CEDD Contract No. KL/2015/03
Kai Tak Development
Stage 3B Infrastructure At Former North Apron Area

Tunnelling for Pedestrian Subway SW4 by Rectangular Tunnel Boring Machine (RTBM)

Speaker: Ir. Wilfred So Yiu Wing

5 November 2019

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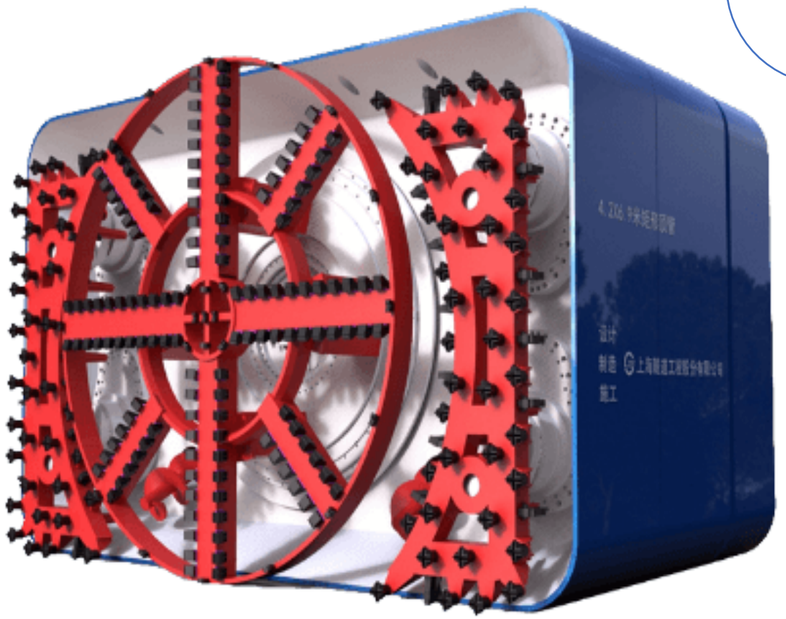
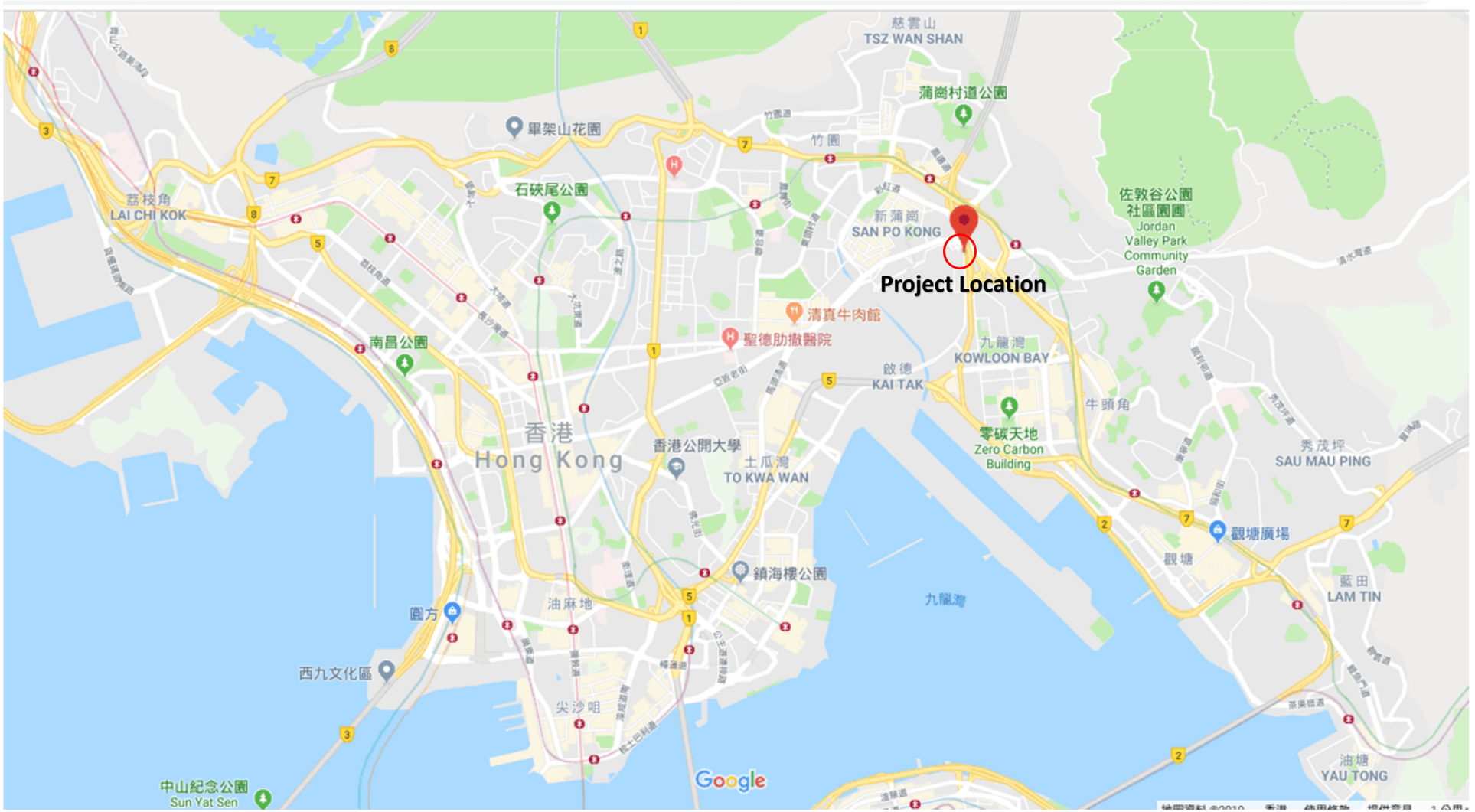


