



# FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

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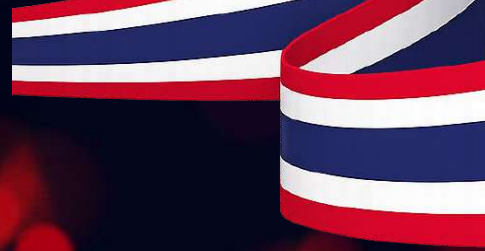
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# TRENCHLESS ASIA 2026

THAILAND



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10<sup>th</sup> APRIL 2026, QUEEN SIRIKIT NATIONAL CONVENTION CENTER BANGKOK, THAILAND

# FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT



 **TRENCHLESS  
ASIA 2026**  
THAILAND



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PT. HARVEST TUNNEL PERKASA



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## FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

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- ❖ Technical Design & Consideration
- ❖ The implementation and Execution
- ❖ Milestone Results
- ❖ Analysis & Improvement
- ❖ Questions & Answers (Q&A)

# PROJECT OVERVIEW

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# PROJECT OVERVIEW



- Project Location
- Purpose of the Project
- Overall Scope of the Project
- Project Delivery Organization

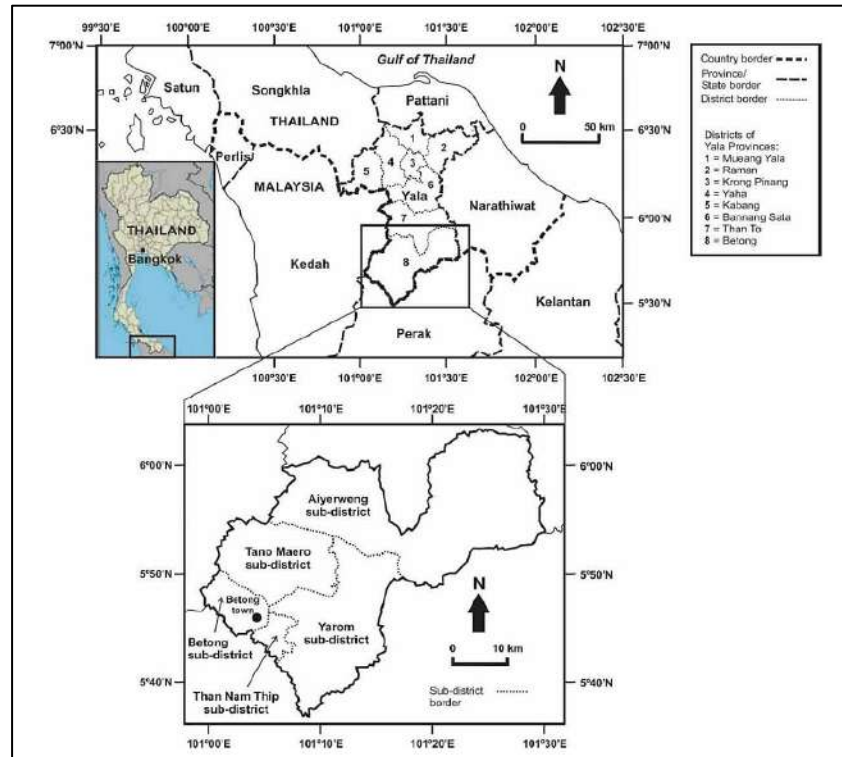
# Overall Project Location



Country : Thailand

District : Betong, Yala (5°46'25"N 101°3'38"E), A = 78m<sup>2</sup>

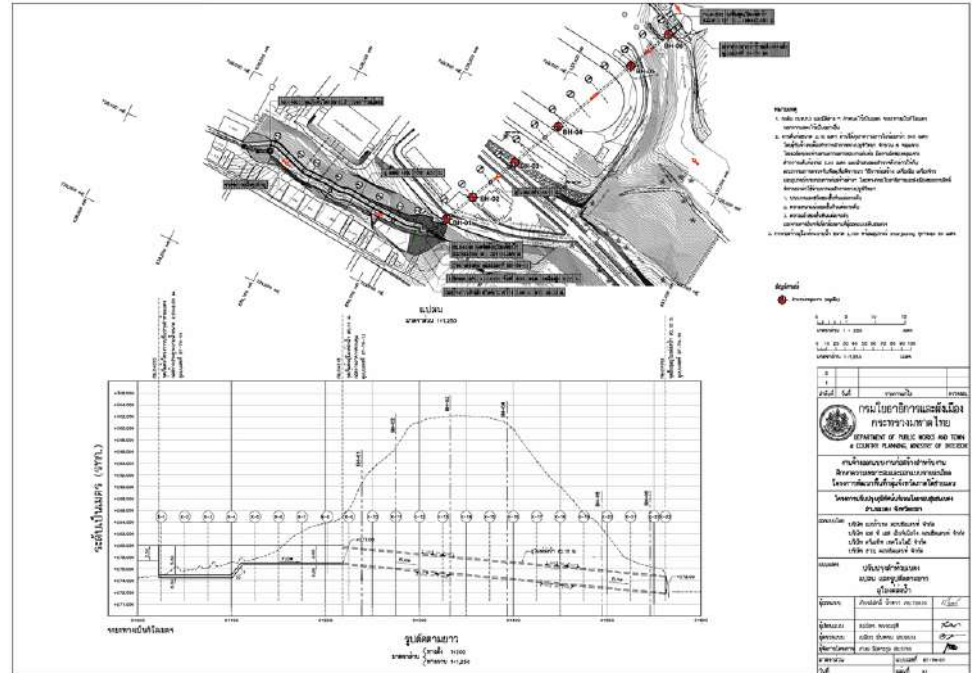
- Southernmost Point of Thailand
- 1200km from Capital of Thailand, Bangkok
- 140km from Yala Province
- Connected to Malaysia states of **Perak and Kedah**. Immigration Border at Bukit Berapit
- Malay word Betung or Betong, meaning "**bamboo**" (*dendrocalamus asper*)
- Population around **63,000 people** and Betong town itself has around **28,000 inhabitants** consist of **Thai Chinese, Thai Malay Muslim and Thai Buddhist**.
- Economy driven by **tourism, agriculture, and cross-border trade** with Malaysia



# Work Site Location

## Unnamed road (CH.0+562) to (CH.0+218)

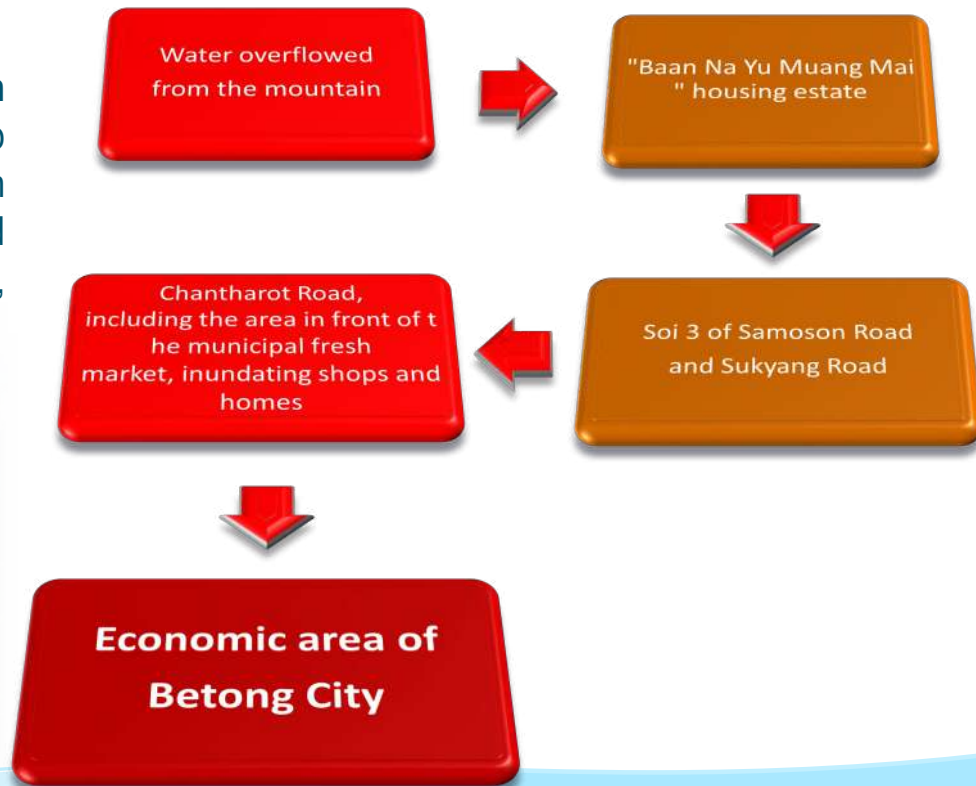
- Coordinates : 5°45'58.6"N 101°04'16.8"E
- Betong City Center next to Betong Mongkolrit Tunnel
- Crossing Betong Municipality Stadium, Betong National Swimming Pool and Betong Boxing & Muay Thai Stadium



## Purpose of the Project

### Flash flood, Rapid Runoff and Landslide

- Water from mountains causes rapid flooding “**flash floods**”, when intense rainfall overwhelms steep terrain, forcing water down valleys. Materialize within hours and driven by high-velocity runoff, saturated soils, and the sudden release of debris-filled water, trapping inhabitants and flooding downstream areas.



# Overall Scope of the Project

## Flood Diversion & Mitigation System

- Improve **water management** efficiency, address flooding, and prevent further flooding in Betong's economic district.

