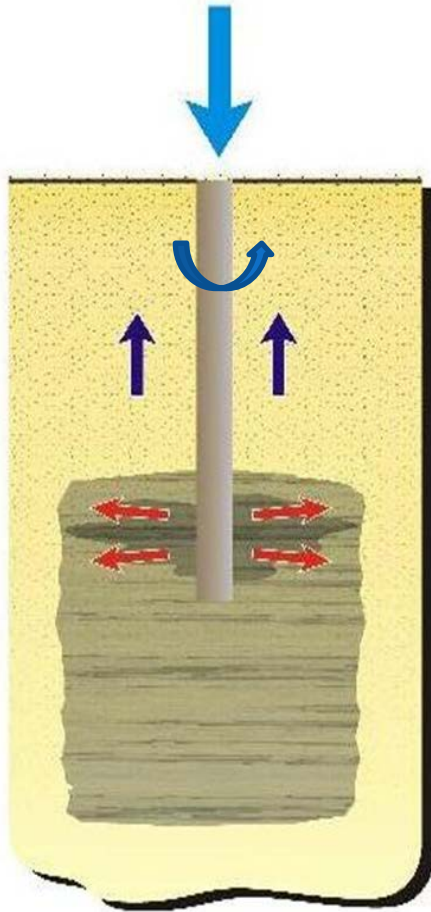
Seminar on Grouting and Deep mixing Jet Grouting Technology

Features:

disaggregation of the soil and its mixing in place with, and partial replacement by, a cement grout mix; the disaggregation is achieved by high energy jet of one or more fluids, one of them being the grout mix itself.

Applicable soils: from peaty clays to gravel

Achievable results: increasing strength
reducing horizontal & vertical permeability (for block treatment)



Limits:

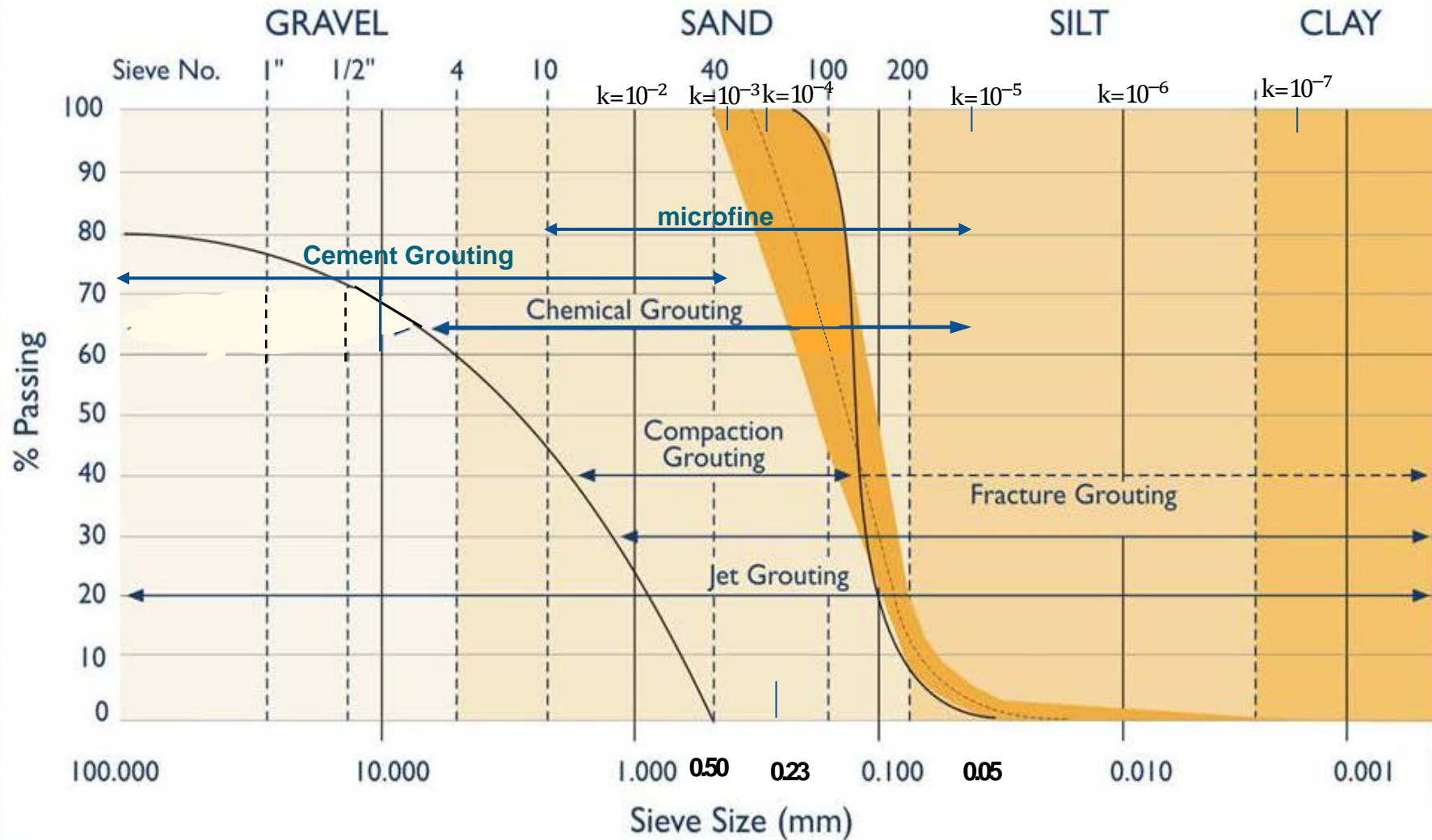
- risk of surface movements
- highly experienced personnel
- strict safety rules
- expensive equipment
- large quantity of spoil to be managed