1. INTRODUCTION

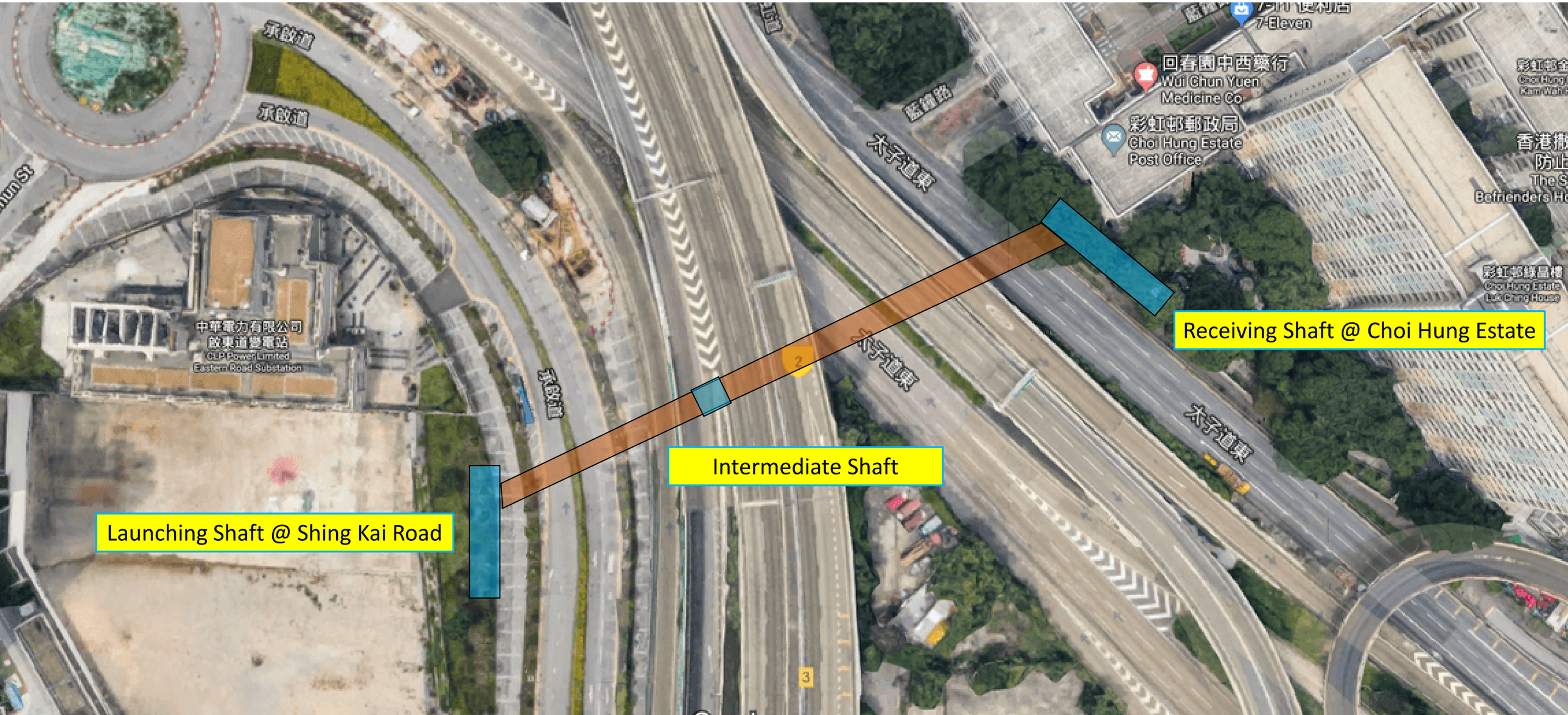
Introduction – Project Information

- ❑ PM: **Civil Engineering & Development Department**
- ❑ PMR/Supervisor: **ARUP**
- ❑ Main Contractor: **Build King - Richwell Joint Venture**
- ❑ Specialist Sub-contractor: **Shanghai Tunnel (HK)**
- ❑ RTBM Design Consultant: **WSP**
- ❑ Construction Period: **July 2019 – April 2020 (for RTBM portion)**
- ❑ Total Driving Length: **Approx. 145m (94 Segments)**