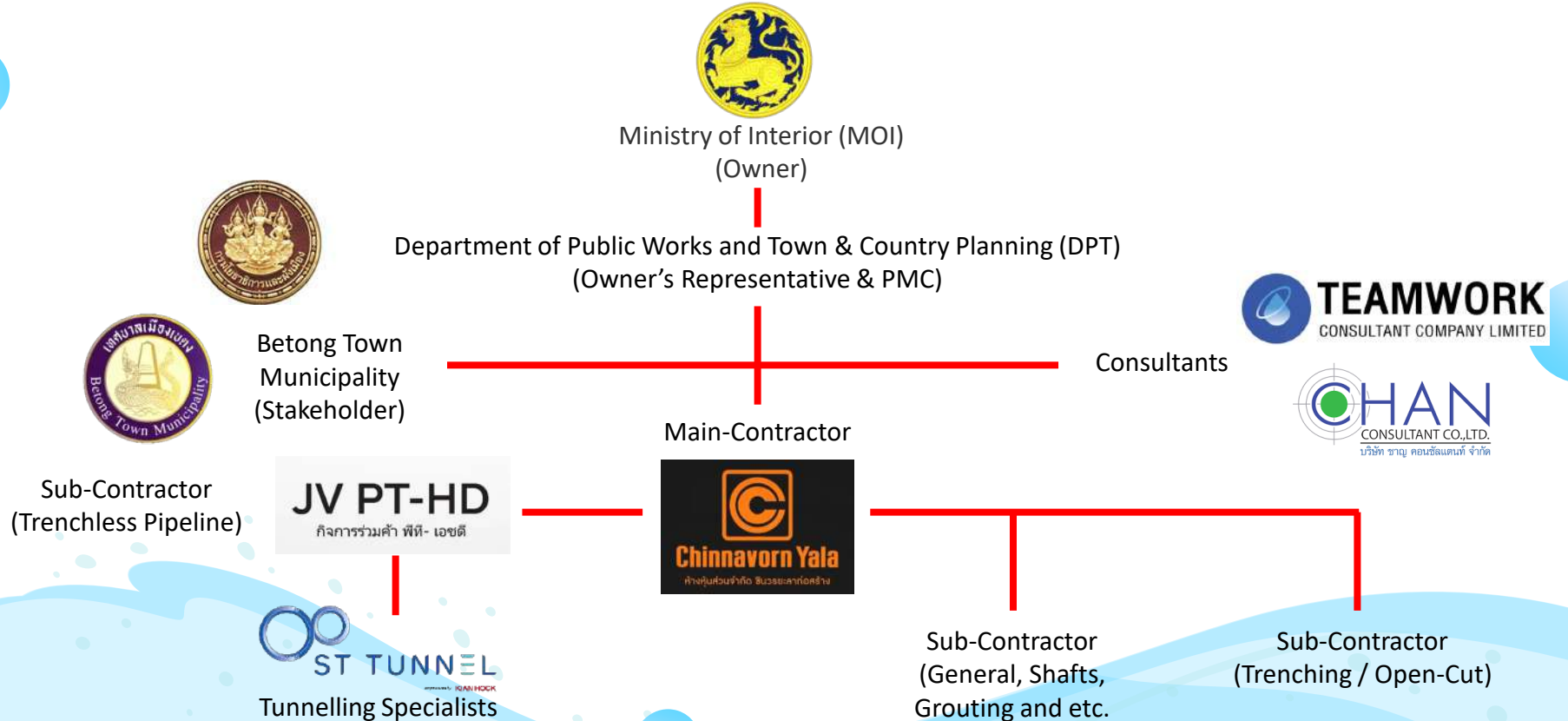


๑. รายละเอียดรูปแบบของงานก่อสร้าง งานก่อสร้างระบบป้องกันน้ำท่วม สังกัดในรูปที่ ๓



ปริมาณงาน			
1 งานก่อสร้างกำแพงรูปแบบที่ 1 (ฝั่งซ้าย+ขวา)	จำนวน 590 เมตร	5 งานก่อสร้างถนน คลส. กว้าง 4 เมตร	จำนวน 216 เมตร
2 งานก่อสร้างกำแพงรูปแบบที่ 2 (ฝั่งซ้าย+ขวา)	จำนวน 765 เมตร	6 งานก่อสร้างอุโมงค์ระบายน้ำ คล.2.10 เมตร	จำนวน 344 เมตร
3 งานก่อสร้างวางระบายน้ำท่อปลิววู้ ลึก 3 เมตร	จำนวน 102 เมตร	7 งานก่อสร้างอาคารควบคุมน้ำ	จำนวน 1 แห่ง
4 งานก่อสร้างวางระบายน้ำท่อปลิววู้ ลึก 5 เมตร	จำนวน 80 เมตร	8 งานก่อสร้างอาคารระบายน้ำท่ออุโมงค์	จำนวน 1 แห่ง

# Project Delivery Organization




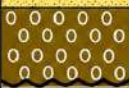


# CHALLENGES

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# Challenges

## Geological Conditions

- Located along **Sankalakhiri Mountain Range** (Granitic rocks with several enclaves of sedimentary/metasedimentary rocks that are overlain by Quaternary deposits), the northern section of the Titiwangsa Range, a mountain range along Peninsular Malaysia.
- **Silurian-Devonian (SD)** sedimentary rocks layer found along the pipeline elevation and route. Confirming to the findings by **The Malaysia-Thailand Border Joint Geological Survey Committee (MT-JGSC, 2009)**
- One critical zone between CH+407.7 to CH+361.2 had been pre-identified as the pipeline may be in between **non-homogeneous strata (Sandstone and Shale)** and **Soft Ground strata (Silty Sand and Silty Clay)**
- Layers of soils and rocks varying from **Stiff Hard Clay, Shale, Sandstone and Phyllite, foliated metamorphic rock with compressive strength, UCS up to 80MPa.**

Era	Period	Formation	Stratigraphic Column	Description
CENOZOIC	Quaternary	Holocene Fluvial deposits		Gravel, sand, silt, and clay (Qa) deposited in river and floodplain environment
		Pleistocene Ai Yoi Boe Chang Gravel beds		Semi-consolidated, gravel, sand, and silt (Qt) deposited in fluvial environment <i>Unconformity</i>
PALEOZOIC	Carboniferous	Yaha Fm.		Shale, schist, phyllite, sandstone (medium to thick-bedded), locally metamorphosed (Cy) deposited in near shore environment
		Devonian - Silurian Betong Fm.		Shale, sandstone and phyllite with limestone, locally metamorphosed (SD) deposited in marine environment

# Challenges

## Geological Conditions

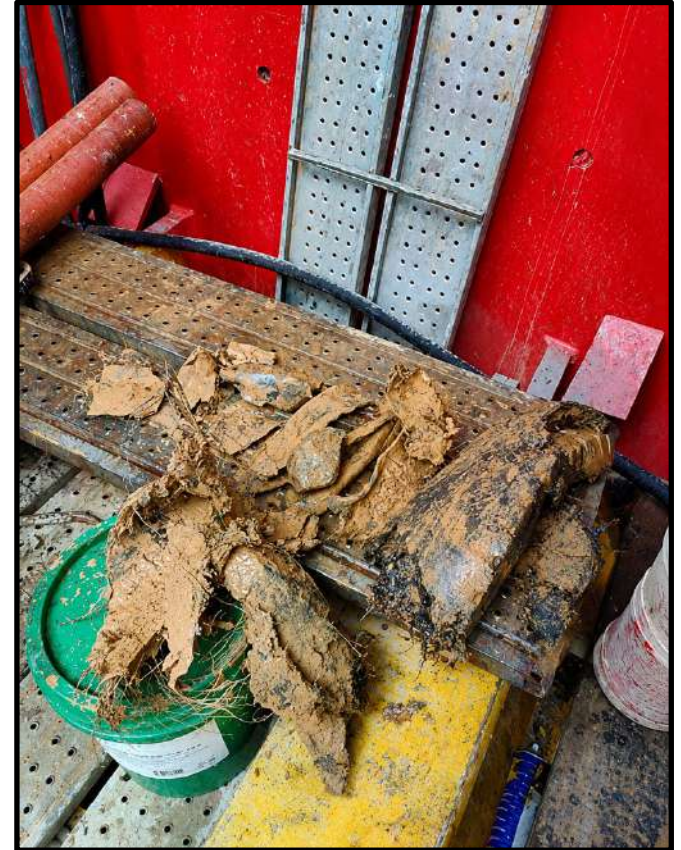
- **Non-homogeneous strata (Sandstone and Shale) , Soft Ground strata (Silty Sand and Silty Clay) , Stiff Hard Clay, Shale, Sandstone and Phylite, foliated metamorphic rock with compressive strength, UCS up to 80MPa.**



# Challenges

## Backfilling Materials

- Existing underground backfilling materials such as **abandon steel reinforcement bars, old tyres, steel pipes, PVC materials, debris** and etc.
- Worst-case conditions, pipe jacking in unforeseen and uncontrolled backfilling ground conditions may lead to **major misalignment, dislocation of TBM or pipe joints, damaged pipes, flooding in the tunnel, high jacking force and ground settlement/collapse.**



# Challenges

## Ecological and Environmental Conditions

- Significant **cultural and transit hub** on the border with Malaysia
- 24/7 around the clock **tourism** activities. Daytime (**natural beauty, historical intrigue, or a culinary adventure**). Sunset (**lively hub of entertainment**), challenges for the works to be carried out especially during mobilization, demobilization, transportation and muck-away works.
- **Betong Mongkhonrit Tunnel**, a prominent tourist attraction point and the first vehicular tunnel under a mountain in Thailand within zone of influent
- Tunnelling crossing under these important and historical landmark:-
  - ❖ **Kanchanapisek Sports Center, also known as Betong Municipal Stadium, Betong Municipal Park, Betong Municipal Swimming Pool, Betong Boxing Stadium (buildings and structure imposed zero settlement requirement)**



# Challenges

## Ecological and Environmental Conditions

- Environmental sensitive area such as **existing river, ponds, durian farms, natural forest and critical slope area**
- Environmental challenges such as **noise, dust, vibration, settlement, cracks and tilts** will significantly impact the surrounding neighbourhoods, road users, local stakeholders and tourist



# Challenges

## Climate & Weather Conditions

- Tropical rainforest climate, characterized by warm temperatures, high humidity, and heavy, year-round rainfall. Heavy rainfall due to the monsoon trough during the month of October to March, similar to Malaysia's Northeast Monsoon. Average of **2262mm of rainfall** per annum.
- **Landslide** had occurs during construction at both the jacking and receiving pits.
- **Flash flood** in year 2024 and recent flooding in Hatyai Province.



# Challenges

## Cross Border Logistics, Temporary Importation and Permits

- Temporary Importation Permit (**6 month in advance**)
- Construction during year end (Peak Tourist Period and Chinese New Year Roadban)
- **37 trucks** movement within 7 trips spreading within a period of 3 weeks (Mobilization) and 5 trips within 2 weeks (Demobilization)
- **Winding and tight Roads** from Pengkalan Hulu, Perak to Bukit Berapit then to Betong
- **Dimensions and weight compliance** to the regulation, **traffic condition** at the Malaysia-Thai border and access through the city of Betong
- **Complex, high-risk endeavors** that often lead to significant project **delays and cost overruns**. These projects require transporting highly specialized, oversized machinery (such as Tunnel Boring Machines - TBMs) and materials **across multiple jurisdictions, demanding rigorous coordination, adherence to local regulations, and precise documentation.**



# Challenges

## Public Acceptance

- The 273-meter **Betong Mongkhonrit Tunnel** in Betong, Thailand, opened on January 1, 2001 after several years of construction. The tunnel was constructed by Drill and Blast method which imposed some impacts on the surroundings and residents of Betong. By then, public acceptance became one of the challenges for the flood diversion pipeline works especially as it is in the close vicinity of the existing vehicular tunnel.