Seminar on Grouting and Deep mixing

Grouting methods verses soil type

Jet grouting can be used in the largest range of soil types

$k=m/s$



Seminar on Grouting and Deep mixing Jet Grouting Soil Erodibility

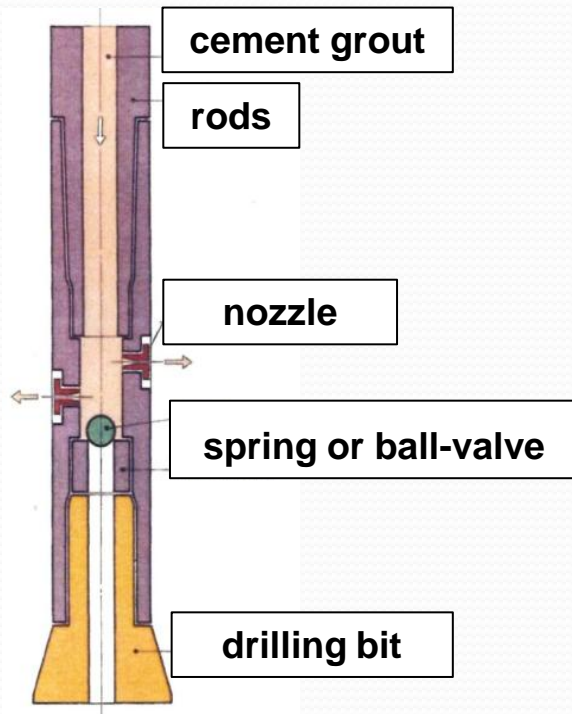


- Soil erodibility plays a major role in determining geometry, quality and production.
- Cohesionless soils are typically more erodible than cohesive soils.



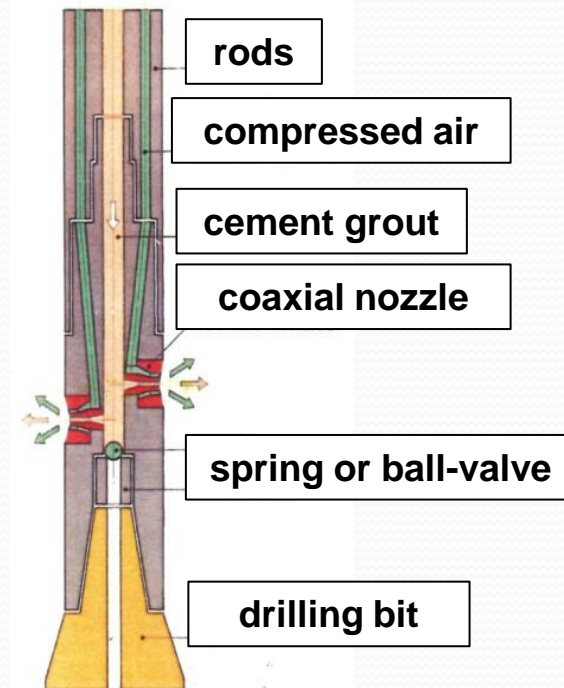
Seminar on Grouting and Deep mixing

Jet Grouting systems in use in Hong Kong by Trevi



“single fluid”

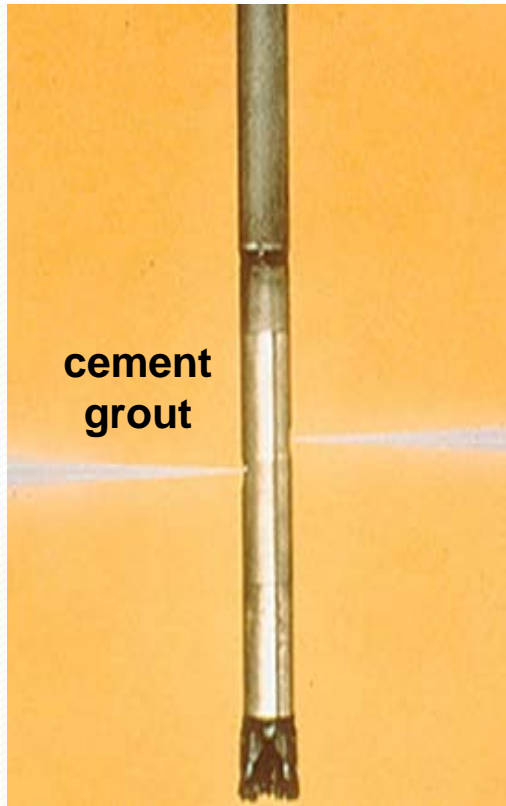
One fluid (cement grout) for both breaking up the ground and cementing it



“double fluid”

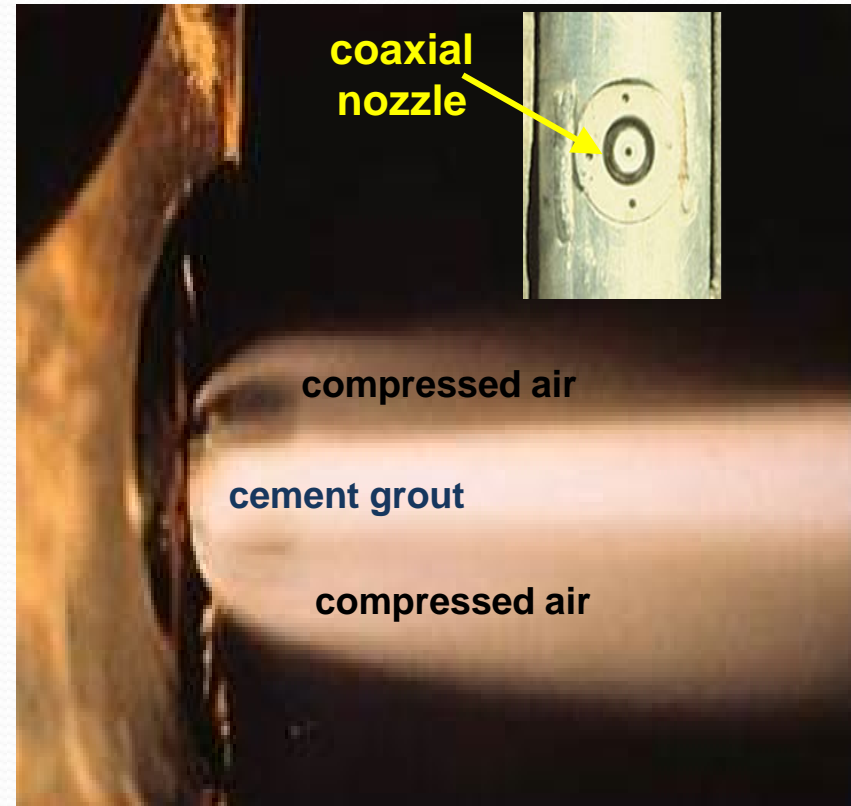
two fluids (cement grout & compressed air) for both breaking up the ground and cementing it