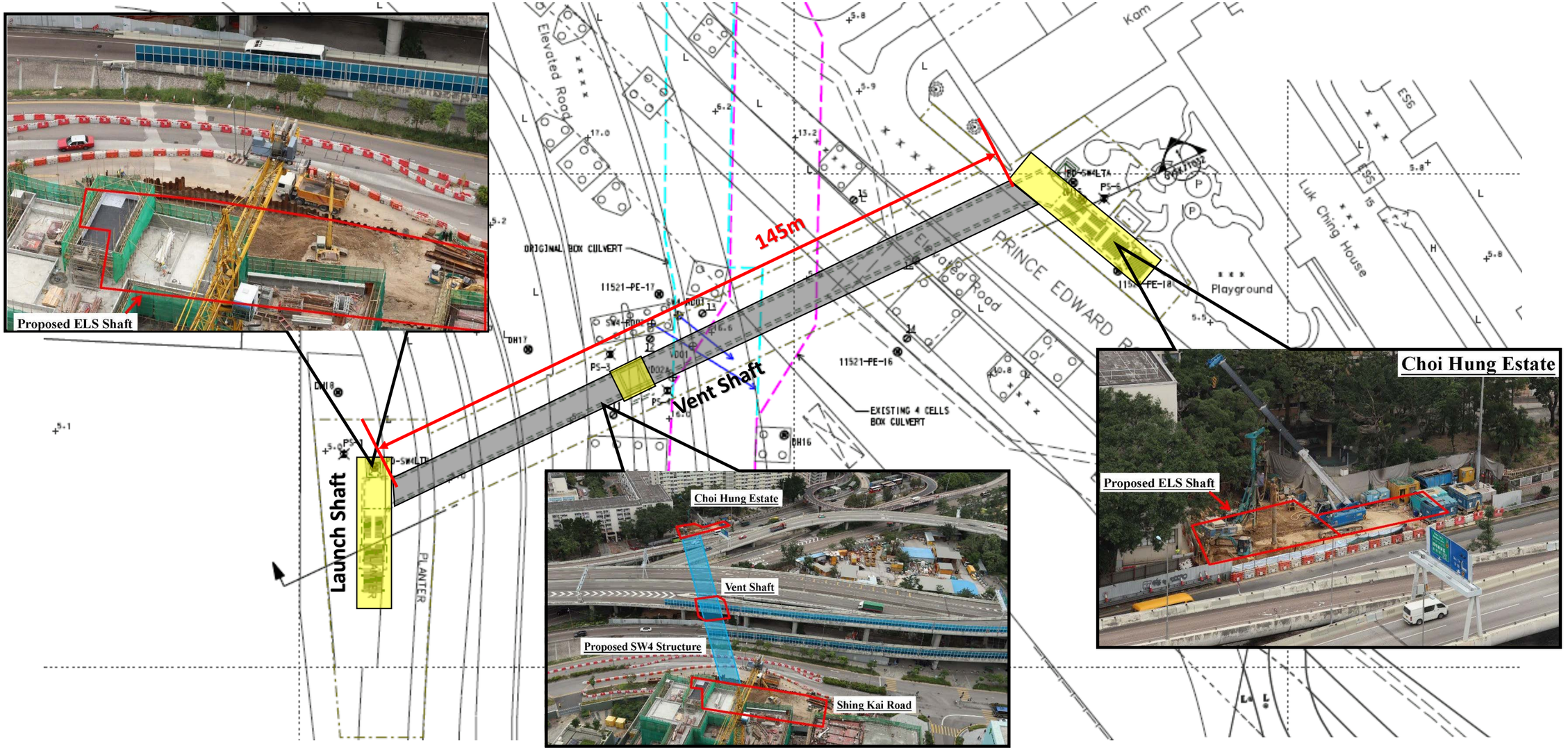
Introduction – Project Location



Introduction – Project Location



Introduction – Project Layout

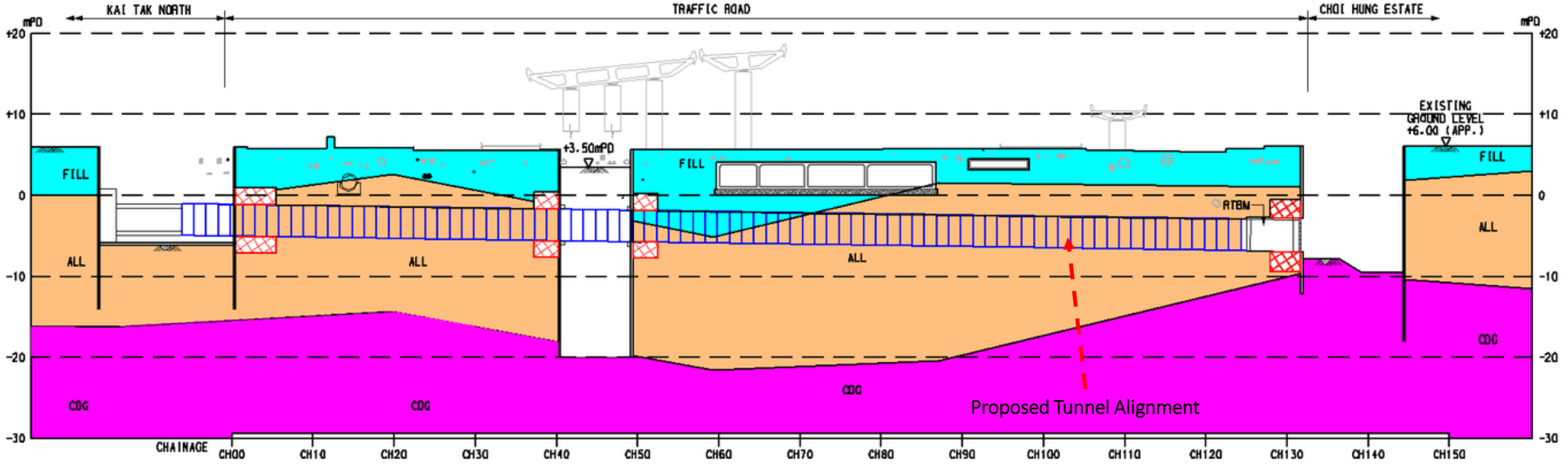


DESIGN RELATED ISSUES

Design - Code and References

- The following design codes and references were used for the design of the Works:
- General Specification for Civil Engineering Works - 2006 Edition (GS 2006)
- Geo-guide 1: Guide to Retaining Wall Design (2017)
- GEO Publication No. 1/2006: Foundation Design and Construction
- Structure Design Manual for Highways and Railways 2013 (SDM)
- BS EN 1992-1-1: Eurocode 2: Design of concrete structures
- BS EN 1998 Eurocode 8: Design of Structures for Earthquake Resistance
- PD 6688 -1-7 2009 Recommendations for the Design of Structures to BS EN 1991-1-7

