

# KCR 320 - LDB201 Tunnels

## TUNNEL PRESENTATION

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Dragages (HK) Joint Venture  
法國寶嘉（香港）聯營



KCR  
九廣鐵路

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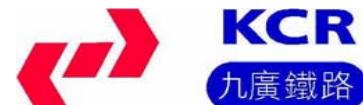
6 - Conception du revêtement du Tunnel

7 - Rameaux de communication et congélation

8 - Analyse de trois aspects particulièrement délicats du projet

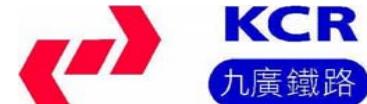


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# 1 - Type de contract:

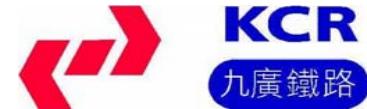
- Conception - construction
- Projet d'origine :
  - Viaduc ???
- Forfait avec risque géologique

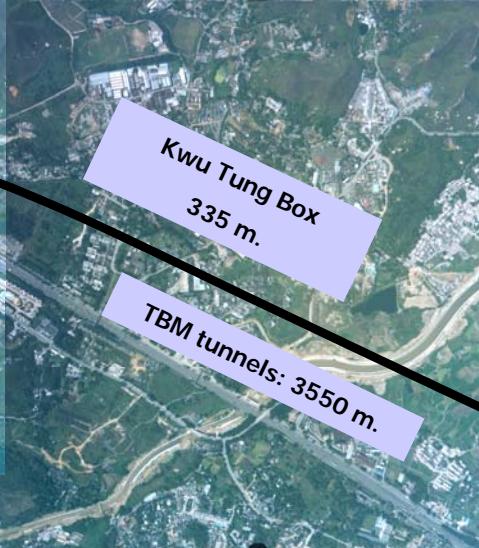
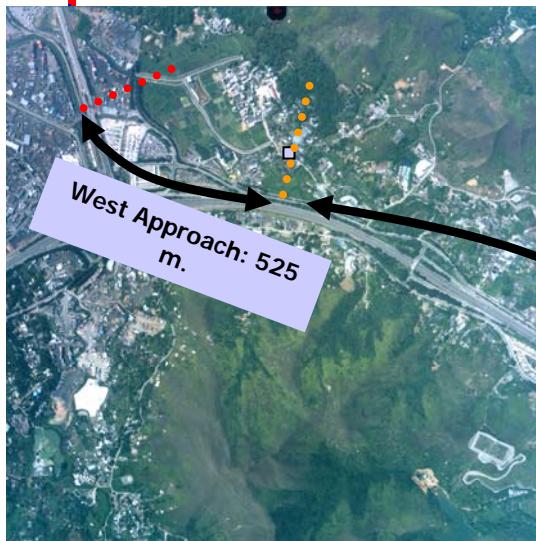


## 2 - Trace Tunnel & Contraintes d'environnement

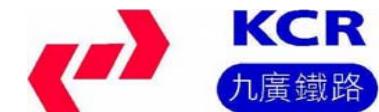
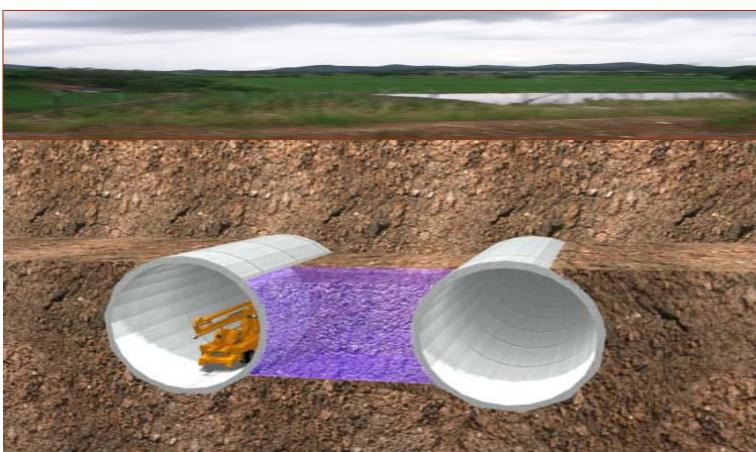


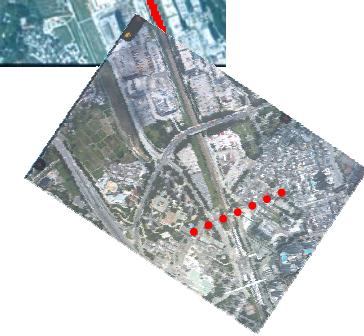
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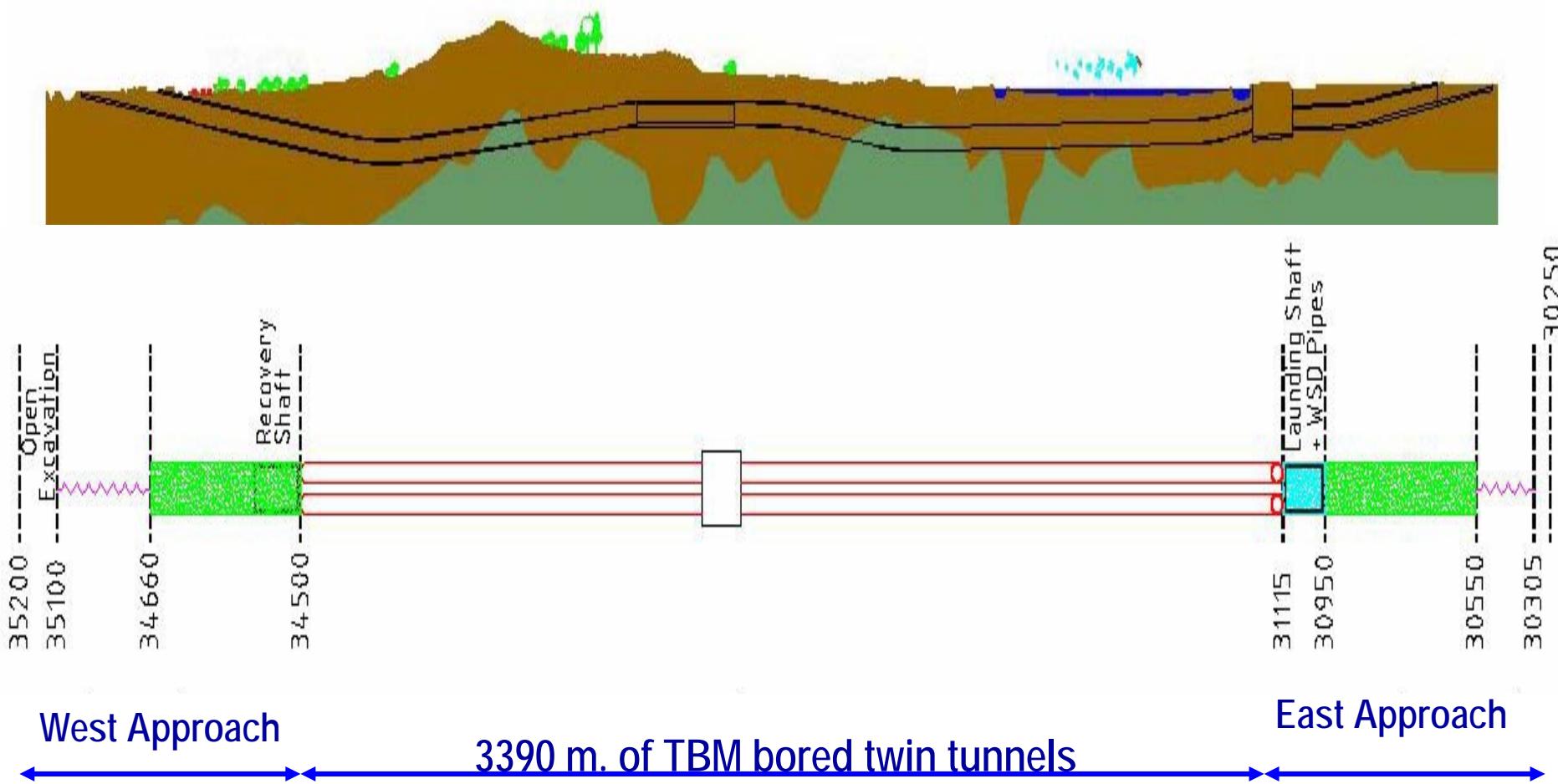