Seminar on Grouting and Deep mixing Jet Grouting systems



“single fluid”

Typical column's
diameters:
400 - 1200 mm



“double fluid”

Typical column's
diameters:
800 - 2500 mm

Seminar on Grouting and Deep mixing Jet Grouting Spoil

Density of spoil
=
1.6 – 2.0 t/mc

40 MPa

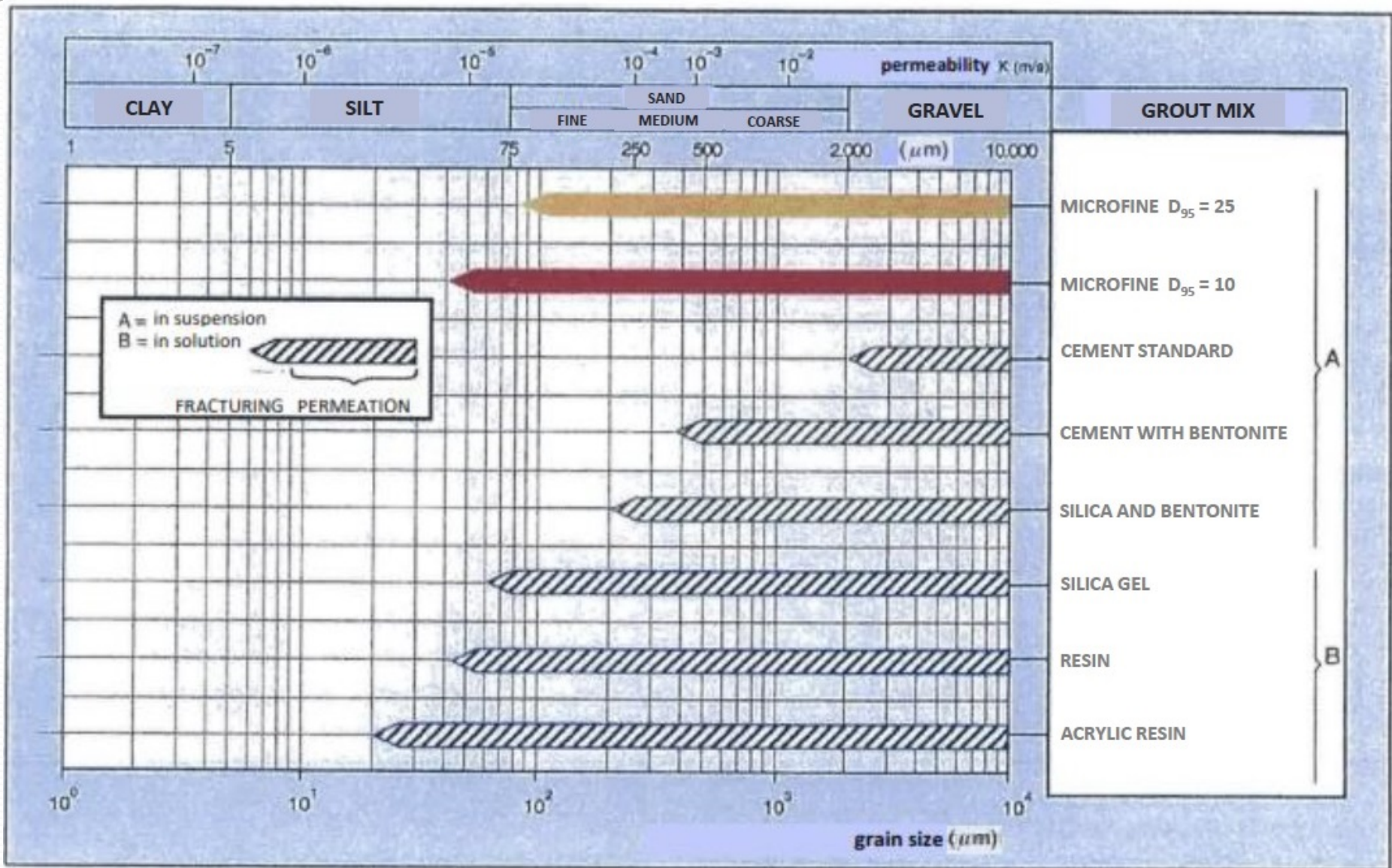
220 m/sec

Pressure → kinetic energy

Spoil return shall be maintained at all times, to avoid hydrofracturing of soil

Seminar on Grouting and Deep mixing

Mix type vs permeability & grain size



Seminar on Grouting and Deep mixing Permeation Grouting

Features:

Replacing interstitial water or gas of a porous medium with a cement based or chemical grout at injection pressures low enough to prevent uplift.