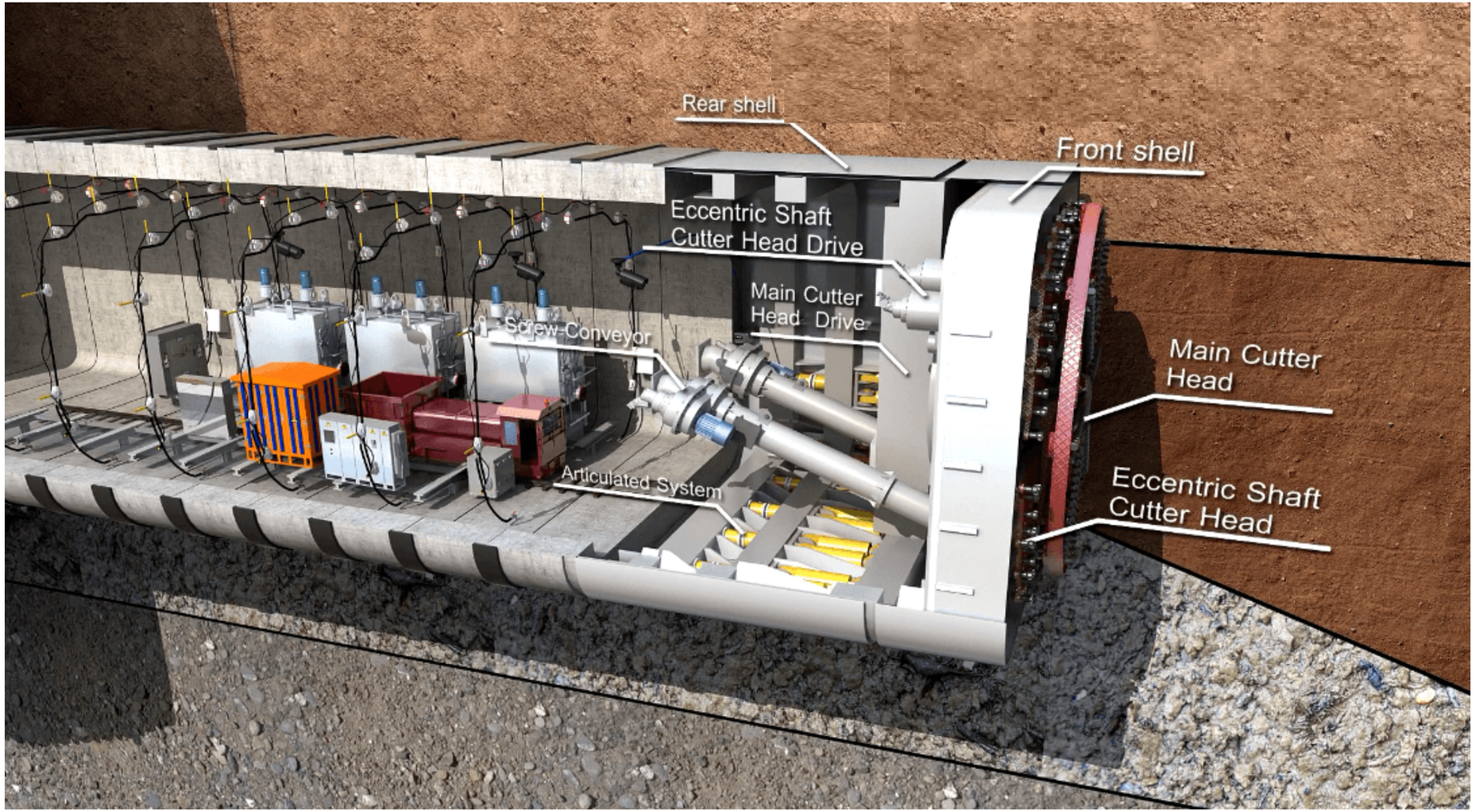
Design - Geological Conditions for Driving of RTBM



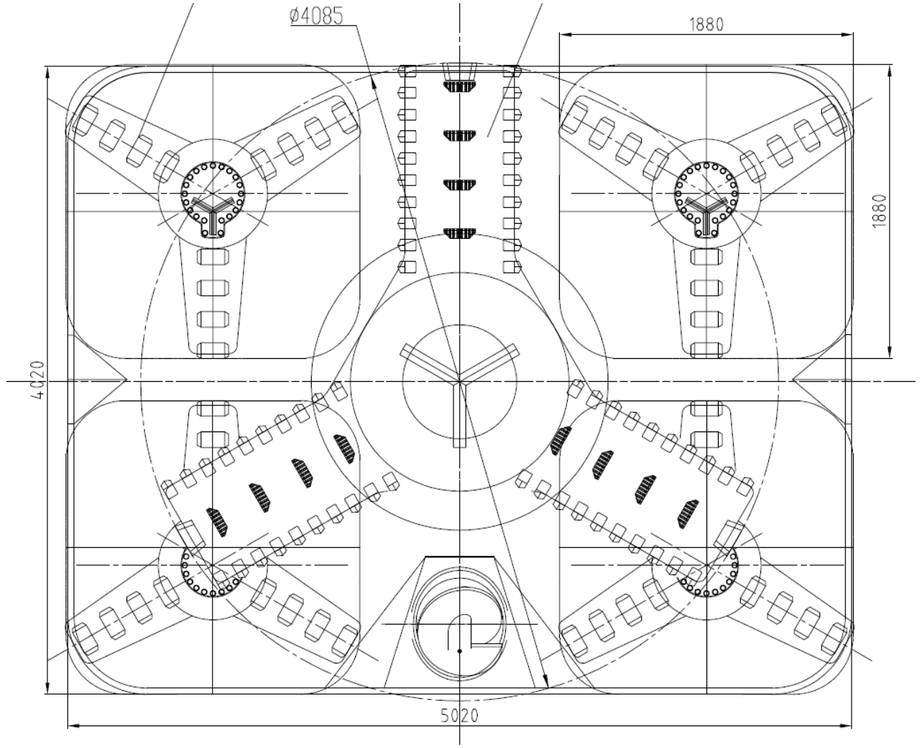
MAJOR BOREHOLE SUMMARY ALONG THE TUNNEL ALIGNMENT		
BL Number	**Soil Conditions**	**SPTN**
DH15	Alluvium, Colluvium	11
I1	Fill, Colluvium	N/A
I2	Silty Sand with Angular Cobble	N/A
I3	Fill, Colluvium	N/A