### 3 - Géologie Tunnel & Reconnaissance de Sol

# KCRC LDB201 Ground Investigation Boreholes



# LDB201 - Tunnel Alignment & Geology



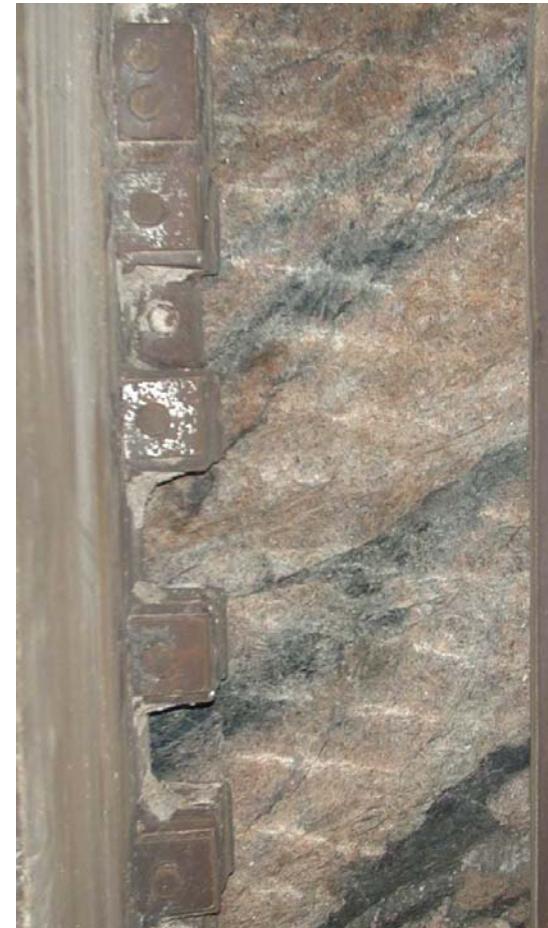
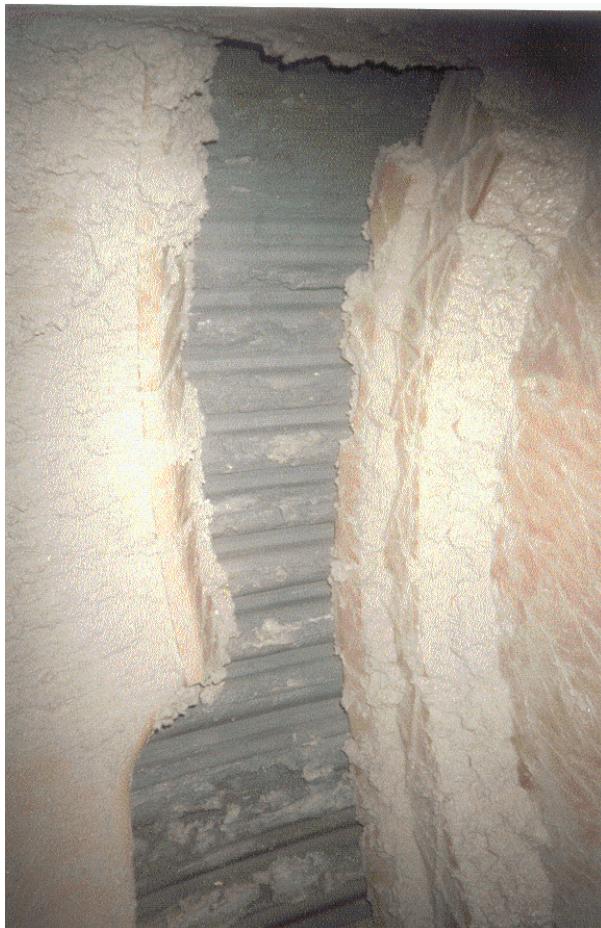
# Study of Rock Samples Recovered



# Study of Soil Samples Recovered



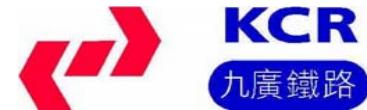
# Verification of Ground Conditions by Mapping in TBM



## 4 - Description Tunnelier & Principes



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# Description Tunnelier

Bouclier.