Applicable soils:

silty sands to gravel

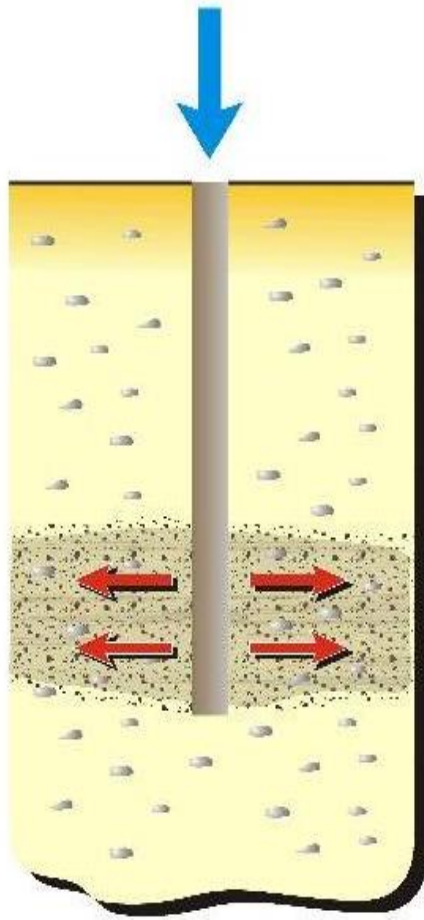


Achievable results:

- increasing strength
- reducing horizontal & vertical permeability

Limits:

- experienced personnel
- quite expensive plants
- quite expensive QC systems
- high costs of materials when dealing with fine fissures



Seminar on Grouting and Deep mixing Fracture Grouting

Features:

fracturing of a ground by the injection of a grout mix under pressure thick enough to induce excess of local tensile strength and confining pressure".

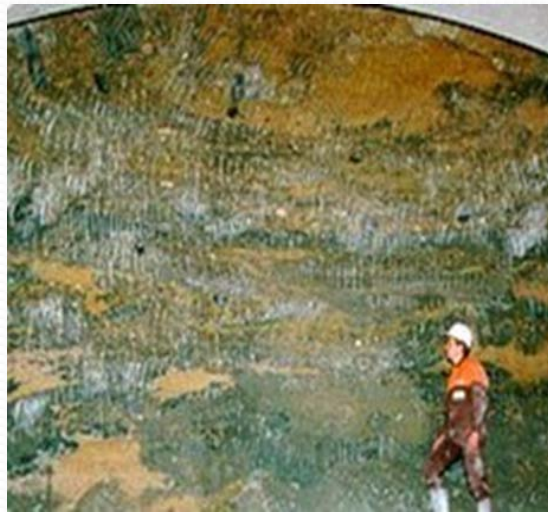
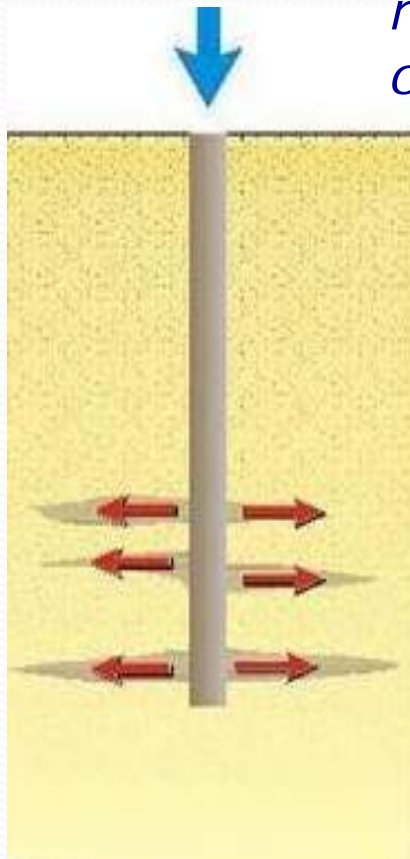
Applicable soils: dense sandy formations, stiff cohesive formations, very soft rock (shale etc.)

Achievable results:

- increased load bearing capacity by compressing the soil between the grout lenses
- reduced vertical permeability

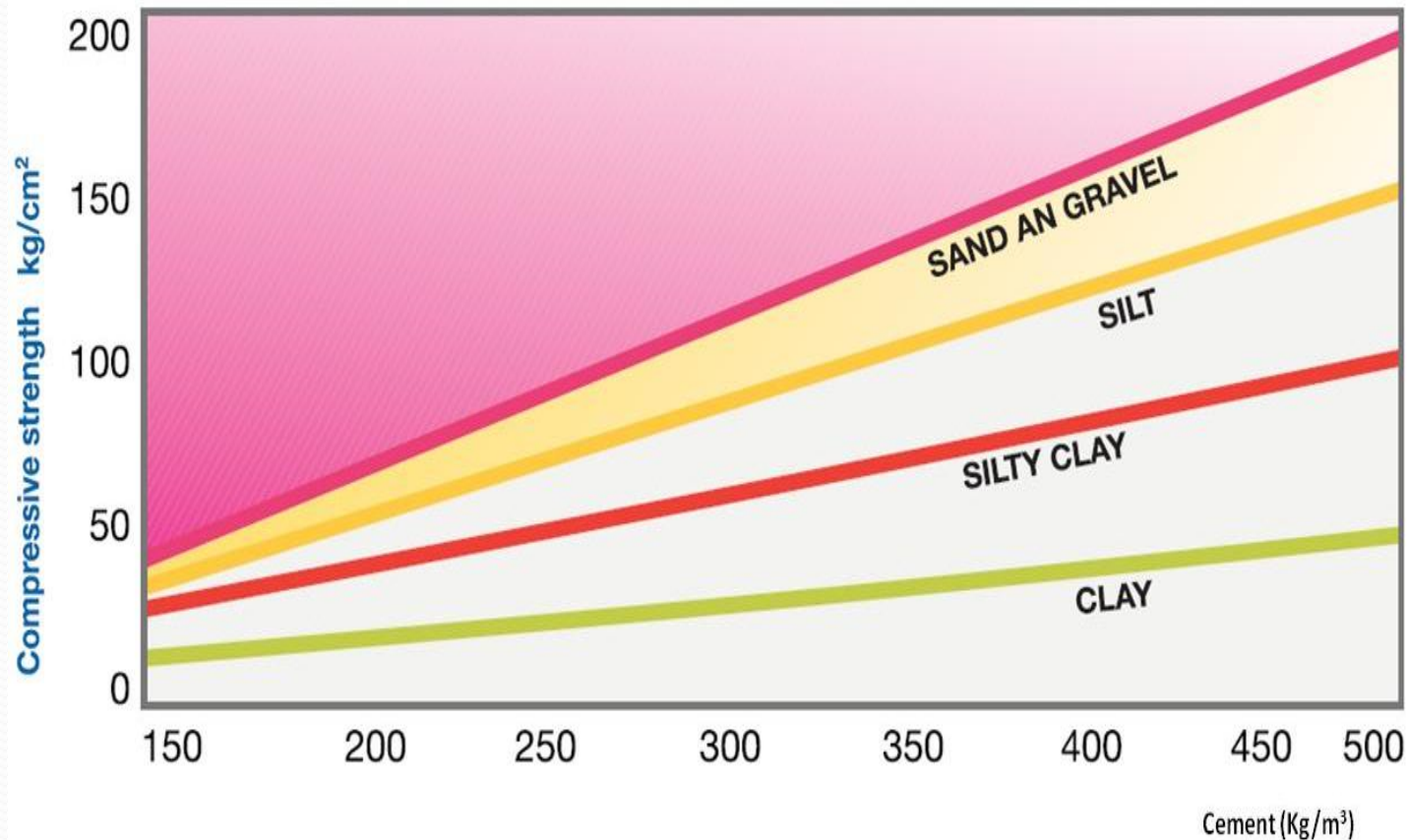
Limits:

- risk of heaves at the surface
- experienced personnel
- extensive instrumentation
- no influence on horizontal permeability



Seminar on Grouting and Deep mixing

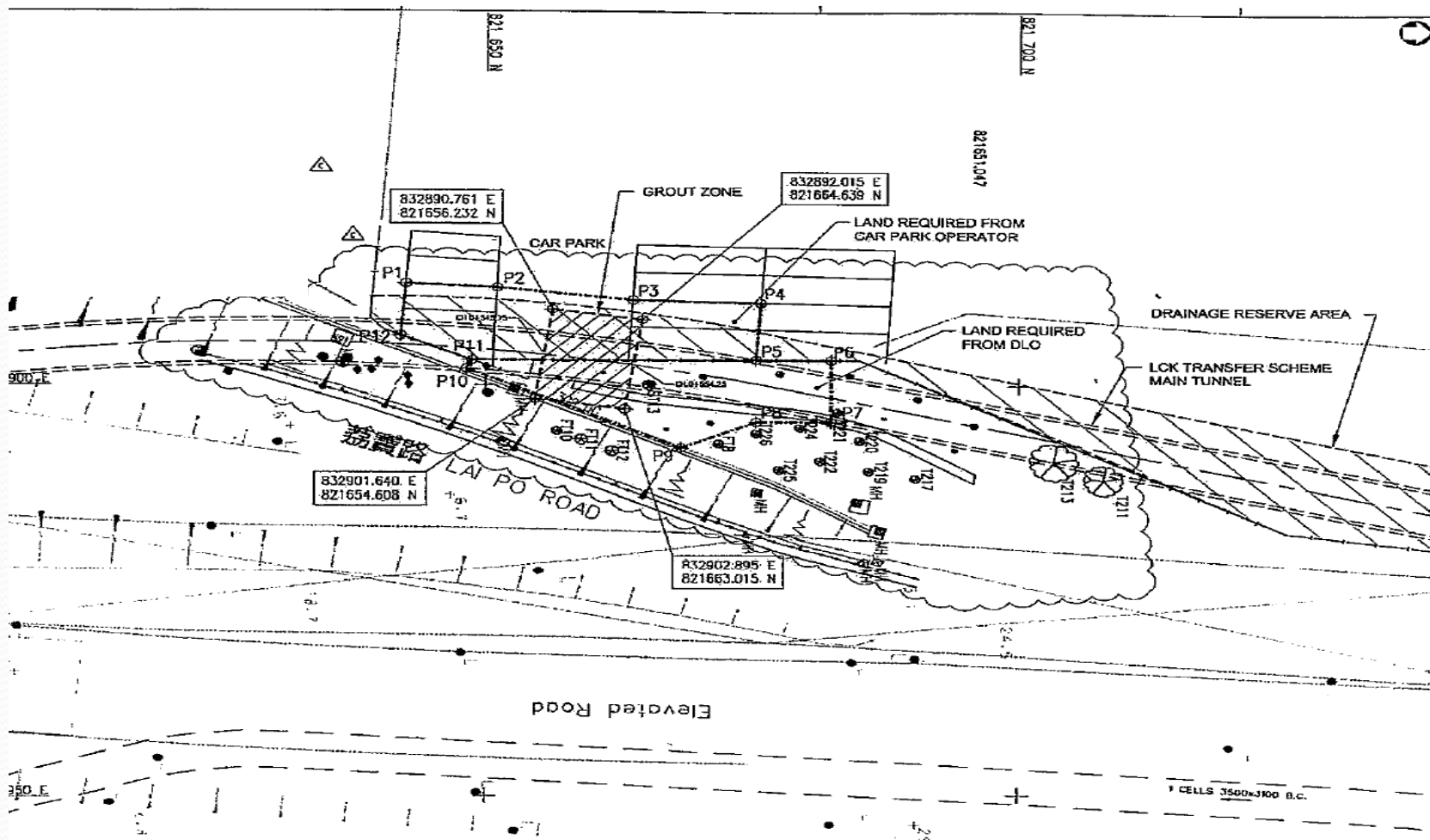
Jet Grouting Characteristics of the treated soils



Final Strength is a function of the original ground and the quantity of cement jetted into the ground itself.