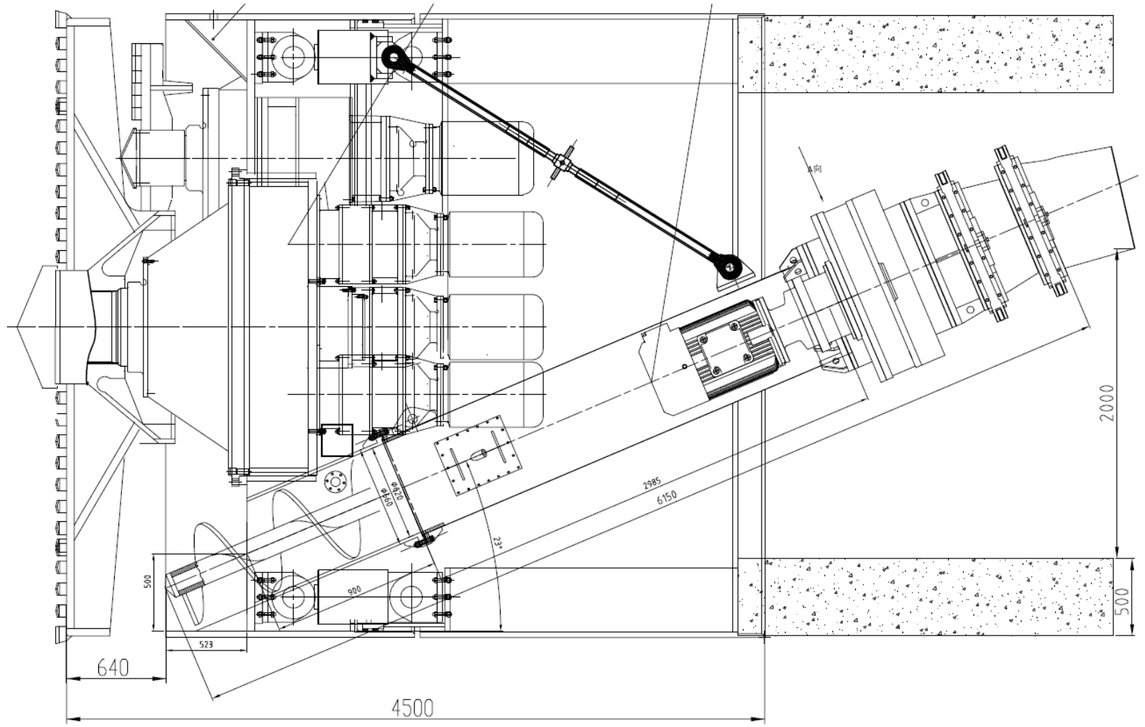
MAJOR BOREHOLE SUMMARY ALONG THE TUNNEL ALIGNMENT		
BL Number	**Soil Conditions**	**SPTN**
I6	Fill, Alluvium	N/A
PS-3	Colluvium	22-34
PS-4	Fill, Colluvium	N/A
VD01	Fill, Alluvium	

Design – RTBM


Rear shell
Front shell
Eccentric Shaft
Cutter Head Drive
Main Cutter
Head Drive
Screw Conveyor
Main Cutter
Head
Articulated System
Eccentric Shaft
Cutter Head

Design – RTBM (Data for KL/2015/03)



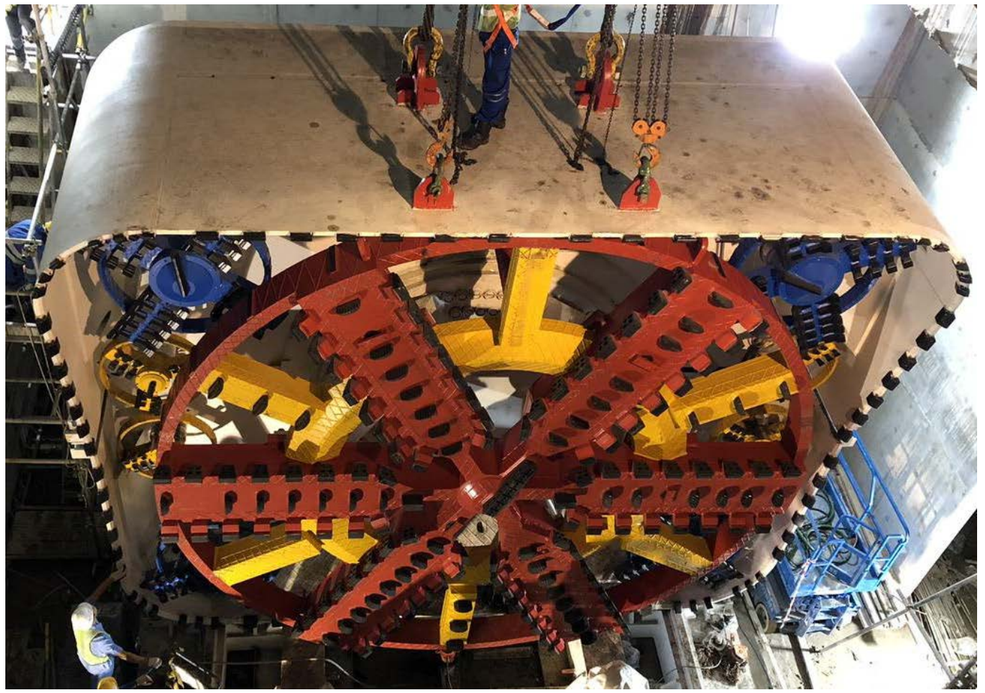


S/N	ITEM	PARAMETER
1	Excavation Dia.	5020mm x 4020mm
2	Installation Power	580kW
3	Cutterhead Rotation	0 - 20 rpm