# Challenges

## Other Challenges

- Existing Underground and above ground utilities (Risk of settlements, disruptions of services, permits, relocation timeline and etc)
- Limited access and working area for heavy lifting works (Tandem Heavy Lifting involving SIMOPS of 2 cranes are required for the TBM launching works)
- Security & Access (In front of entertainment area, business centre, major tourist attraction spots, public toilets and etc.)
- High Traffic Flow (Congested area with high traffic flow around the clock, Road closure due to festive seasons, city events and etc.)
- Logistics, Supplies and Material Procurement (Limited resources, spare parts, consumable, Fuel and etc. for the new technology machinery such as TBM)
- Contractual Challenges such as working schedule (Tight working program to complete the works by 6 months)
- Contractual Challenges such as construction tolerances (Installation to be within the allowable vertical tolerance of +/-25mm & horizontal +/-50mm only)



# FACTS & FIGURES

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# Fact & Figures

## DN2100 (ID2100mm/OD2500mm) Pipe Jacking Work By Microtunnelling Works Along Ch.0+562 To Ch.0+218

Jobsite location : 5°45'58.6"N 101°04'16.8"E (Unnamed road next to Betong Mongkolrit Tunnel)

Start Pipeline : CH. 0+562.00m Start IL. : 272.000

End Pipeline : CH. 0+218.00m End IL. : 277.000

Tunnel Length : 344.00m

Tunnel Profile and Gradient :

### Horizontal Section

H1, Straight ∞ (CH+562.00 - CH+504.62) L=57.382m

H2, Curve R=2000m (CH+504.62 - CH+242.75) L=261.865m

H3, Straight ∞ (CH+242.75 - CH+218.00) L= 24.750m

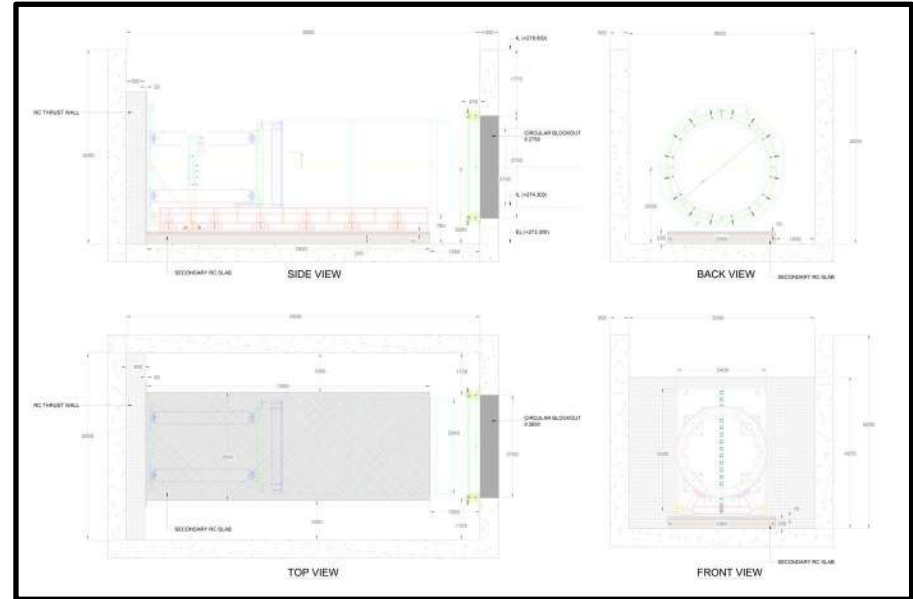
### Vertical Section

V, Straight 1:69 (+1.45%) (CH+562 - CH+218) L=344.00m

Pit Construction Method and Dimensions:

**Starting Pit**, 9.5m(L) x 5m(W) x 5.2m(D) – Cast-In Situ Method

**Arrival Pit**, 7.0m(L) x 4m(W) x 4.2m(D) –Sheet Piling Method



## Important Dates & Figures:

- Launching Ceremony on **17/11/2025**
- TBM Break-out on **22/11/2025**
- TBM Break-in on **8/1/2026**
- Total **39** Drilling Days

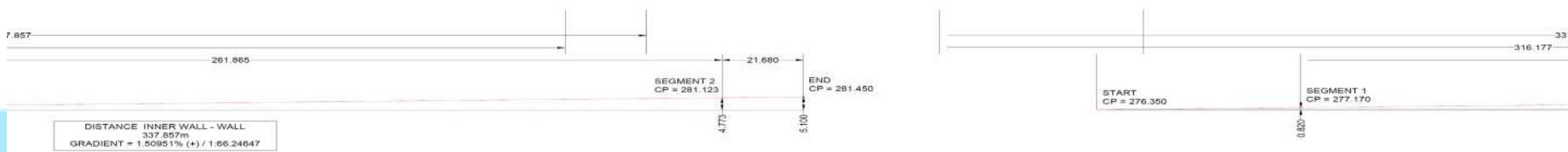
# Fact & Figures

## DN2100 (ID2100mm/OD2500mm) Pipe Jacking Work By Microtunnelling Works Along Ch.0+562 To Ch.0+218

### Tunnel Plan & Profile



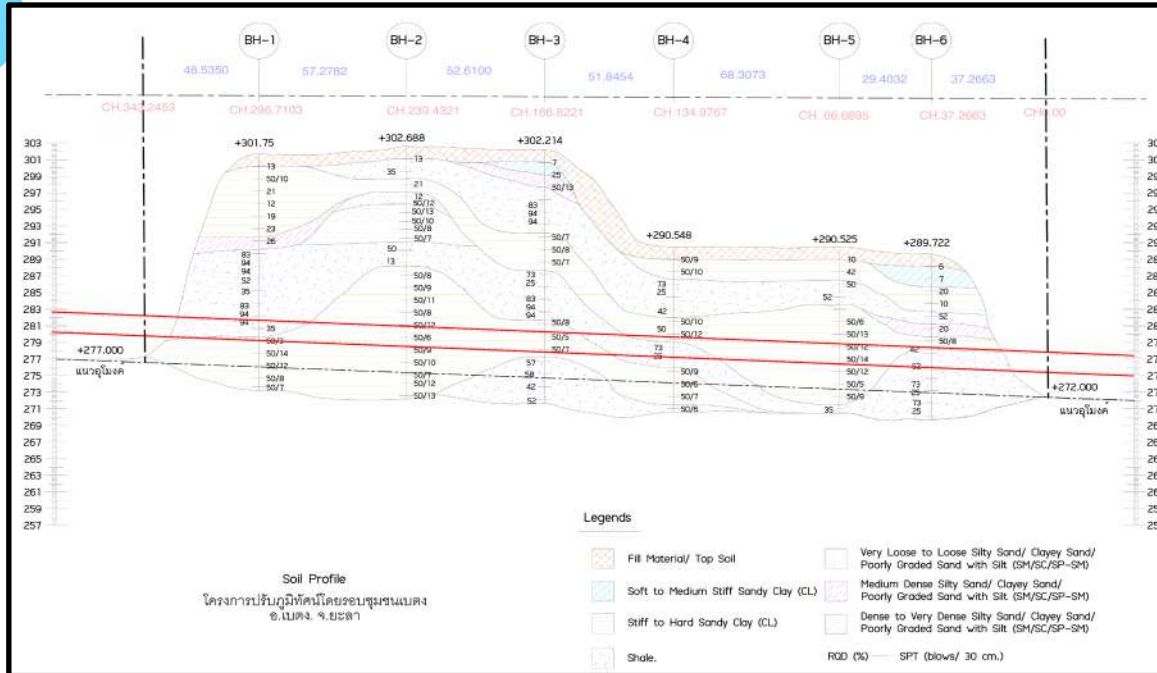
หมายเลข	พิกัด	ค่าระดับปากท่อเจาะ	
N	E		
BH-1	637,944.598	729,154.733	+301.715
BH-2	637,921.166	729,206.999	+302.688
BH-3	637,900.198	729,255.250	+302.214
BH-4	637,879.257	729,302.678	+290.548
BH-5	637,851.741	729,365.198	+200.525
BH-6	637,840.248	729,392.262	+289.722



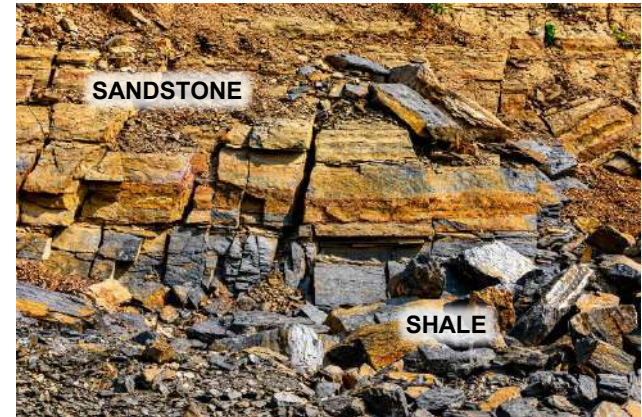
# Fact & Figures

## DN2100 (ID2100mm/OD2500mm) Pipe Jacking Work By Microtunnelling Works Along Ch.0+562 To Ch.0+218

### SI Summary & Geological Profile



Location	Pipeline		SI Report	
	Chainage (CH)	IL. (m)	Depth from CL (m)	BH Ref.
Starting Pit	0+562	+272.00	5.00	06
Mid S section	0+500	+272.90	16.80	06
Mid S section	0+467	+273.40	17.10	05
Mid S section	0+407.7	+274.20	16.30	04
Mid S section	0+361.2	+274.90	27.30	03
Mid S section	0+311.5	+275.60	27.10	02
Mid S section	0+258.9	+276.40	25.40	01
Receiving Pit	0+218	+277.00	8.00	01



# TECHNICAL DESIGN & CONSIDERATION

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# PROJECT OVERVIEW



- Tunnel Installation Method
  - QHSSE Compliances
- Sustainable & Creative Construction
  - Monitoring & Controls
- Mitigation & Contingency Plans

# TUNNEL INSTALLATION METHOD

- Selection of Installation Methodology
- What is Microtunnelling?
- The Site Setup
- Techniques to be Applied
- Equipment – Design & Criteria
- Pipe Design & Allocation Plan
- Engineering Calculations



# TUNNEL INSTALLATION METHOD

## Selection of Installation Methodology

- Drilling **between 5.0m to 35.0m** below ground level and Hydrostatic between 0.3 to 2.5 bar;
- Actual Geological & Soil Properties (**Shale, Sandstone, Silt & Stiff Clay**)
- A system that does not alter the **delicate lithostratigraphic and hydrogeological balance**.
- To prevent any disruption to the **inhabitant, buildings, utilities and environment** .
- **Settlement Proof & Non-Disrupted Method (NDM)**
- **Product Pipe Design, Material and Installation methodology**
- Effective, engineering sound and could fit in the **construction period**
- Working **environment & Climate**