Permeability = **10^{-6} m/s** - **10^{-8} m/s**
(lower values associated to cohesive formations).

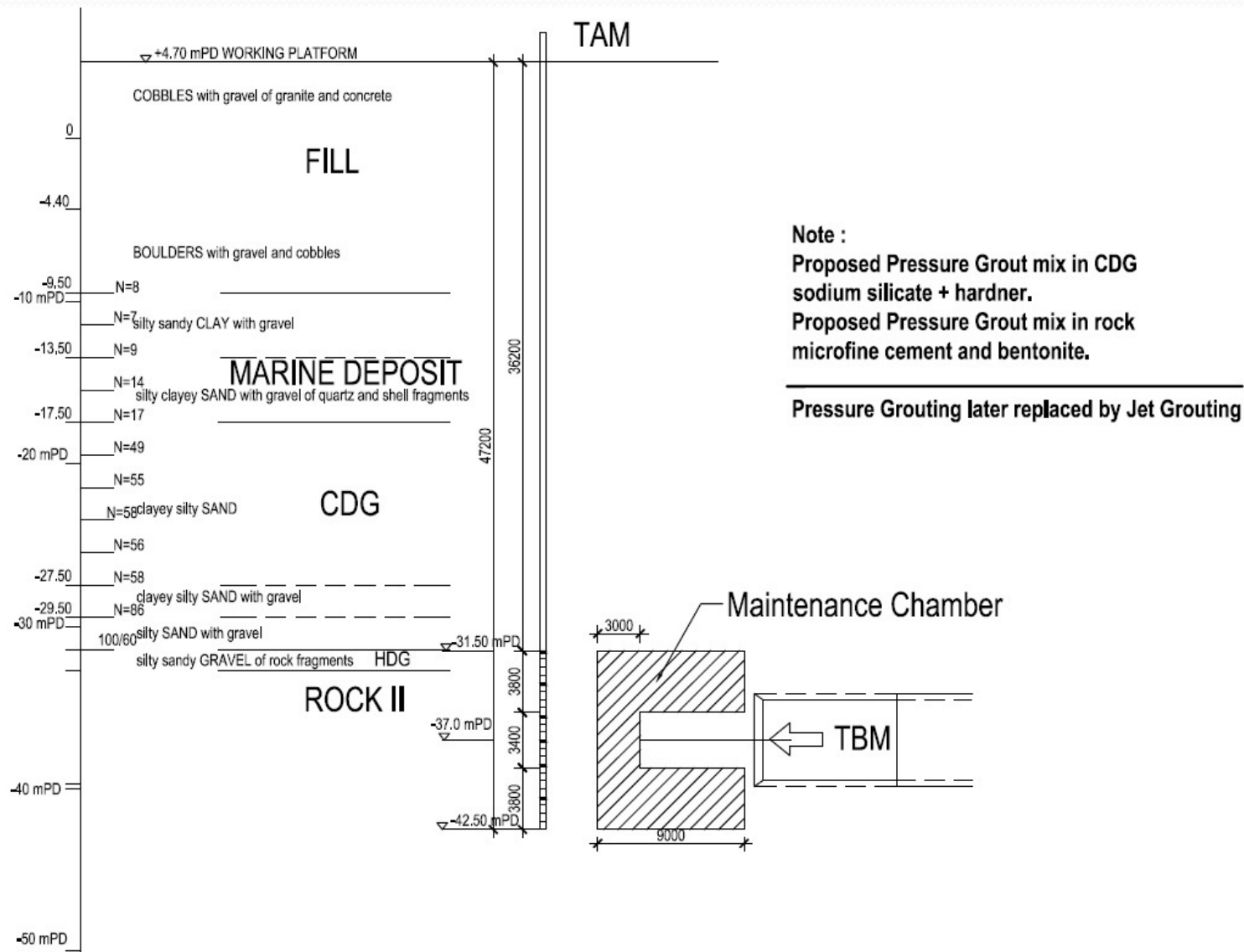
Lai Chi Kok Transfer Scheme Location at Ch. 545 TBM maintenance chamber



DC/2007/16

Lai Chi Kok Transfer Scheme

Cross-section chainage 545 (TBM maintenance chamber)



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Lai Chi Kok Transfer Scheme
TBM Maintenance Chamber at chainage 545