S/N	ITEM	PARAMETER
4	Total Length	4500mm
5	Total Thrust Force	36000kN
6	Muck Out Capacity	120m3/h

RTBM Fabrication in PRC – TBM Cutter Head

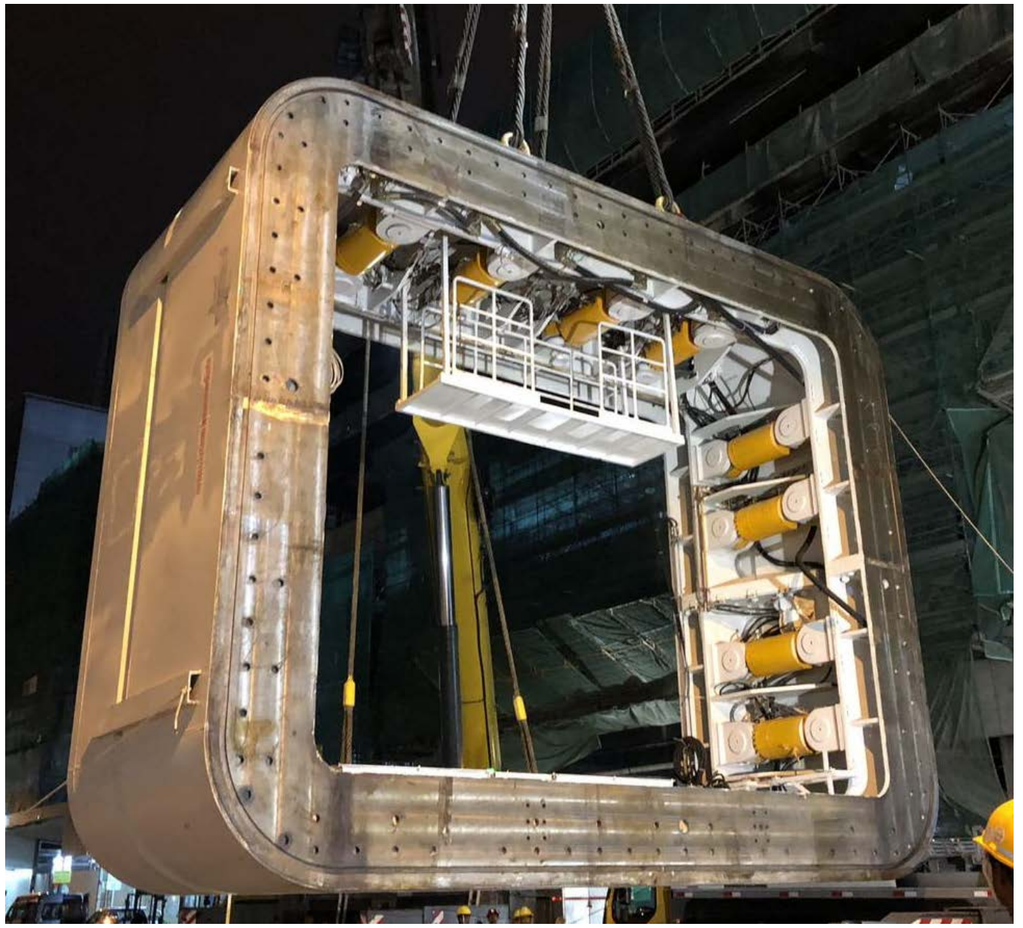
Front Shield body under Fabrication



Similar TBM in other Project

RTBM Fabrication in PRC – Cutter Head Jack Component

External body under Fabrication



Similar Component in other Project

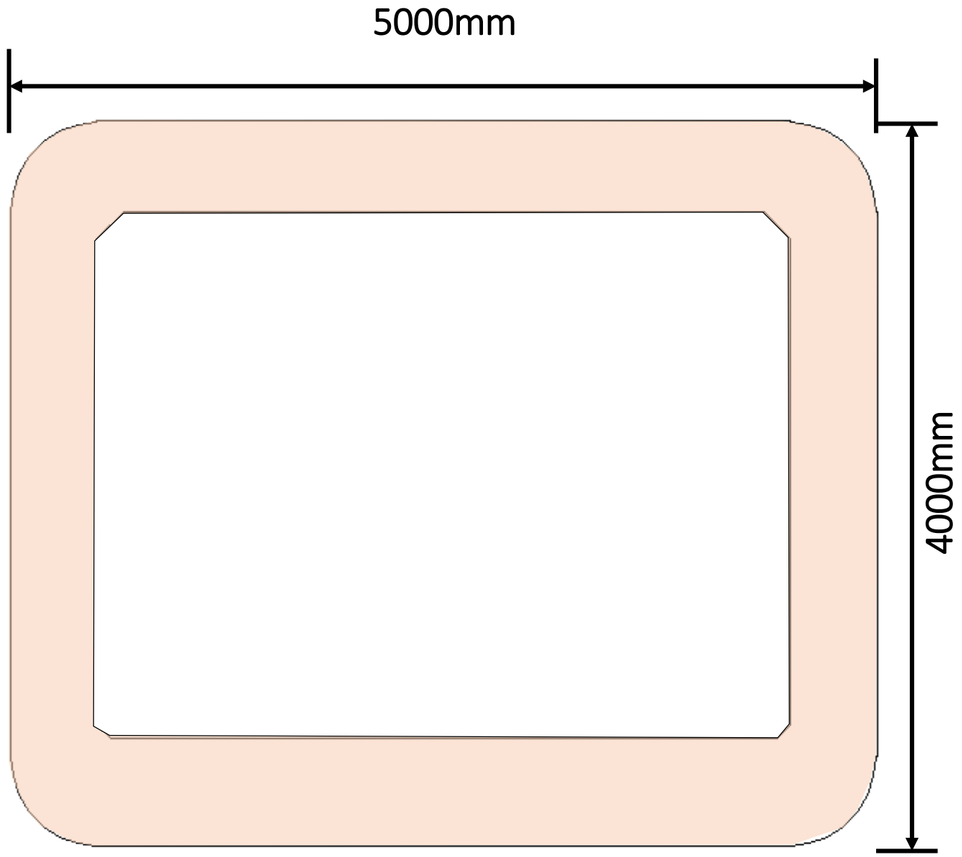
RTBM Fabrication in PRC – Other Major Components