Train suiveur



115 mètres

- Poids Total : 1200 t
- Poussée Totale : 6600 t
- Vitesse Max. d'avancement : 80 mm /min

# Tunnelier en mode mode fermé

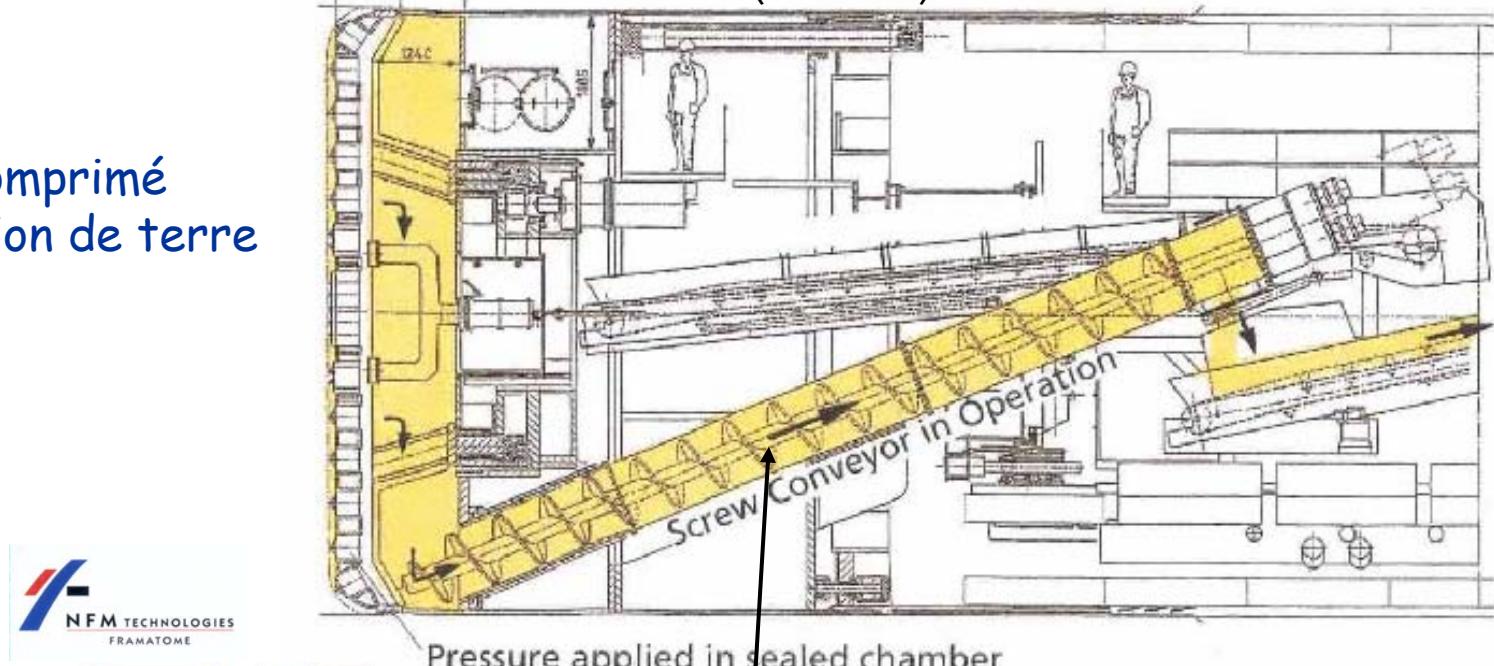
Diamètre d'excavation: 8.75 m

Type: Bouclier à confinement mixte (Classification AFTES GT 4) :

- Outils d'abattage (282 dents pour terrain meuble + 60 mollettes pour roche dure)
- Puissance installée sur la tête (2250 kW)

Mode fermé :

Air comprimé  
Pression de terre

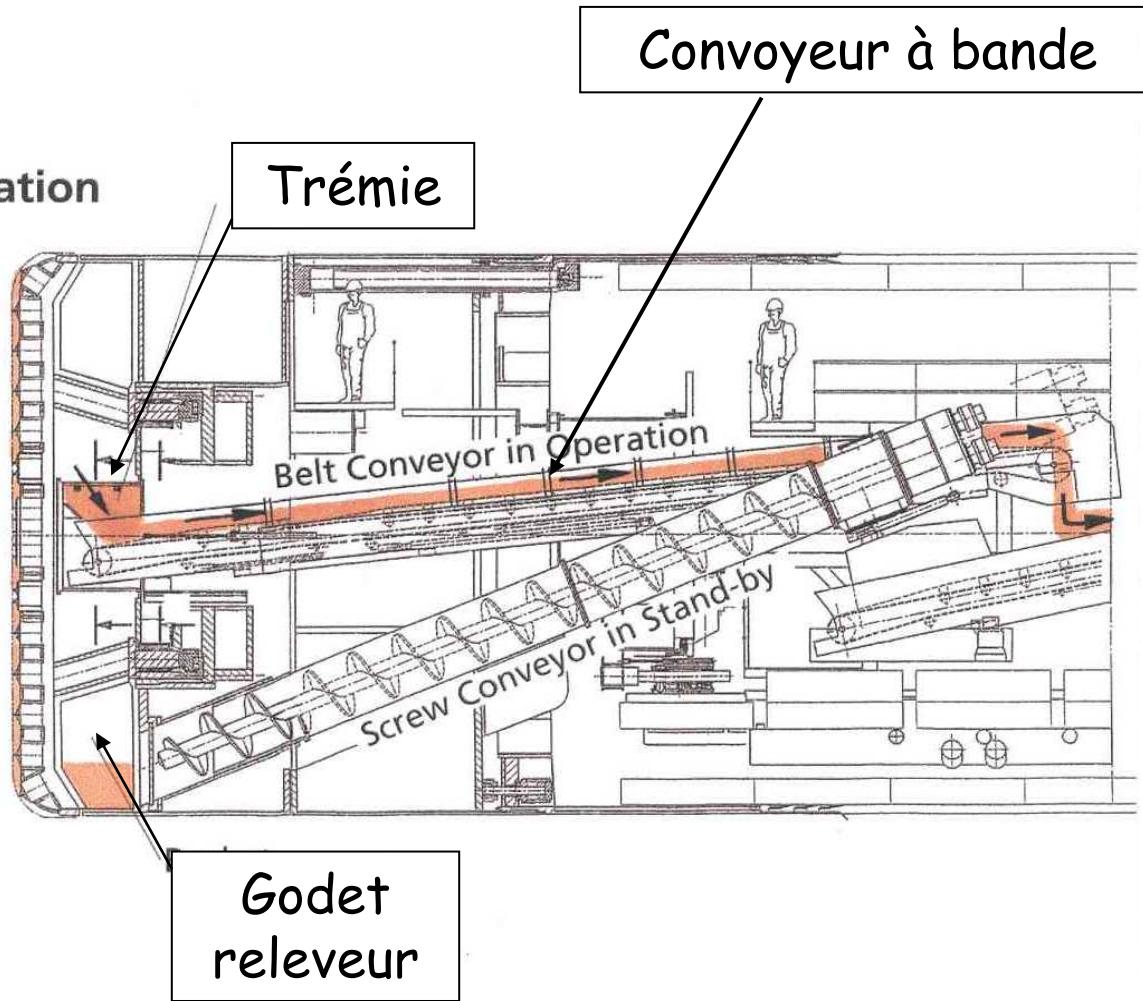
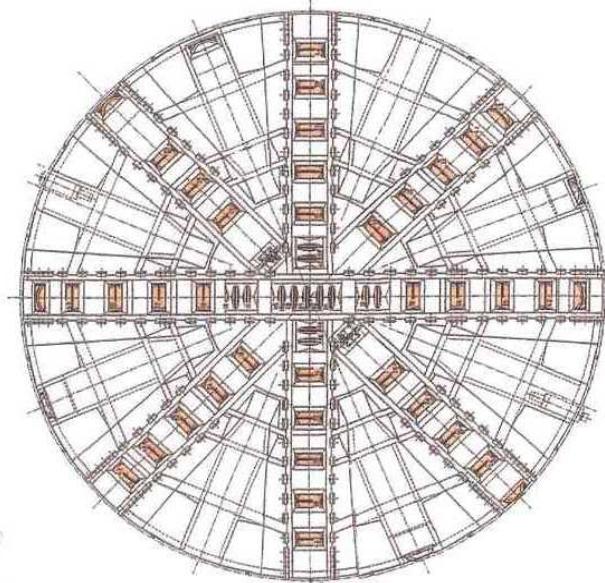