**MICROTUNNELLING**

# TUNNEL INSTALLATION METHOD

## What is Microtunnelling?

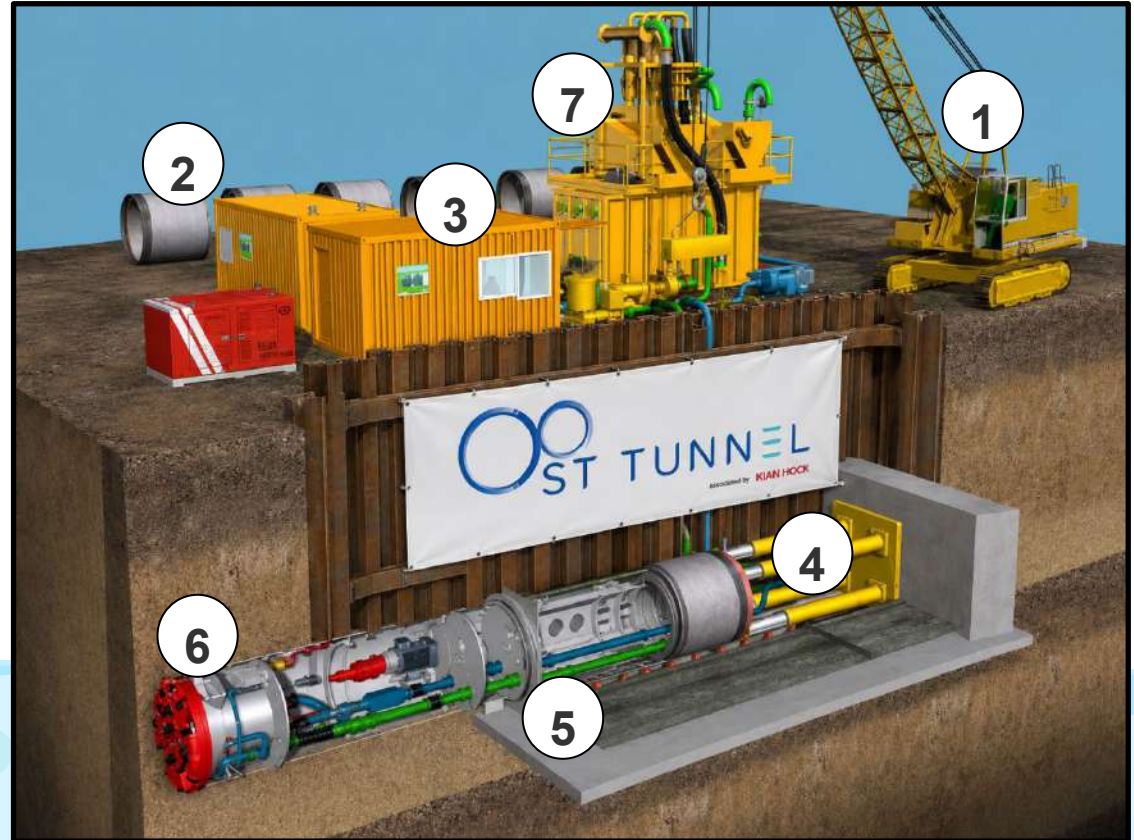
- **Trenchless Construction Techniques**
- Roads don't need to be dug up or cordoned off and traffic congestion is **minimized**
- Earth shifting or construction site traffic (trucks) kept to a **minimum**
- **Minimum inconvenience** to inhabitants from dirt and noise
- **No danger** to historic buildings
- Existing underground utilities and buildings **not subject to subsidence**
- Groundwater lowering required only at certain spots resulting in **minimum environmental impact**



# TUNNEL INSTALLATION METHOD

## The Site Setup

- [1] Lifting Machinery
- [2] Pipes
- [3] Control Container
- [4] Main Jacking Station
- [5] Launching Seal Ring
- [6] Tunnel Boring Machine
- [7] Separation Plant



# TUNNEL INSTALLATION METHOD

## Techniques Applied

- **Totally sealed** jacking shaft and receiving shaft with In-Situ Caisson and Steel Sheet Piling Method
- **Gyro Navigation** Guidance System for Long Curvature Drive
- **Emergency seal** system
- **Automatic and Redundant** Spoil Separation Plant
- 360° Pan & Tilt Wireless Tunnel **Surveillance**
- 4G/5G Wireless Internet **Data Access** in Tunnel
- **CCTV Monitoring and Communication** System
- Slurry Mixture to maintain **Hydrostatic Pressure** at the TBM Bulkhead and **Lubricate** the Cutting Tools
- Automatic Lubrication System to continuously **monitor, control and lubricate** the overcuts



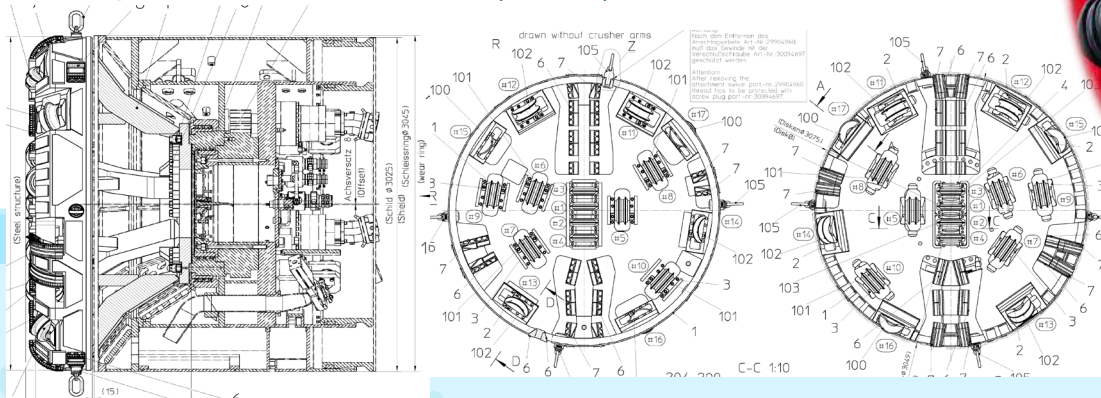


# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

### Cutting Wheel Design

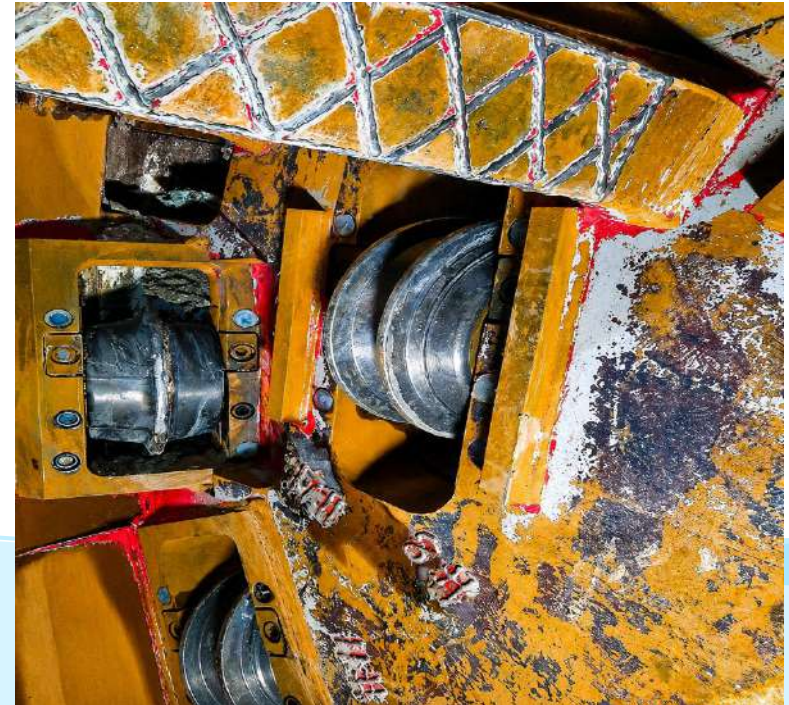
- Rock Ground with Cutting Tools (Max 200 MPa) w/ HF Plates
- Raucers with TCI ( 4 pairs – 18 nos.)
- Center Cutter – MonoBloc Special Disc 305mm ( 4 nos.)
- Gauge Cutter – MonoBloc Special Discs 305mm ( 3 nos.)
- Face Cutter – DoubleBloc Special Discs 305mm ( 7 nos.)
- Scraper Bits with TCI 140mm ( 8 nos.)



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

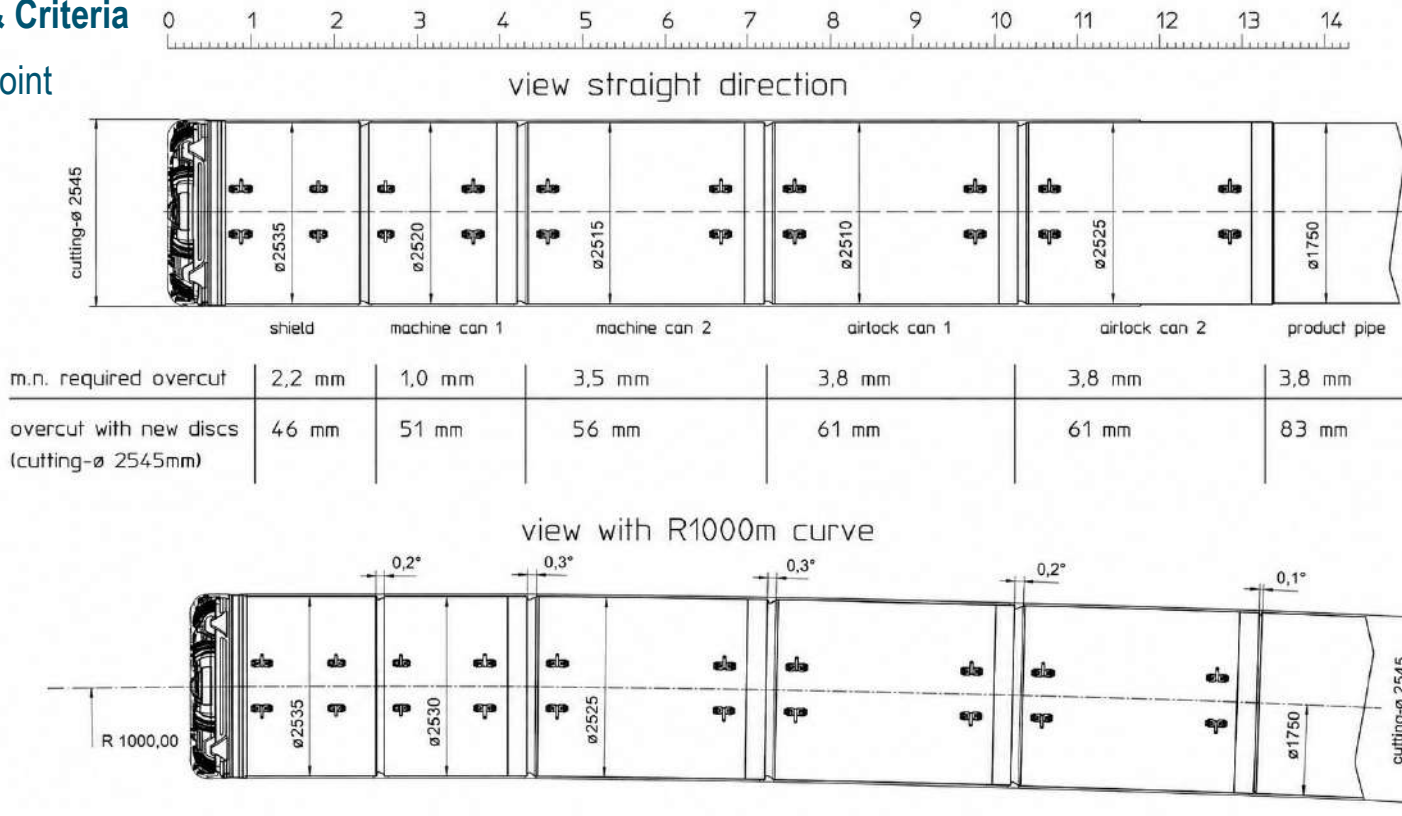
- Cutting Tools Replacement (**Back Loading Design**)