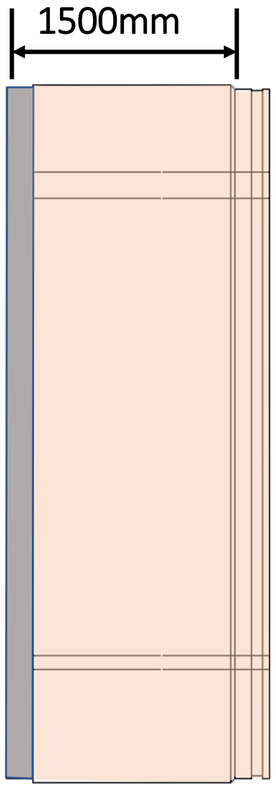
Screw Conveyor Rod

Hydraulic Jacks

Similar Components in other Project

Design – Precast Concrete Segment

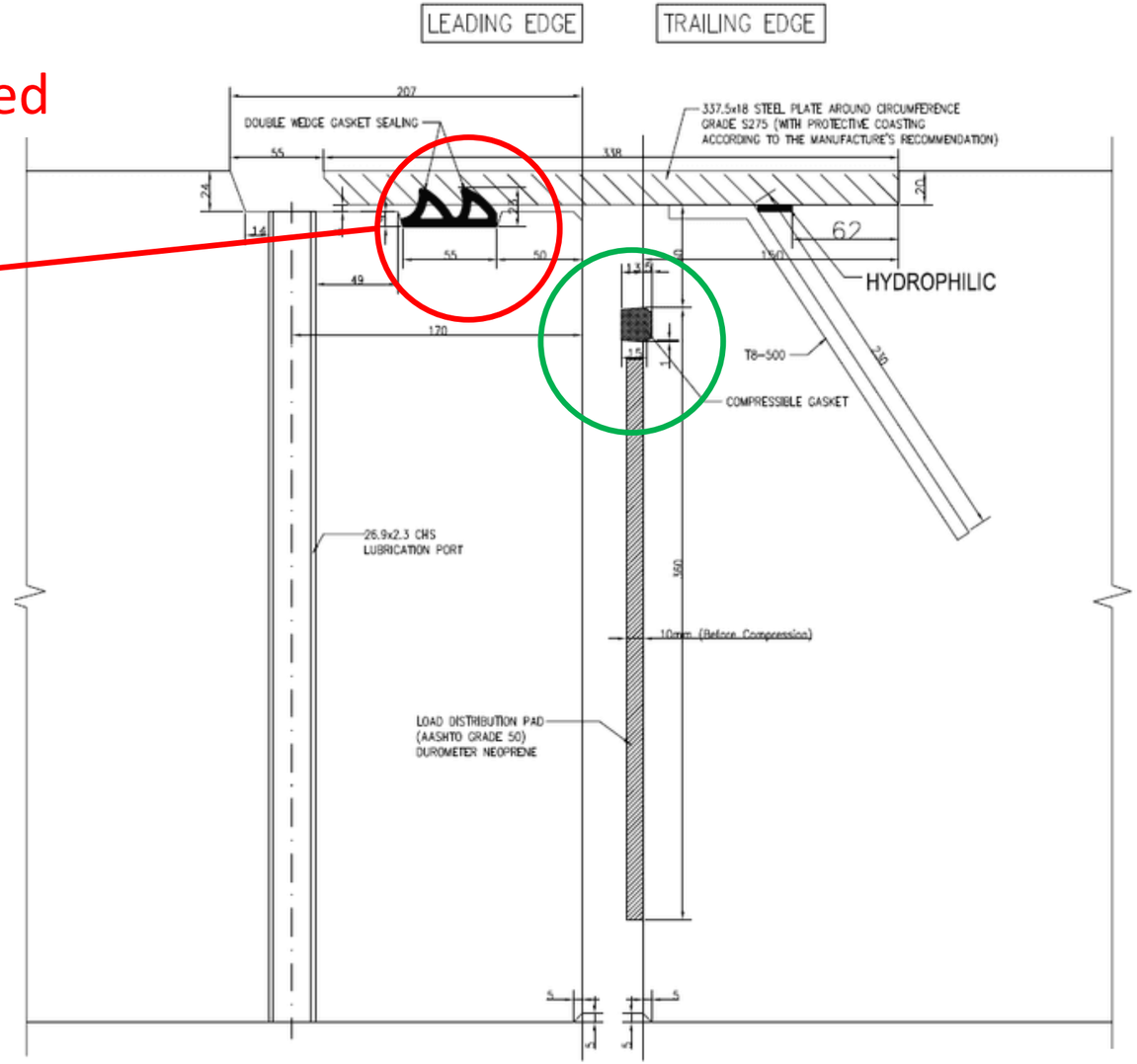




Overall Dimension