Vis d'Archimède



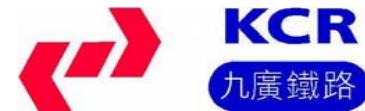
# Configuration en mode ouvert

Open Mode for hard-rock excavation





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# TBM SPECIFICATIONS

## TBM - "MULAN"

- Type : Mixed face shield  
Earth Balance Pressure (EPB)-Compressed AIR- Open mode
- General Specifications :
  - Internal diameter 7.625 m, Minimum tunnel radius = 400 m,
  - Max tunnel slope = 4%
  - Total length 108 m - Total weight 1,400 tons
  - Supply of material by train
  - Evacuation of spoil : 1 m wide conveyor belt
  - Power supply 11kVolts - Total installed power : 4,100 kW.
- Shield : in 3 parts : Cutter head center shield, articulated tailskin 12.5 meters, thickness 70 mm - Weight 860 tons (inc Head)  
Cutter head drive : 9 motors \* 240 kW, 0 to 3 rpm.

## TBM - "MULAN" (cont'd)

Hydraulic grippers and stabilizers

Hydraulic segment erector, radio controlled.

2 personnel air locks + 1 emergency lock + 2 equipment locks

Thrust : 0 to 5,200 tons, 13 pairs of thrust rams

excavation speed : 0 to 80 mm/mn

- Backup, 6 gantries (90 meters)