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

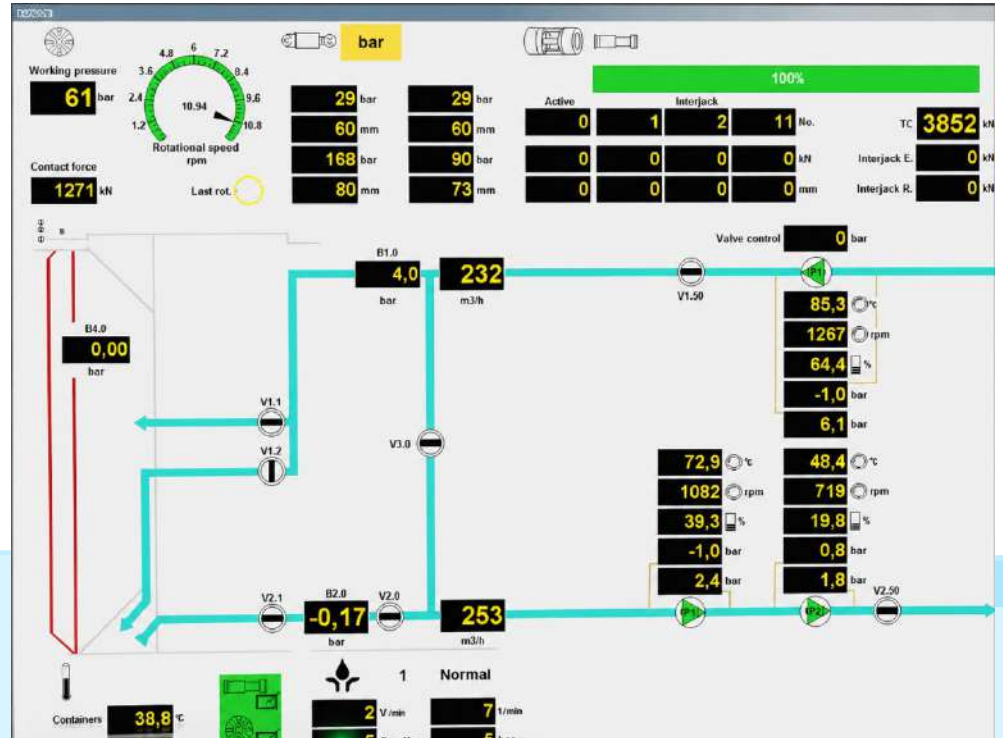
- Overcuts and TBM Joint Engineering



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

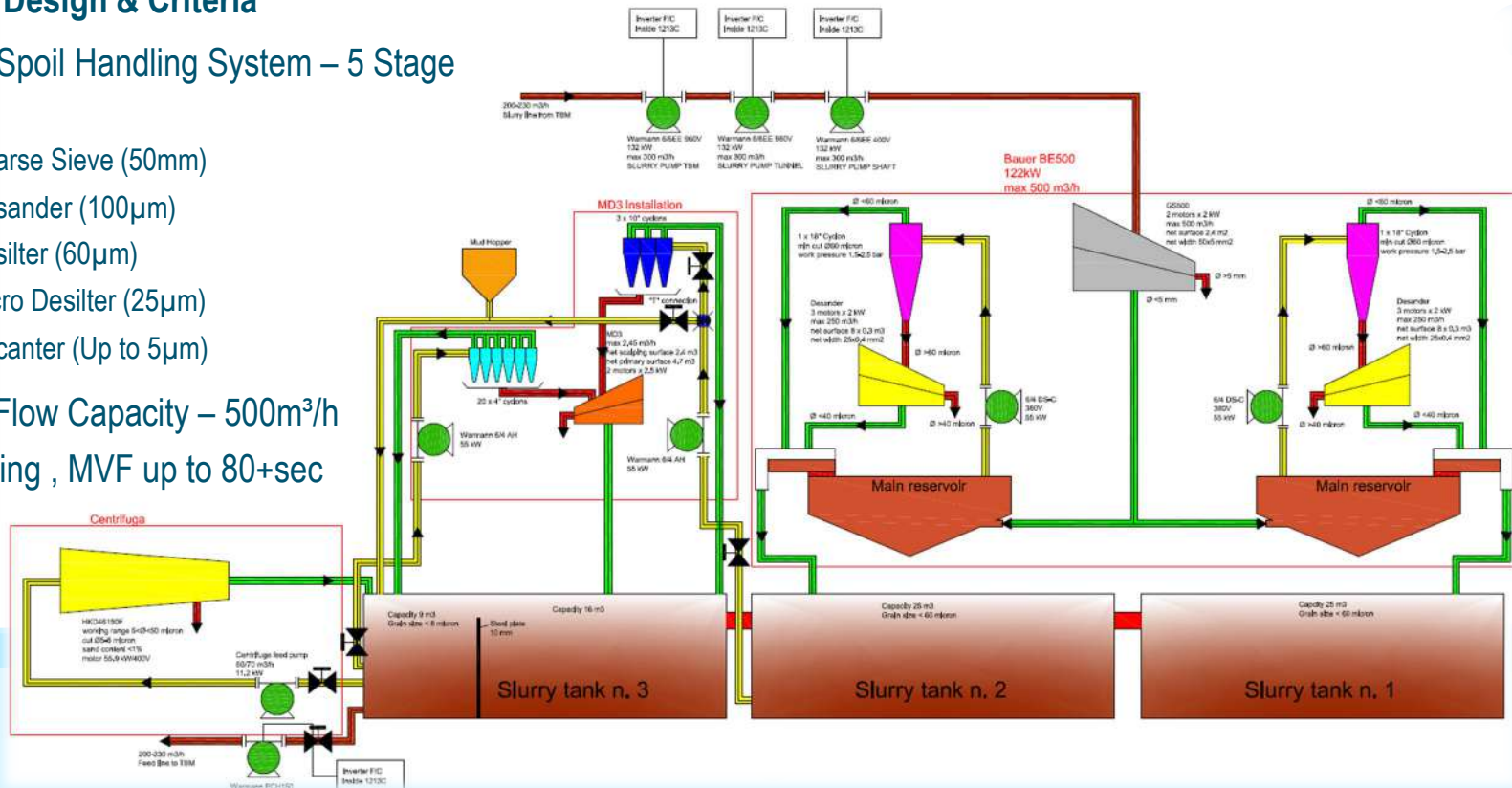
- Control & Operation
- Full Digital Visualization
- Automatic Data Logging and Control System



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

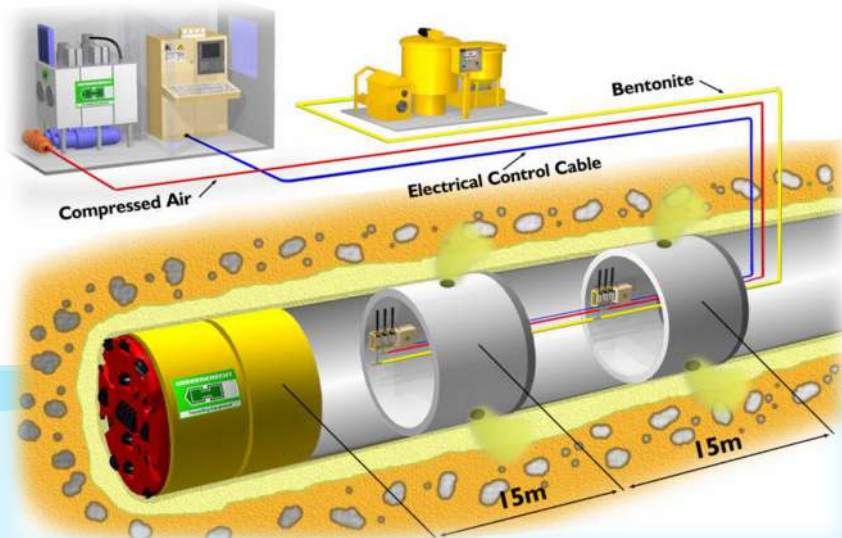
- Automatic Spoil Handling System – 5 Stage System
- Stage 1 – Coarse Sieve (50mm)
- Stage 2 – Desander (100µm)
- Stage 3 – Desilter (60µm)
- Stage 4 – Micro Desilter (25µm)
- Stage 5 – Decanter (Up to 5µm)
- Maximum Flow Capacity – 500m<sup>3</sup>/h
- Mud Handling , MVF up to 80+sec
- SC < 3%



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

- Automatic Lubrication System (Installed every 12-15m)
- 3 sets of Injection Pump for 3 lines (TBM & Tunnel1&2)
- 1 set of automatic mixing unit & 1 unit of venturi mixer
- Programmable Sequence (Time / Volume)



# TUNNEL INSTALLATION METHOD

## Lubrication & Face Support Fluid Mix Design

Lubrication Slurry (Target MFV:120+sec / Qtr), Formulation per 1m<sup>3</sup> of mixture

- Mix up water : EC≤0.8-1ms/cm
- Mix up water : PH >9.5
- Soda Ash : Solvay-L = 1kg
- Bentonite : Bentonil = CF 65 - 70 kg
- Polymer : SC VIS GSTP = 1.5 – 2 kg

Front Face Stabilization Slurry (Target MFV:50+sec / Qtr), Formulation per 1m<sup>3</sup> of mixture

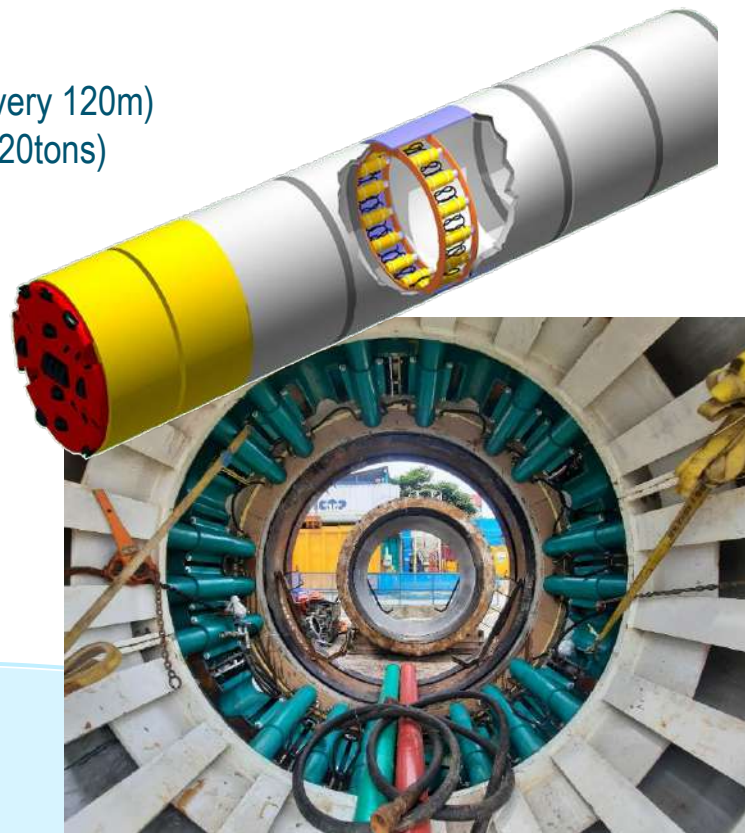
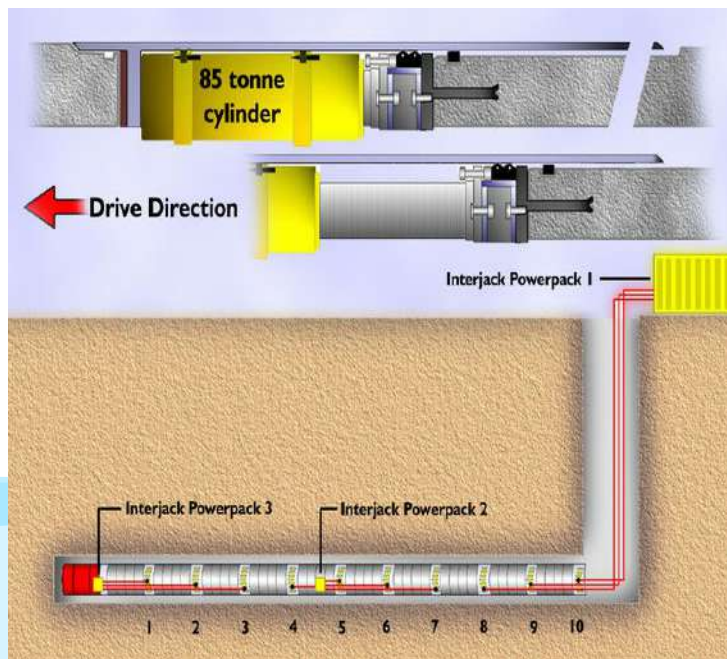
- Mix up water : EC≤0.8-1ms/cm
- Mix up water : PH >9.5
- Soda Ash : Solvay-L = 1kg
- Bentonite : Bentonil - CF = 50 kg
- Polymer : SC VIS GSTP = 0.75 kg



# TUNNEL INSTALLATION METHOD

## Equipment – Design & Criteria

- Integrated Intermediate Jacking System (Installed every 120m)
- 14 nos. of 700mm stroke Cylinder (Max Capacity 1020tons)



# TUNNEL INSTALLATION METHOD

## Pipes – Design & Criteria

- Pipes (Joints, Dimension, Concrete Properties, sealing system, collars, allowable jacking force, reinforcement and etc.