DC/2007/16

Lai Chi Kok Transfer Scheme

TBM Maintenance Chamber at chainage 545



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Lai Chi Kok Transfer Scheme

TBM Maintenance Chamber at chainage 545



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Lai Chi Kok Transfer Scheme

TBM Maintenance Chamber at chainage 545

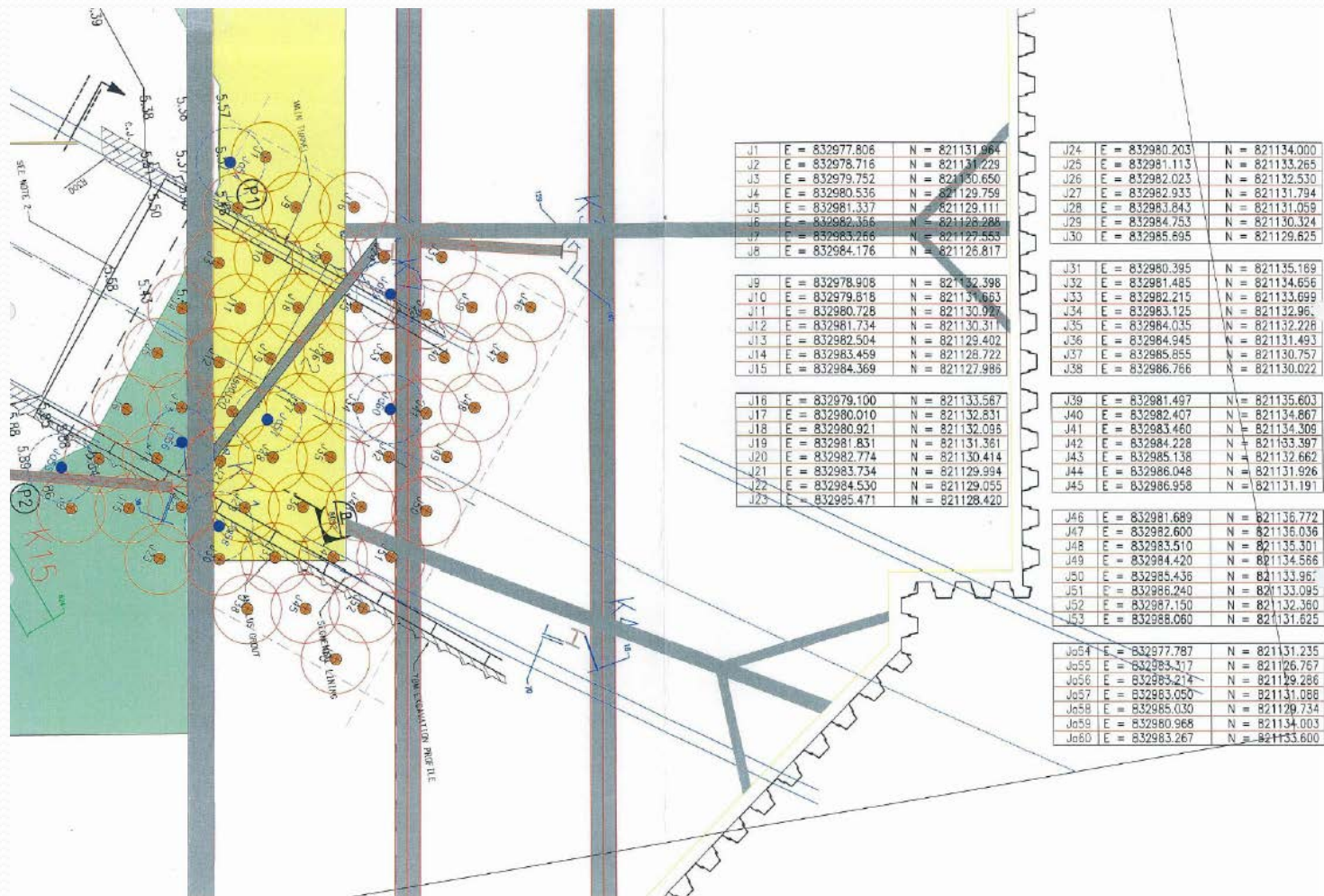


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Lai Chi Kok Transfer Scheme
TBM Maintenance Chamber at chainage 545