Grouting system : 0 to 40 m<sup>3</sup>/h

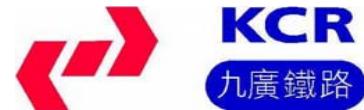
Ventilation system 15 m<sup>3</sup>/s

Foam injection system

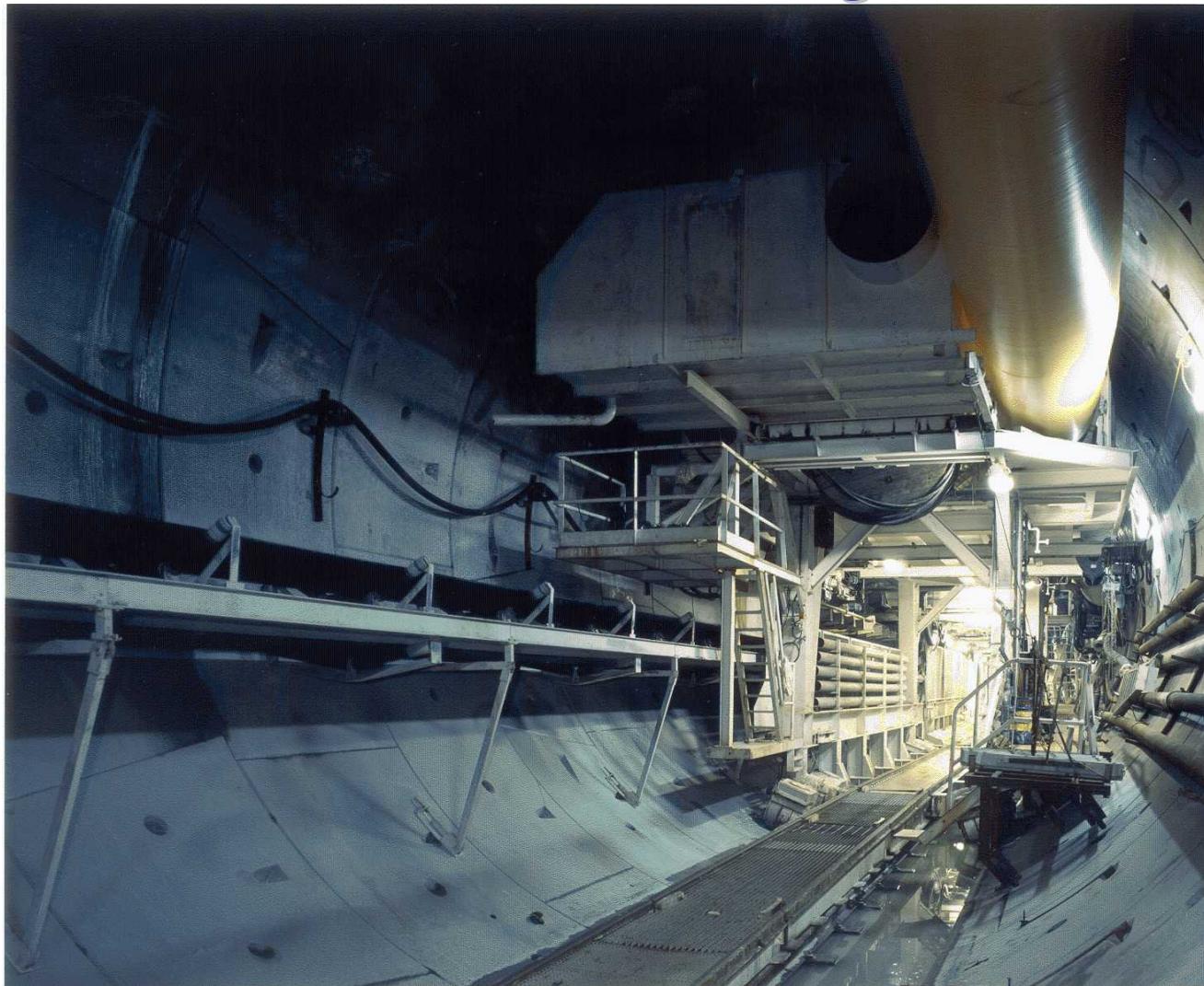
Bentonite injection "recaking" system

Breathable and industrial compressed air system

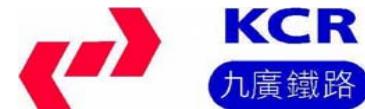
- Technical specification  
Direction Technique Bouygues TP
- Manufacturer :  
NFM (Framatome Group France) under Mitsubishi licence  
Design in Lyon  
Components manufactured in France & Europe  
Steel structure & assembly in Shanghai (SHMP)



# View of TBM in tunnel during excavation



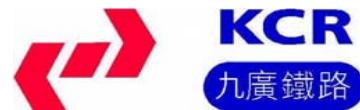
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# KCRC DB320 Tunnel (25m under water table)



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# TBM Tunnel with Permanent Ways Installed



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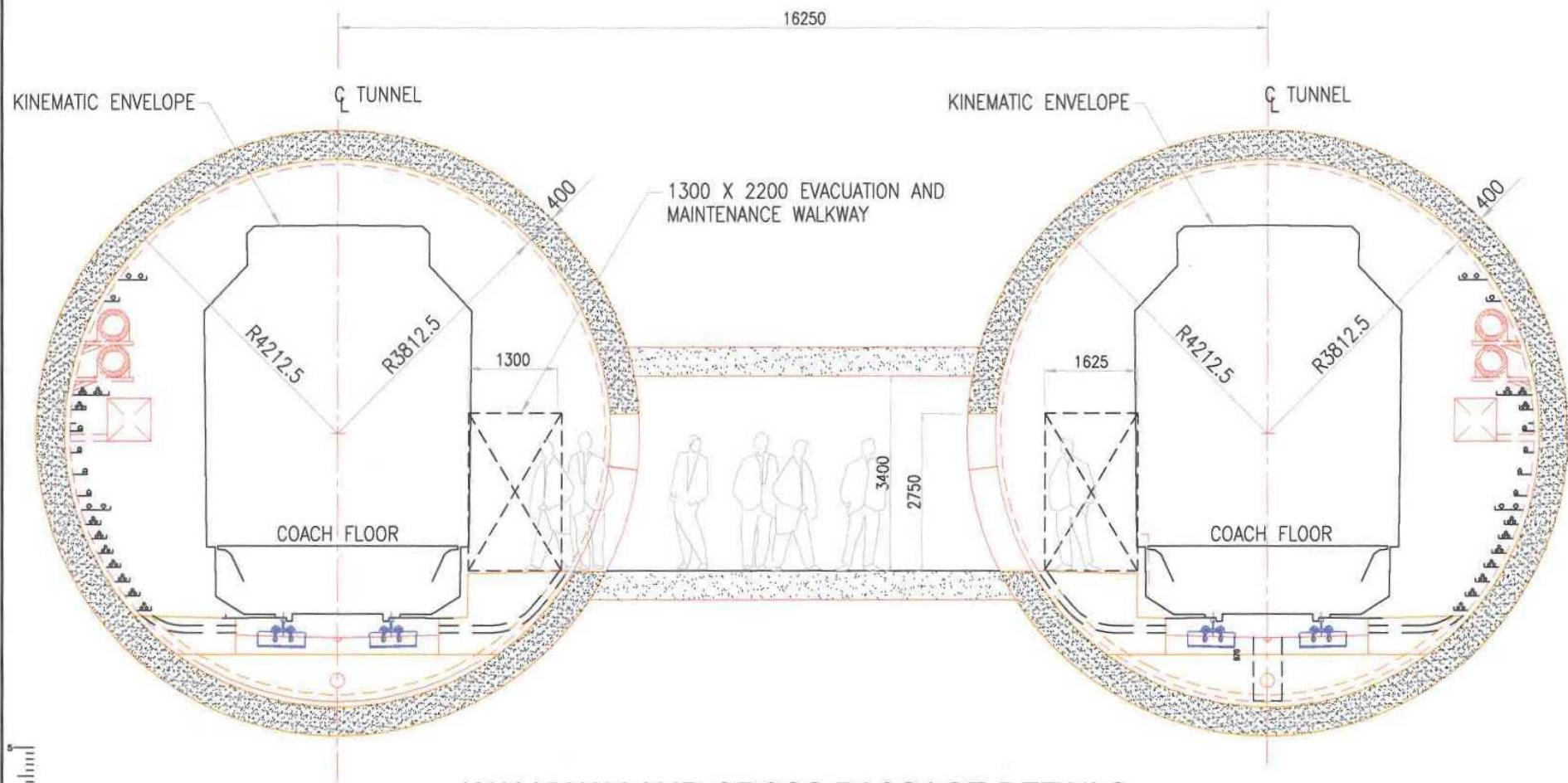
# 6 -Tunnel Lining



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# Typical Section at Cross Passage Location