## Specification

Type : Concrete Reinforcement Jacking Pipe

Pipe ID/OD (2100mm / 2500mm)

Unit Weight (4.8tons/m)

Class : 2.5Z

Work Proof Load : 184kN/m

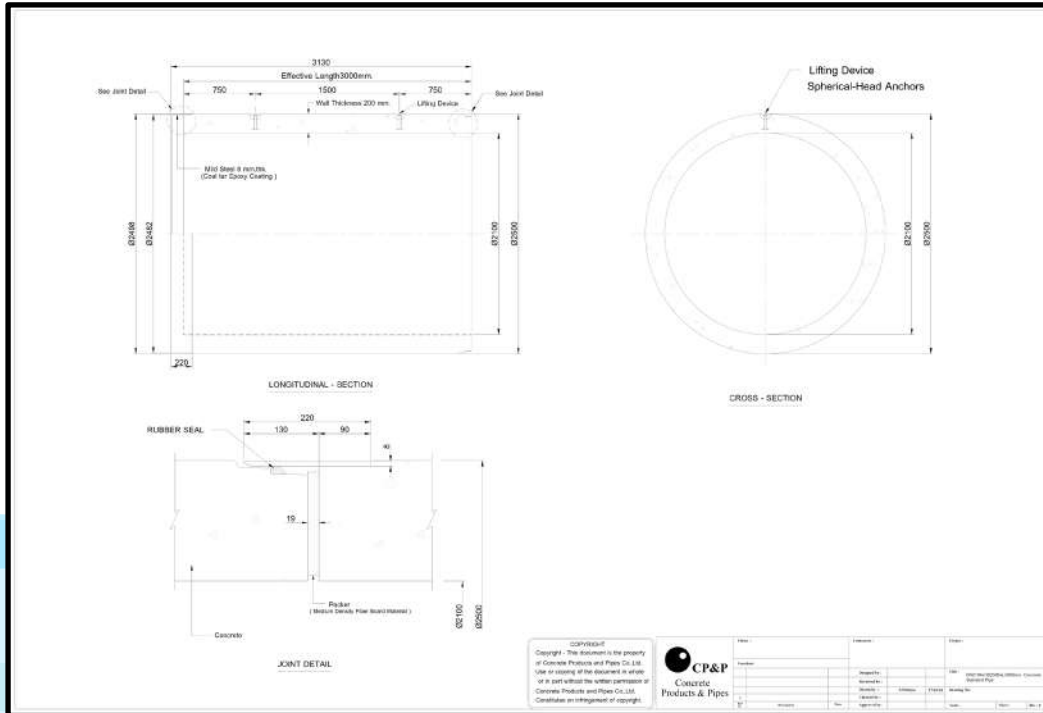
Concrete Strength : 50MPa

Standards : BS-5911 Part 120

External MS Steel Collar (10mm)

Pressure Transfer Ring : Packer Ring

Allowable Jacking Force : 6261kN

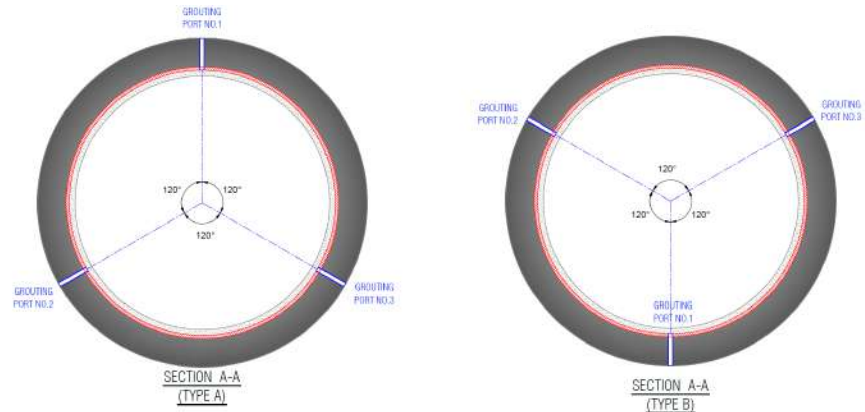


# TUNNEL INSTALLATION METHOD

## Pipes Allocation Plan

Project:		COMMUNITY LANDSCAPE IMPROVEMENT AROUND BETONG COMMUNITY PROJECT - DK2100 (D2150MM/OD2500MM) PIPE JACKING WORK BY MICROTUNNELLING WORKS ALONG CH-9-32 TO CH-9-218																																																																																																																																							
Pipe Allocation Plan		ST TUNNEL		ST TUNNEL THAILAND CO., LTD.		Date: 10/11/2023		Rev: 04																																																																																																																																	
Drive Sequence: CH-9-32 to CH-9-218		Location: 3 muu Samnakwit 4 km size 2 Betong, Yala, Thailand		Type of Drv: CURVE R=2000		F.F Length: 330.863																																																																																																																																			
Pipe Diameter: OD2100mm / OD2500mm		TBM ID: A (AVH1800TB R + EXT100) - M2150M		F.F Length: 330.863		Rev: 04																																																																																																																																			
*Pipe Sequence May Subject to Changes as required by Active Drive Conditions																																																																																																																																									
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Length per (m)	7.52	3.02	3.02	3.02	3.02	3.02	4.15	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02																																																																																																																					
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Length per (m)	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02																																																																																																																					
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Length per (m)	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02																																																																																																																					
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Station	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																					
Allocation	STD	LUB-A	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	LUB-A																																																																																																																					
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Length per (m)	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02																																																																																																																					
Cumulated Length (m)	254.9	257.9	259.9	260.9	264.1	267.1	270.1	273.1	276.1	279.1	282.1	285.1	288.1	291.2	294.2	297.2	300.2	303.2	306.2	309.2																																																																																																																					
<table border="1"> <thead> <tr> <th>Station</th><th>101</th><th>102</th><th>103</th><th>104</th><th>105</th><th>106</th><th>107</th><th>108</th><th>109</th><th>110</th><th>111</th><th>112</th><th>113</th> </tr> </thead> <tbody> <tr> <td>Allocation</td><td>LUB-A</td><td>STD</td><td>STD</td><td>STD</td><td>LUB-A</td><td>STD</td><td>STD</td><td>LUB-A</td><td>STD</td><td>STD</td><td>STD</td><td>STD</td><td>STD</td> </tr> <tr> <td>Description</td><td colspan="13"></td> </tr> <tr> <td>Specification</td><td>LUB-A</td><td>STD</td><td>STD</td><td>STD</td><td>LUB-A</td><td>STD</td><td>STD</td><td>LUB-A</td><td>STD</td><td>STD</td><td>STD</td><td>STD</td><td>STD</td> </tr> <tr> <td>Length per (m)</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td><td>3.02</td> </tr> <tr> <td>Cumulated Length (m)</td><td>314.3</td><td>317.3</td><td>320.3</td><td>323.3</td><td>326.4</td><td>329.4</td><td>332.4</td><td>335.4</td><td>338.4</td><td>341.4</td><td>344.4</td><td>347.4</td><td>350.4</td> </tr> </tbody> </table>												Station	101	102	103	104	105	106	107	108	109	110	111	112	113	Allocation	LUB-A	STD	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	STD	STD	STD	Description														Specification	LUB-A	STD	STD	STD	LUB-A	STD	STD	LUB-A	STD	STD	STD	STD	STD	Length per (m)	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	Cumulated Length (m)	314.3	317.3	320.3	323.3	326.4	329.4	332.4	335.4	338.4	341.4	344.4	347.4	350.4																																										
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Type	Description	L (m)	Qty	Length
AVN	Jacking machine	7.519	1	7.52
STD	Normal pipe	3.015	73	220.10
LUB-A	Lubrication Injection Pipe (Typ1)	3.015	38	114.57
IJS	IJS Stroke 700mm fully collapsed	4.145	2	8.29
<b>Total length (m)</b>				<b>350.47</b>



# TUNNEL INSTALLATION METHOD

## Engineering Design and Calculations

- Theoretical Horizontal Jacking Force & Face Pressure Calculations (Sample only)

REQUIRED HORIZONTAL JACKING FORCE CALCULATION FOR PIPE JACKING / MICROTUNNELLING WORKS

Project Information		Project No. P1101-PAAB-PLU1-CN-CAL-ICP-401	
Client: [Redacted]		Contract No. [Redacted]	
Location: [Redacted]		Drawing No. [Redacted]	
Scale: 1:100		Date: [Redacted]	
Prepared by: [Redacted]		Checked by: [Redacted]	
Reviewed by: [Redacted]		Approved by: [Redacted]	
Project Description		[Redacted]	
Tunnel Details		[Redacted]	
Soil Conditions		[Redacted]	
Jacking Parameters		[Redacted]	
Jacking Force Calculations		[Redacted]	
Face Pressure Calculations		[Redacted]	
Total Jacking Force		[Redacted]	
Safety Factor		[Redacted]	
Remarks		[Redacted]	

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Jacking Parameters		[Redacted]	
Jacking Force Calculations		[Redacted]	
Face Pressure Calculations		[Redacted]	
Total Jacking Force		[Redacted]	
Safety Factor		[Redacted]	
Remarks		[Redacted]	



# TUNNEL INSTALLATION METHOD

## Engineering Design and Calculations

- Theoretical Ground Settlement Calculation (Sample Only)
- Theoretical Friction Force Calculation (Sample Only)

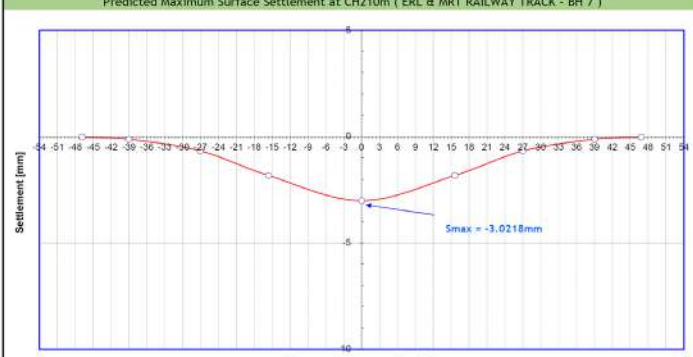
Project: PROPOSED DEVELOPMENT OF LANGAT 2 WATER TREATMENT PLANT AND WATER RETICULATION SYSTEM IN KELANGOR DARUL EHSAN / MELAYAH PERSEKUTUAN KUALA LUMPUR PAKS 11 Ref.: P211001-PAAB-PKJ11-CN-CAL-ICOP-4002.8