Pictures taken inside the chamber from TBM

DC/2007/16 Lai Chi Kok Transfer Scheme Jet Grouting Block Treatment at Break-out

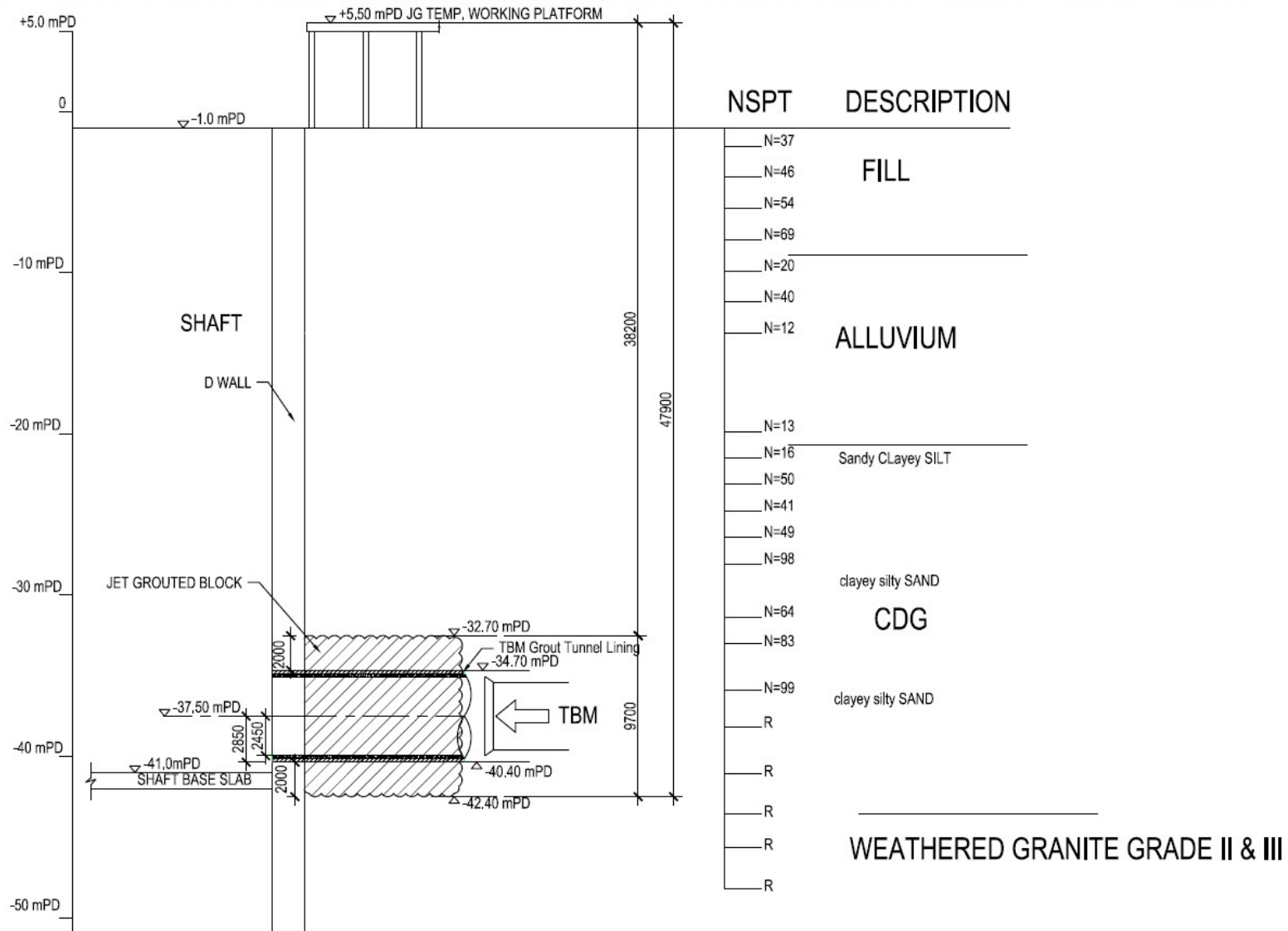


Setting out of the Jet Grout column in relation to the outfall shaft M2

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Lai Chi Kok Transfer Scheme

SHAFT CROSS-SECTION BREAK-OUT



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Lai Chi Kok Transfer Scheme



Steel platform erected for the support of the jet grouting rig

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Lai Chi Kok Transfer Scheme
Grout Column Sample Coring at TBM Shaft



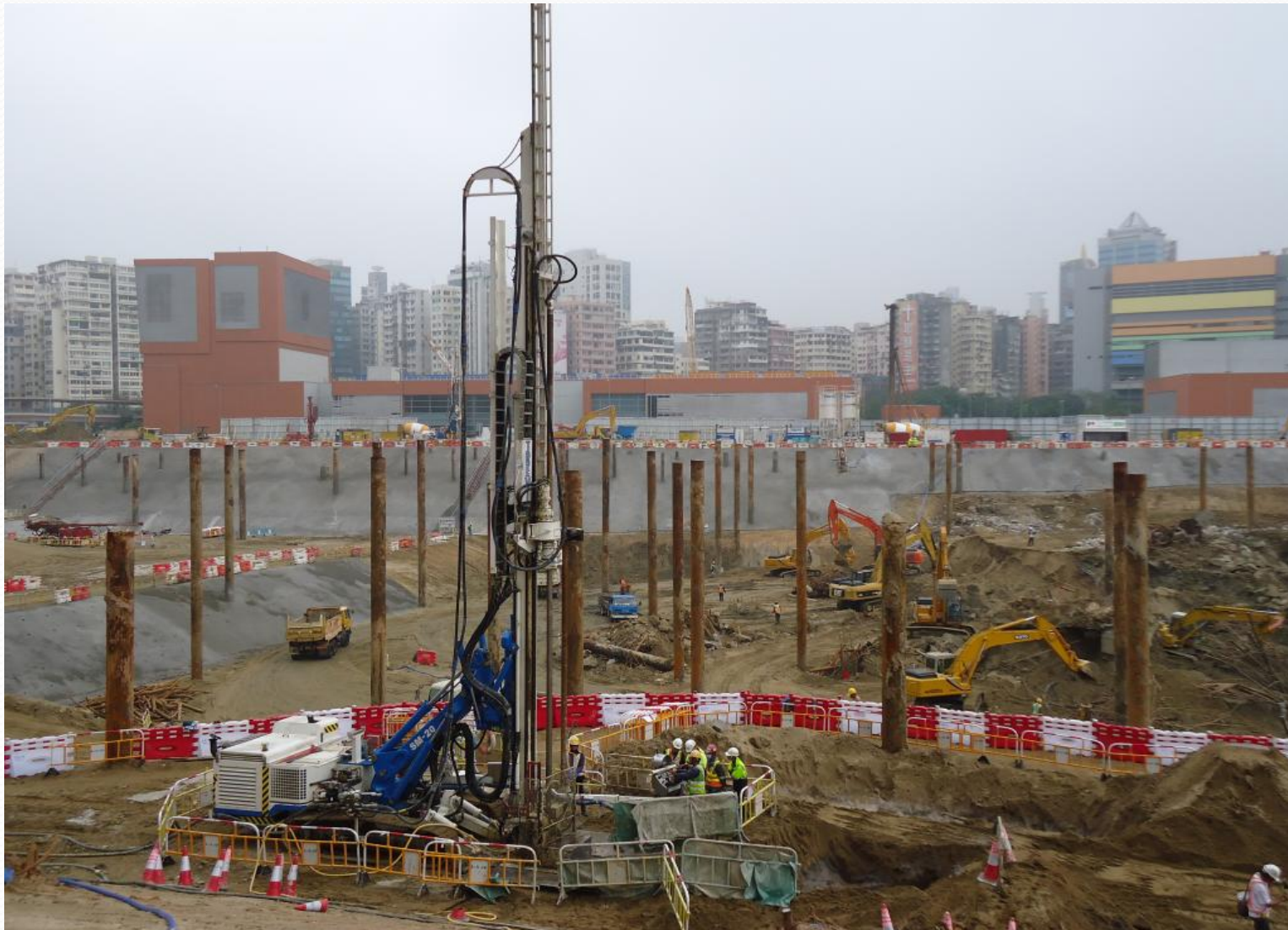
DC/2007/16
Lai Chi Kok Transfer Scheme
Grout Column Sample Coring at TBM Shaft



DC/2007/16
Lai Chi Kok Transfer Scheme
Grout Column Sample Coring at TBM Shaft



Jetting rig SM20 in action at Kowloon (MTR 810A)



Excavated column in Marine Deposit at Kowloon(MTR 810A)



Jetting rig SM14 with horizontal silo(background) where overhead restriction applies(Pier 15)



Mixing plant with vertical silos in Central (Contract 18)



Stans – Tunnel Excavation