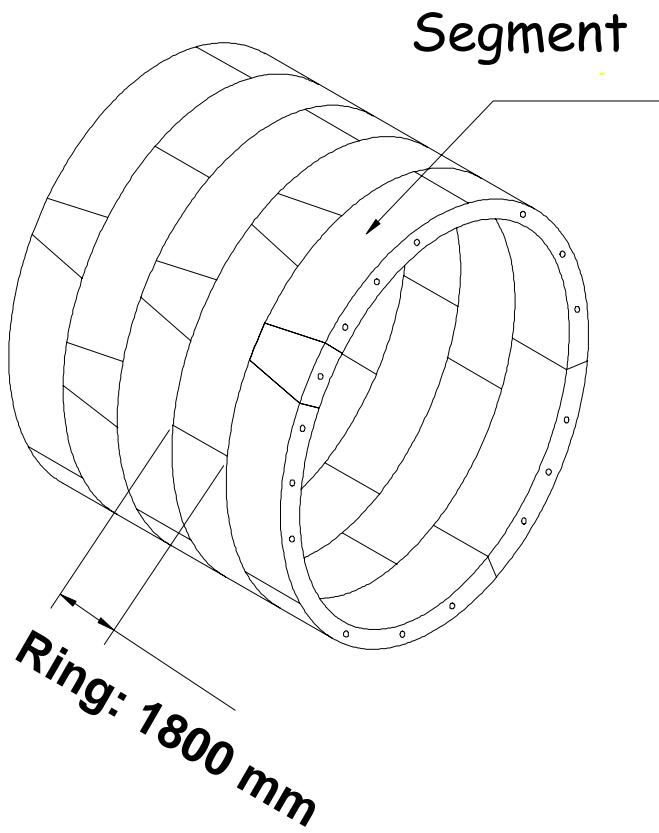


WALKWAY AND CROSS PASSAGE DETAILS

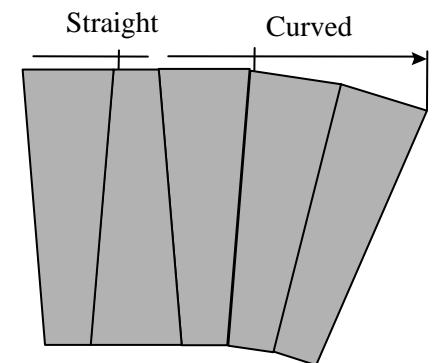
# Proposed TBM Lining with Precast Segments

Universal keyed segments (13 positions)

- 4 + 2 secondary key segments + 1 keystone
- Length : 1.8 m
- Thickness : 40 cm
- Design life : 120 years
- Fully watertight after installation
- High construction tolerances
- Finished tunnel inner diameter = 7.625 m
- Finished tunnel outer diameter = 8.425 m



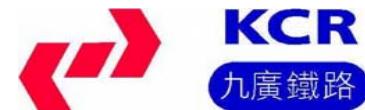
# Ring Build inside TBM



Plan view



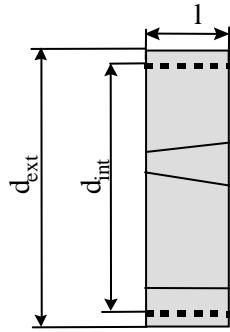
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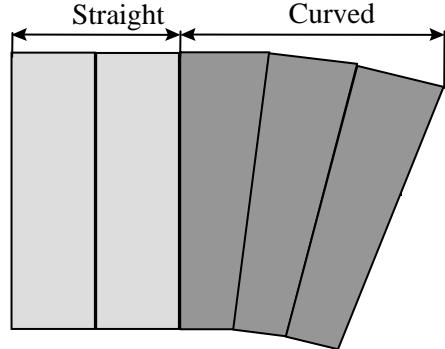
# Precast segment factory



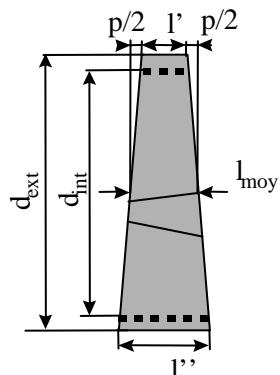
# Segments



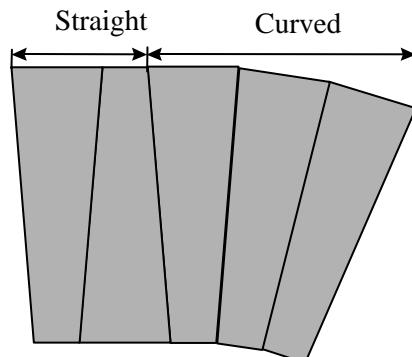
Straight ring



Plan view



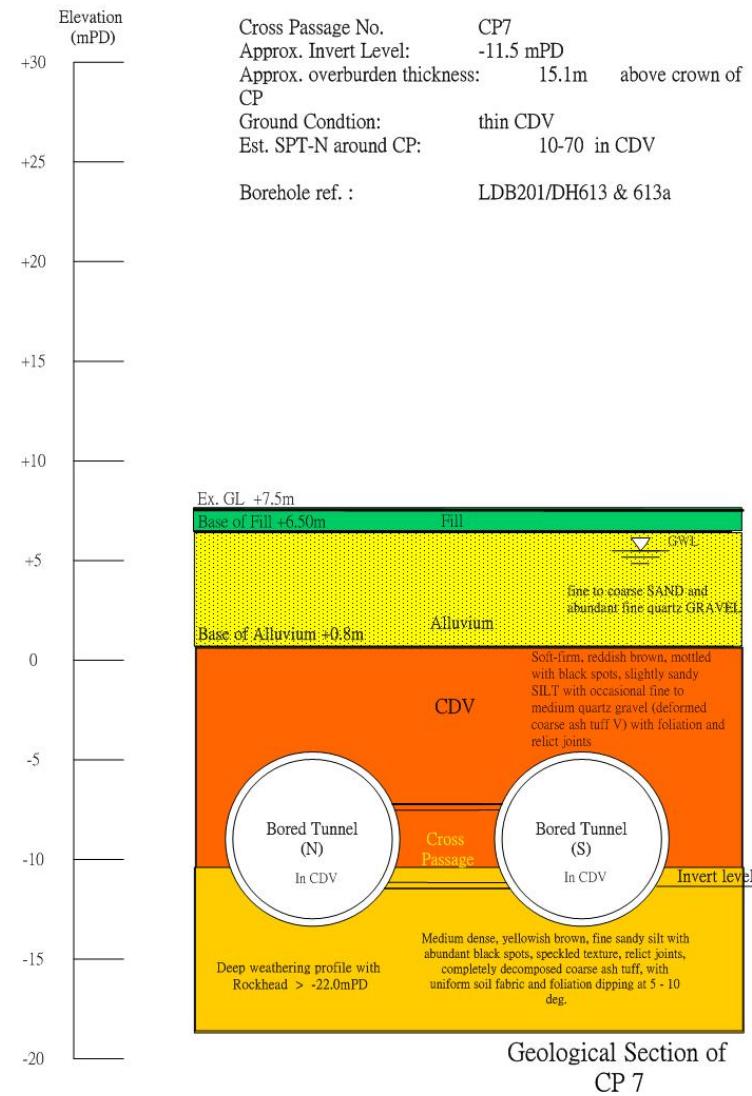
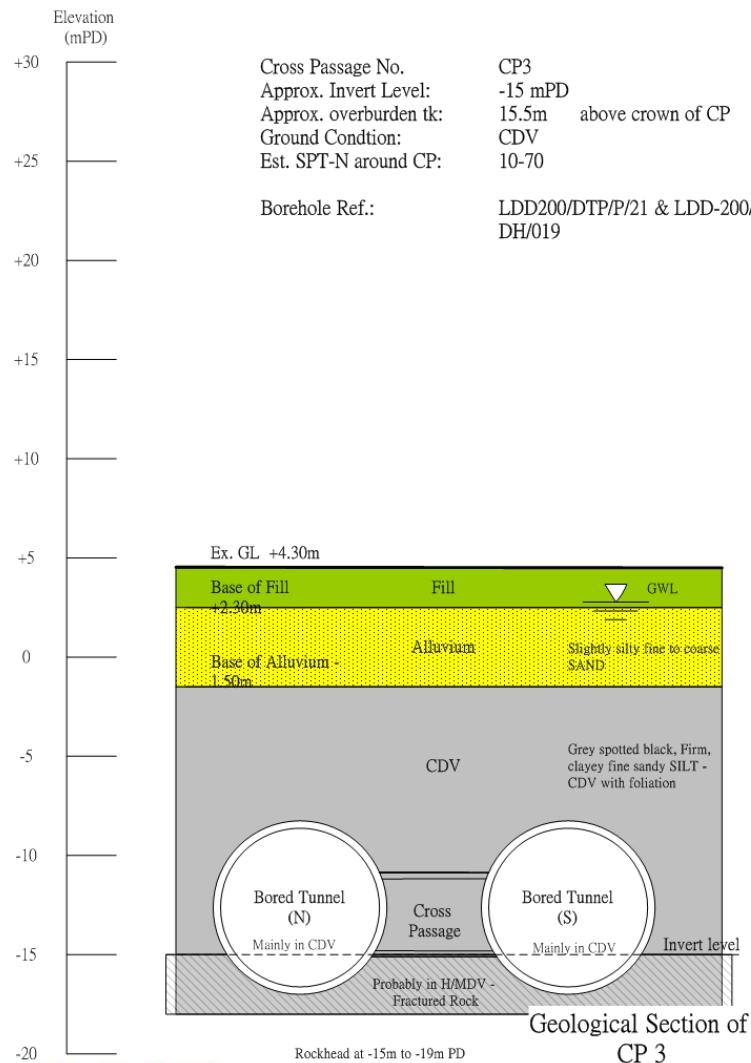
Universal tapered ring