Work: DESIGN PIPE JACKING WORK BY MICROTUNNELLING METHOD CROSSING BERSIRI HIGHWAY, RTM TRACK, ENL TRACK, MRT ELEVATED TRACK AND KL-SEREMBAN HIGHWAY, KUALA LUMPUR FROM CH. 48.170 to CH. 48.130

### MAXIMUM SETTLEMENT AND GROUND LOSS CALCULATION

1) U. Winkler and Hen, 1982  
2) Adnan R.A., Mohamad H. (2021) Greenfield Settlement of KVMRT SSP Line 2 in Kuala Lumpur Limestone Formation - Page 8 (6 Calculations)

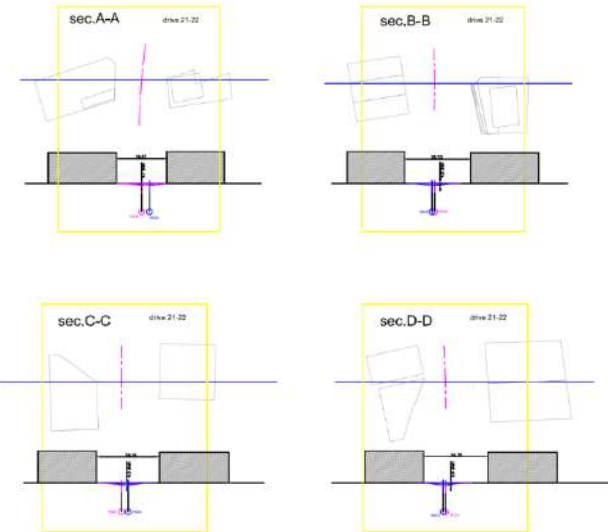
**Predicted Maximum Surface Settlement at CH210m ( ERL & MRT RAILWAY TRACK - BH 7 )**



Settlement [mm]

Distance from centre line [m]

$S_{max} = -3.0218\text{mm}$



# QHSSE COMPLIANCES

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# QHSSE COMPLIANCES

## HSSE Equipment – Design & Criteria (Above Ground) – Master Control Room & TBM Operator Room

- 360° Pan & Tilt QHD CCTV Surveillance (Online IP Camera with Live View through the internet)
- Communication System
- 4G/5G Wireless WIFI Data Access throughout entire Jobsite



# QHSSE COMPLIANCES

## HSSE Equipment – Design & Criteria (Shaft, In Tunnel)

- 360° Pan & Tilt QHD CCTV Surveillance (Online IP Camera with Live View through the internet)
- Communication System
- 4G/5G Wireless WIFI Data Access throughout entire tunnel until TBM
- Automatic Gas Detector and Monitoring System in TBM
- DC Power Tunnel Lighting with Emergency Lighting (Battery Recharged)



# QHSSE COMPLIANCES

## HSSE Equipment – Design & Criteria

- ELSA & SCABA units
- Tunnel Portable Stretchers
- Gas Detectors & Automatic System in TBM
- PPE & Trainings (Civil Defense)



# QHSSE COMPLIANCES

## MTBM Sustainability and Environmental Compliances

- **Ecological and biodegradable** MTBM consumable products
- Since 2007 STTM has taken a path to gradually move on the MTBM consumable products from mineral hydraulic fluids to **eco-friendly** hydraulic fluids, then followed by grease and coolant. The main environmental benefits of these oils and grease are biodegradability, **low eco-toxicity**, and the **reduction of CO2**. The employment of **eco-friendly** fluids ensures a **lower environmental impact** in case of spills into terrestrial and aquatic environments. All ST TUNNEL GROUP's Herrenknecht MTBM uses only environmentally-friendly oils and grease as follows:



Type	Section of Use in MTBM	Brand	Model / Title
Hydraulic Fluid	All hydraulic circuit, pumps, tanks, cylinders, motors and etc	Shell	Naturelle HF-E 68
Grease	All bearing, moving joints, articulation segments, connection and etc	Fuchs	Plantogel 2N
Coolant	All heat exchanger, cooling circuit, HWL water hoses	Davor Lubricants	Cassida FM Coolant



\*Afbeelding ter illustratie \*For illustration purposes only

# QHSSE COMPLIANCES

## Ecological and biodegradable Pipe Jacking/Construction Lubrification products

- The use of specialty drilling fluids for pipe jacking is critical to the success of all trenchless projects. Only by considering the right rheological properties at an early stage of the project, the bentonite-based drilling mud can fulfil its functions. Utilizing the right polymers and bentonites for pipe jacking that provide essential lubrication and stabilization of the tunnel face when a slurry shield is used. To achieve a successful application of both these elements (drilling fluid for lubrication as well as stabilisation of tunnel face), a good understanding from the construction team is absolutely necessary. ST TUNNEL GROUP collaborates with Siam Minerals whom provides technical assistance alongside drilling fluids for pipe jacking projects to help and understand the trenchless project better and get the right and desired solution. All ST TUNNEL GROUP's pipe jacking and microtunnelling jobsites and projects uses only **environmentally-friendly** bentonites, polymers and additives as follows: -



Type	Rheological Properties	Brand	Model / Title	MSDS & TDS
Bentonites	Viscosity (Plastic Viscosity), Water Retention (Filtration Loss); Stability (Water Dissociation Ratio)	Siam Minerals	Tixobent Series (Natural Clay only)	<a href="https://siam-minerals.com/drilling-fluids-pipe-jacking">https://siam-minerals.com/drilling-fluids-pipe-jacking</a>
Polymers	Thixotropy (Thixotropic Value)	Siam Minerals	Sim Series (Water Base only)	
Additives	Enhancer or retarder to the type of Lubrification products above	Siam Minerals	GELBOOST, CEM CONTROL & BMS500	



# MONITORING & CONTROLS

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# MONITORING & CONTROLS

## Instrumentation & Monitoring (Settlement & On Ground Movement) – By Others

- Surface Settlement Points
- Inclinator
- Piezometer
- Tiltmeter
- Miniprism

## Jacking Force (Tunnel Installation)

- Real time pressure between IJS

## Lubrication & Slurry (Tunnel Installation)

- Marsh Viscosity
- Sand Content
- Density
- Filtration
- Reology & Kugelharfe

## Survey & Control Measurement (Tunnel Installation)

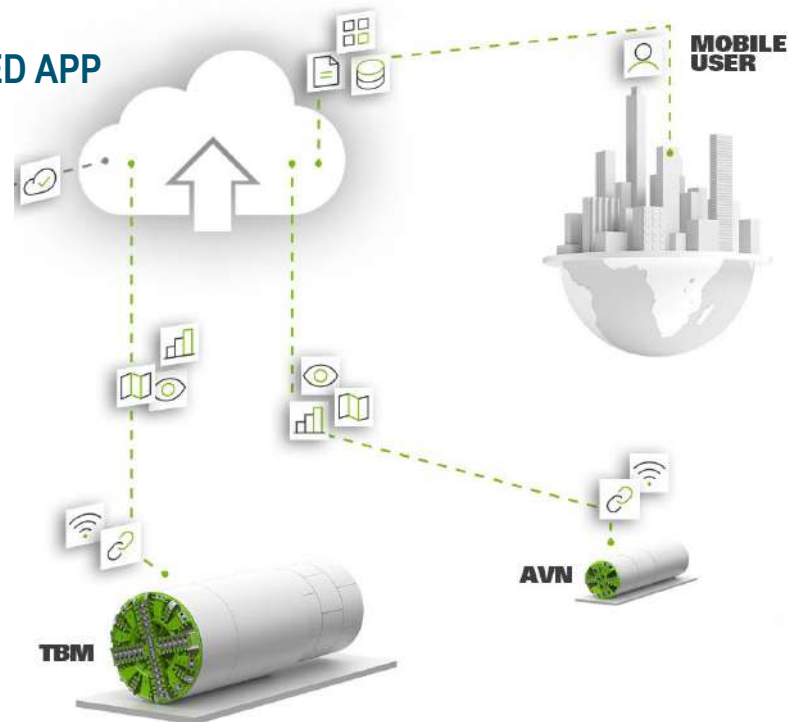
- Network Survey
- Periodical Tunnel Survey (Every 50-m)



# MONITORING & CONTROLS

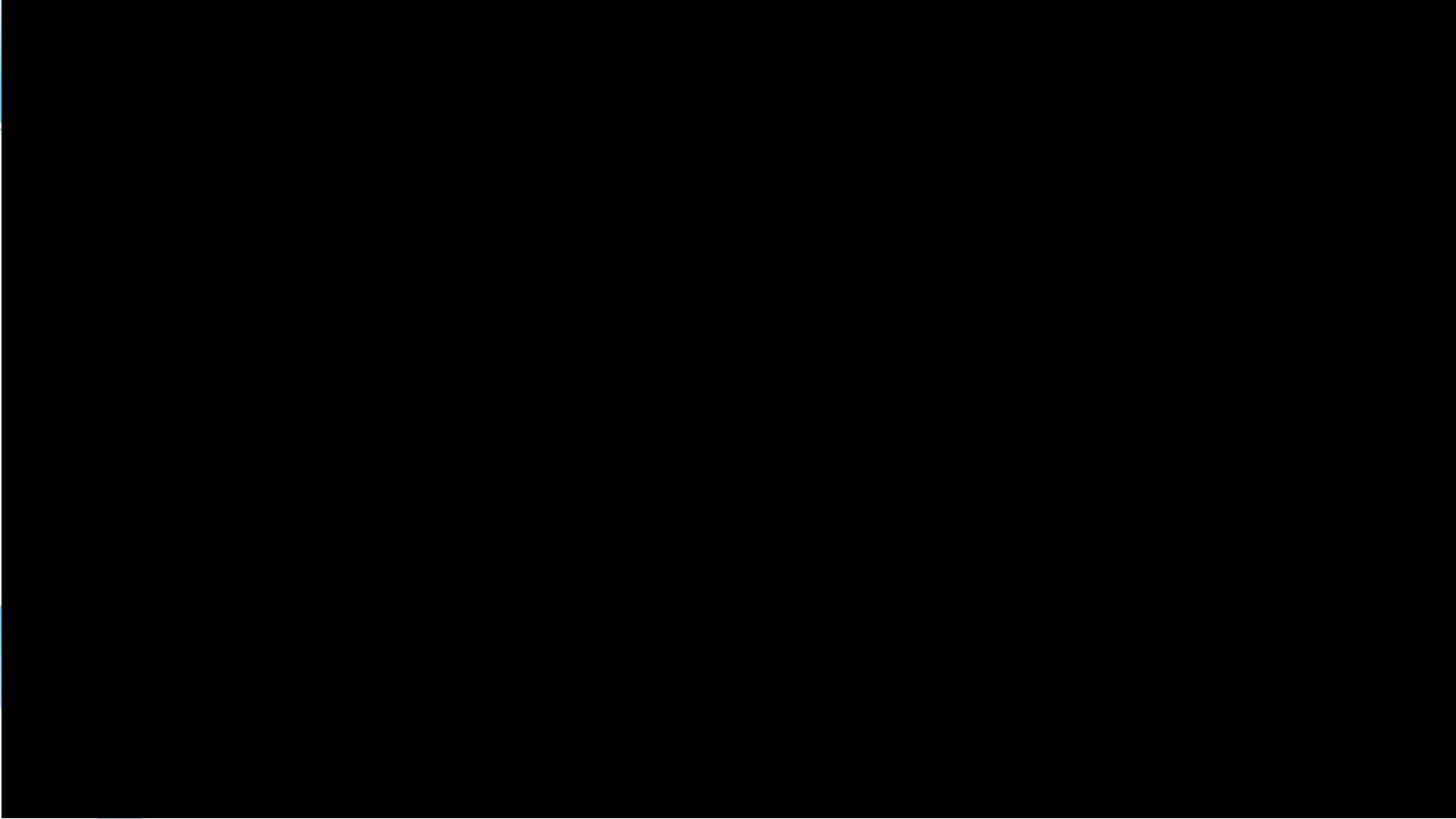
## Big Data Collection And Online View Tunnel Management