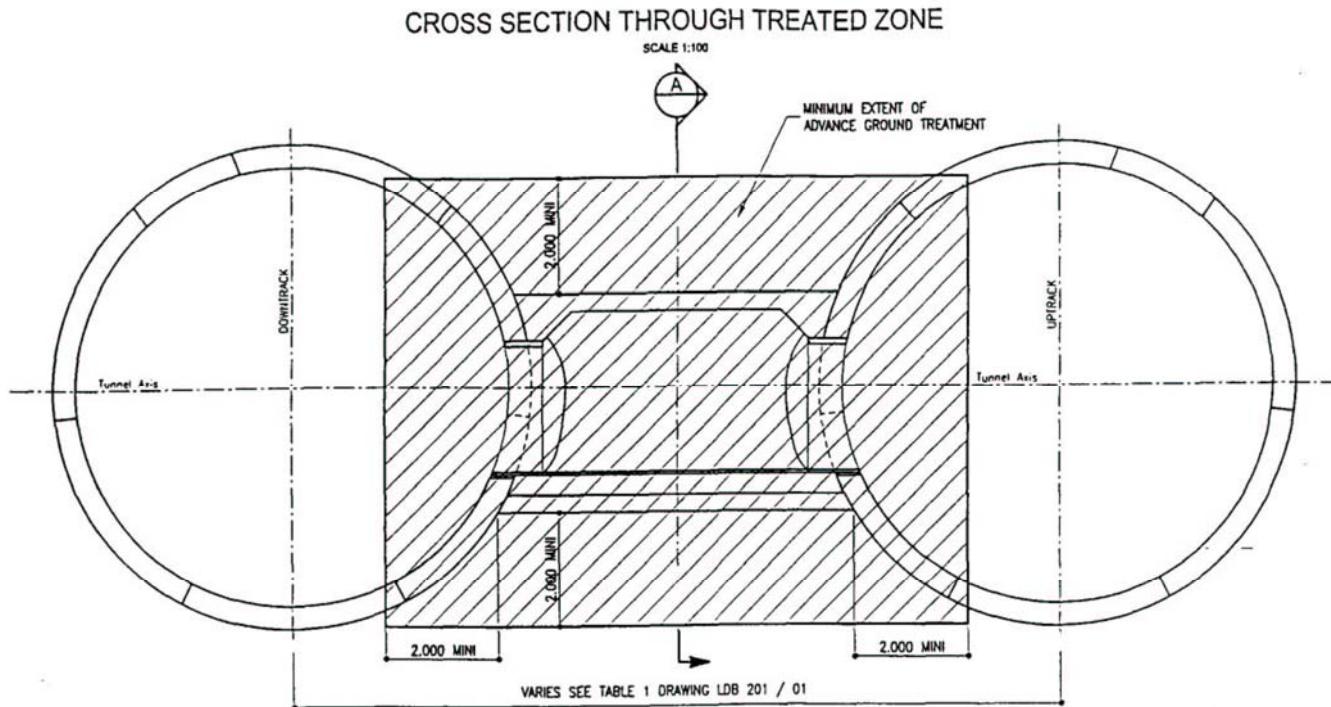
Plan view

## 8 - Cross Passage Ground Treatment & Ground Freezing

# Assessment of Ground Conditions at Each Cross Passage



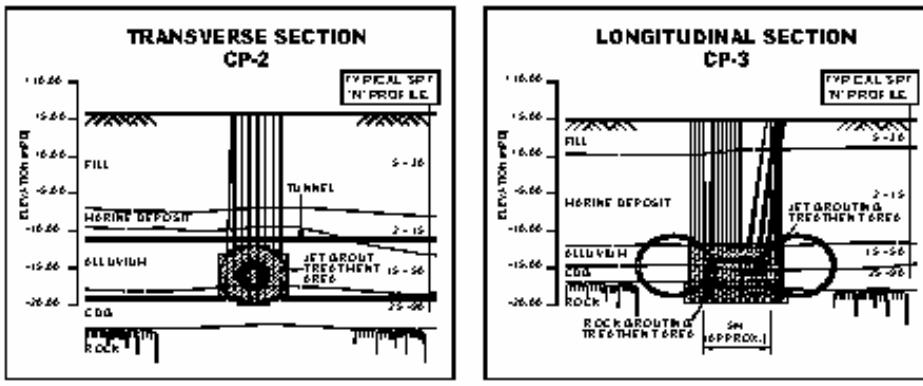
# Ground Treatment



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# Ground Treatment by Jet Grouting