- Collection of Drilling / Tunnelling / Lubrication Datas
- Online Real time View through Herrenknecht **CONNECTED APP**
- Online Tunnel Management



# IMPLEMENTATION & EXECUTION

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

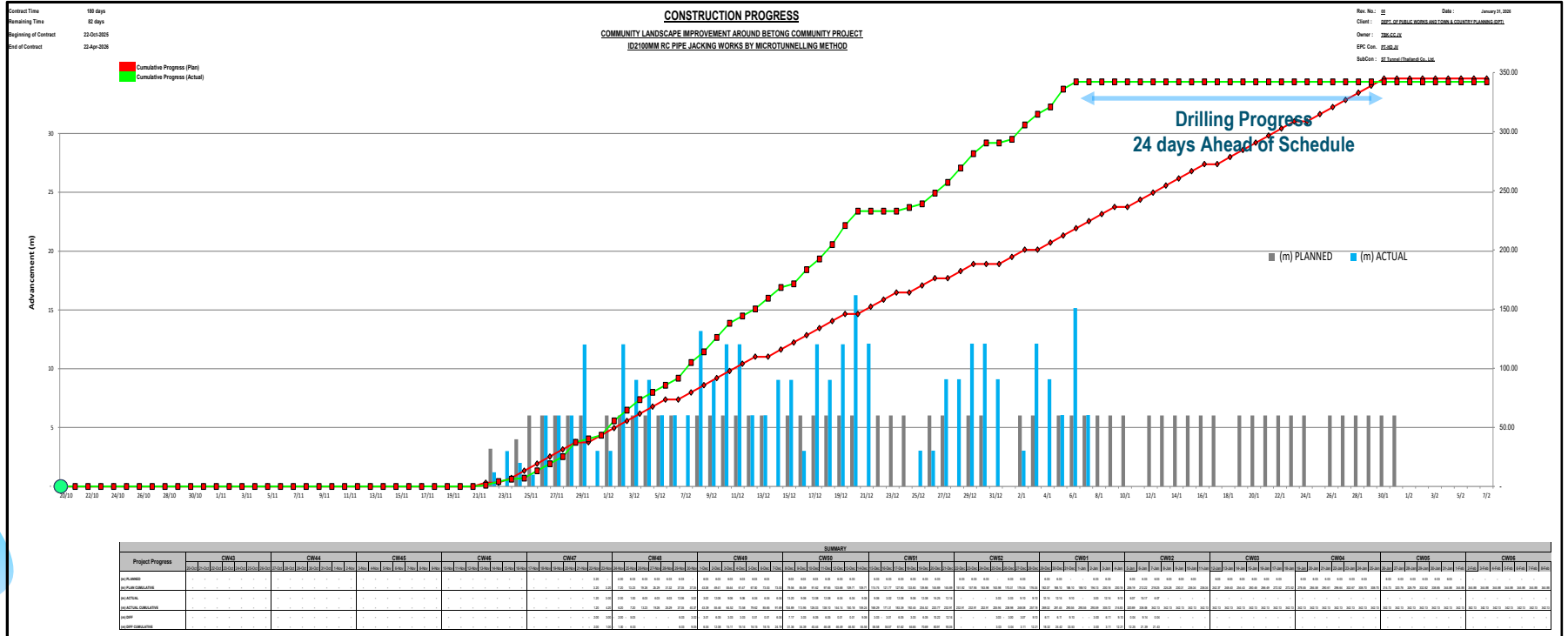


# STATISTICAL RESULTS

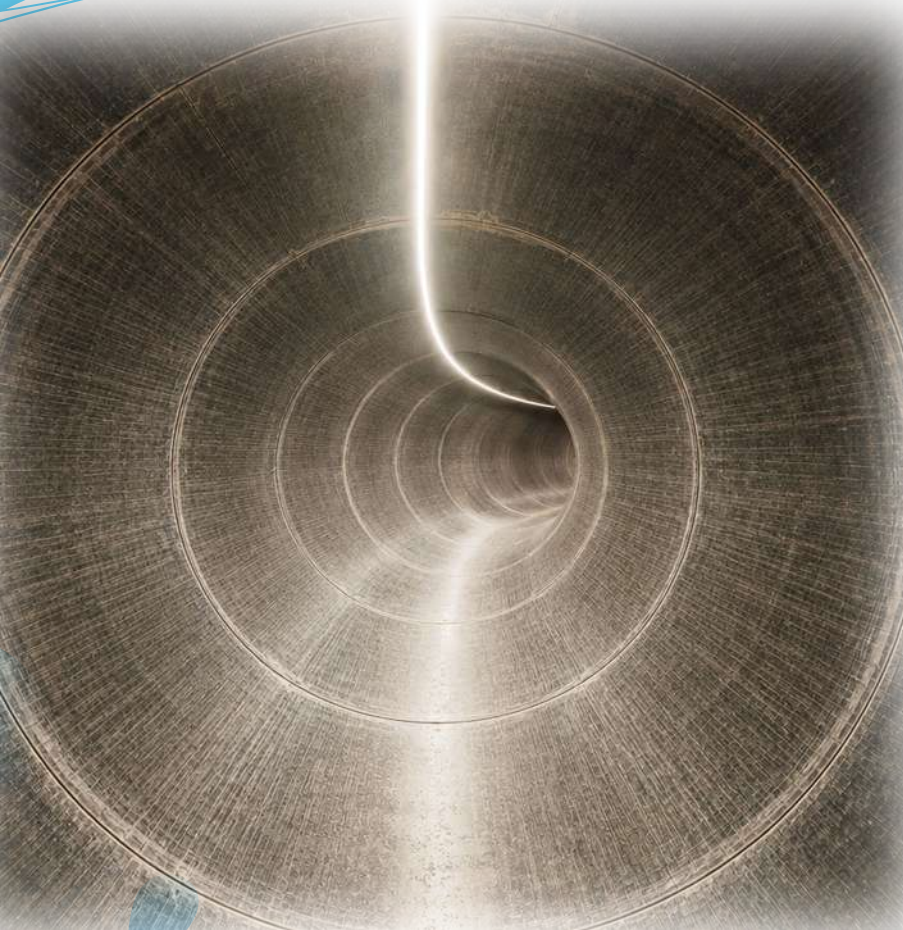
FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

# STATISTICAL RESULTS

## Progress (Plan Vs Actual)



# STATISTICAL RESULTS



## PROJECT PROGRESS DATA & ANALYSIS

### NOTICE TO PROCEED

Thursday, 2 October 2025

ITEM	DATA	UNIT	CONTRACT	ACTUAL	REMARKS	DIFF	%
1	DURATION OF WORKS	(CD)	180	135	AHEAD	-45	-25.0%
2	WORKING DAYS	(WD)	152	125	AHEAD	-27	-17.8%
3	MOBILIZATION	(WD)	15	10	AHEAD	-5	-33.3%
4	DEMOBIZATION	(WD)	16	10	AHEAD	-6	-37.5%
5	SETTING UP	(WD)	18	30	DELAY	12	66.7%
6	PIPE JACKING	(WD)	56	39	AHEAD	-17	-30.4%
7	DOWNTIME DUE TO OTHERS	(WD)		0	vs Actual		0.0%
8	DOWNTIME DUE TO OBSTRUCTION	(WD)		2.5	vs Actual		2.0%
9	DOWNTIME DUE TO QHSSE NON-COM.	(WD)		4	vs Actual		3.2%
10	DOWNTIME DUE TO STTT	(WD)		1	vs Actual		0.8%
11	MAINTENANCE	(WD)		4	vs Actual		3.2%
12	AV. DAILY PRODUCTION	m/d	6.37	10.12	Higher		158.8%
13	HIGHEST PRODUCTION	m		16.25	vs. Av. Prod		160.6%
14	AV. ADVANCEMENT RATE	mm/min		12.5			
15	HIGHEST ADVANCEMENT RATE	mm/min		50.5	vs. Av. Adv		404.0%
16	DURATION TO DRILL THROUGH ROCK	(WD)		20			
17	CUTTER REPLACEMENT DURATION	(WD)		0	N/A		
18	TOTAL CUTTER REPLACED	set		0	N/A		

## List of Downtime

**Downtime Duration (7.5 WD)**

(Backfilling Material)

(Cracks at IJS no.2)

**Maintenance Duration (4.0 WD)**

**QHSSE Non-Conformance (0)**

# STATISTICAL RESULTS

## Benefits and Savings

### Advantages of trenchless installation techniques - Microtunnelling

With the extend of high sophisticated and technologies, longer and more challenging curvature pipeline could be installed under variable and critical ground conditions.

### Minimal impact on the environment due to:

- minimal surface disruption, no deterioration of existing ground water level, lower emissions.
- minimal impact on the existing infrastructure, therefore; applicability in high density urban areas,
- no disturbance of tourism, impact on existing underground utilities.

### Cost saving and time impact

- saving on additional requirement for intermediate shafts
- saving on mobilization and demobilization from intermediate shafts
- permits, detours, loss of business opportunity and etc.

### Construction Standards

- less risk of settlements, higher seismic safety
- achievable construction tolerances
- value engineering and higher production rates
- much controlled and systematical work sequence

### Health, Safety and Environmental

- Minimized traffic congestions , road accidents and needs of detour or sophisticated traffic management
- Minimized truck and muck disposal
- Lower emissions
- Low vibration and noise impact
- Minimal efforts for the reinstatement of site after finishing the installation.

## THE MILESTONE RECORD

Planned, 180 days  
Actual, 135 days

Ahead



# QUESTIONS & ANSWERS

FLOOD MITIGATION TUNNEL WITH MICROTUNNELLING  
TECHNIQUES FOR THAILAND'S SOUTHERNMOST POINT

Ir. Ts. C.K. Cheng (Danny)  
Managing Director

ST TUNNEL PTE. LTD.  
ST TUNNEL (M) SDN. BHD.  
ST TUNNEL (THAILAND) CO., LTD.  
PT. HARVEST TUNNEL PERKASA



**TRENCHLESS  
ASIA 2026**

THAILAND

10<sup>th</sup> APRIL 2026, QUEEN SIRIKIT NATIONAL  
CONVENTION CENTER BANGKOK, THAILAND