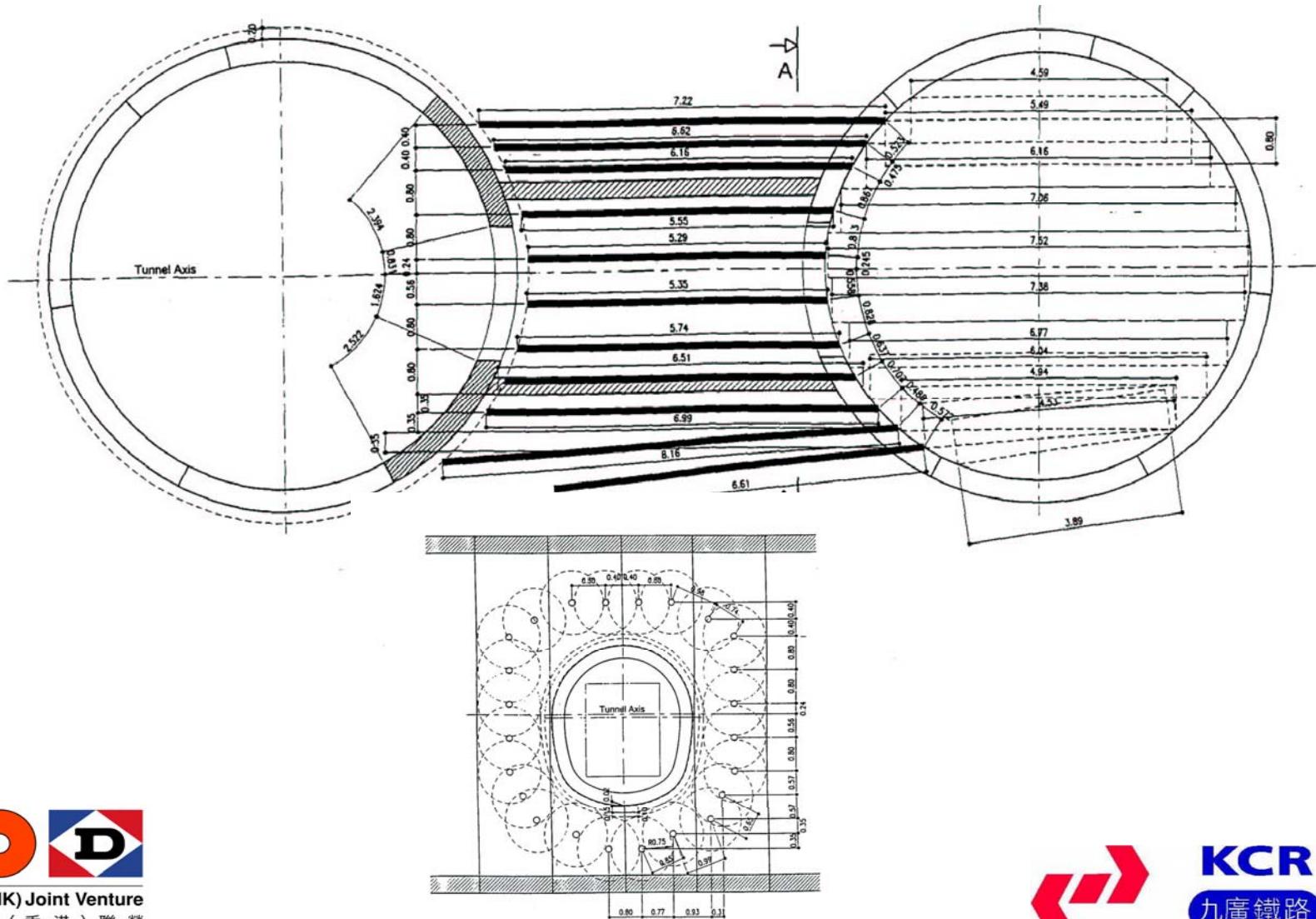


# Jet Grout Treated Ground



Connection of  
Treated Ground  
with Tunnel  
Segments

# Ground treatment by Ground Freezing - Long Valley, CP2, 3 and 4



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# Ground Treatment by Ground Freezing



# Analyse de trois aspects particulièrement délicats du projet :

1. Le confinement à l'air comprimé en roche dur.
2. Les transitions de roches dures à sols meubles sous la nappe
3. Un problème de soutènement très pointus avec un front situé dans des alluvions perméables et un « toit » d'alluvions maritimes très peu perméables

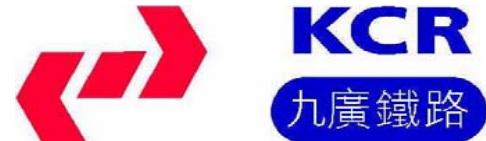
# Le confinement à l'air comprimé en roche dur

Intérêts d'un confinement à l'air comprimé par rapport au mode ouvert (quand cela est possible):

- Franchissement des discontinuités
- Maîtrise des infiltrations d'eau
- Maîtrise de la stabilité temporaire des anneaux de voussoirs
- Meilleure maîtrise des injections de bourrage

Inconvénients :

- Peu : usure quoique .....



# Les transitions de roches dures à sols meubles et perméable sous la nappe

- Problématique : confiner au premier contact des alluvions où le front est encore à 100 % en roche dure
- Solutions :
  - Pression de Boue : Aisée mais ....
    - usure
    - Production de bloc
  - Pression de terre : Difficile mais...
    - Cela marche grâce aux progrès des conditionneur de déblais

## Un problème de soutènement très pointus avec

- un front situé dans des alluvions perméables sans cohésion
- un « toit » d'alluvions maritimes argileuses très peu perméables avec cohésion.

## • Problématique :

- Absence de fuite d'air
  - Confiance à poursuivre sous confinement d'air comprimé
  - L'air comprimé chasse l'eau du terrain
  - Absence de gradient de pression au niveau du front → absence de soutènement → création d'une grotte dans les alluvions jusqu'au toit du sol imperméable