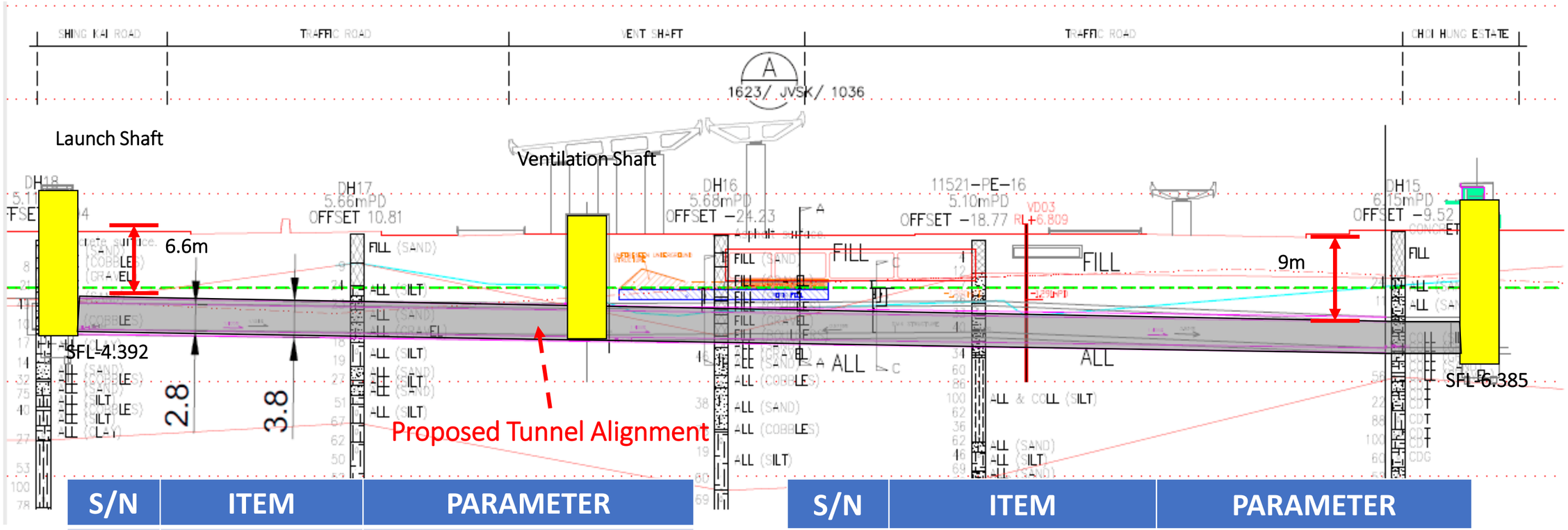
Design – Waterproofing Arrangement

Double layers of gasket used



Site Operation

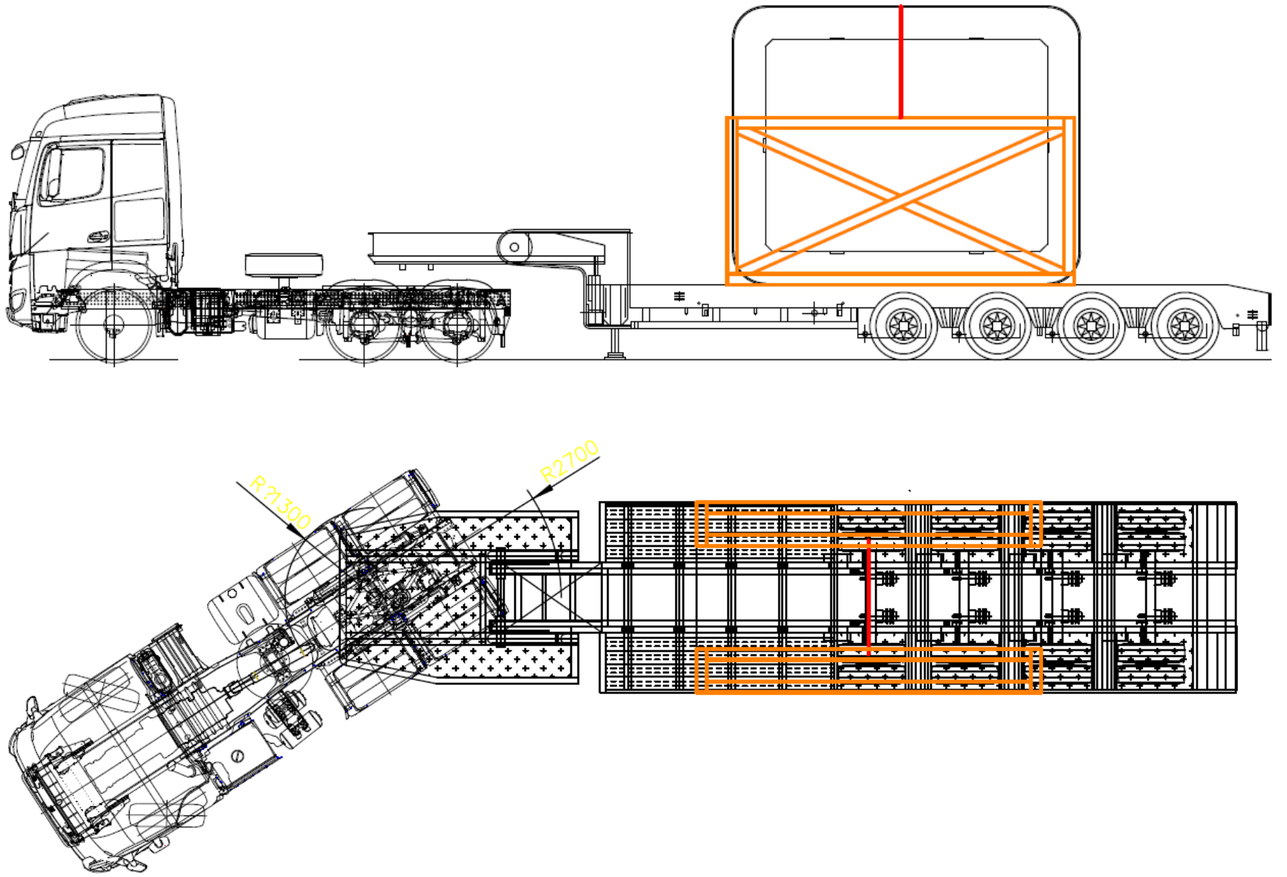
Site Operation – Subway Alignment



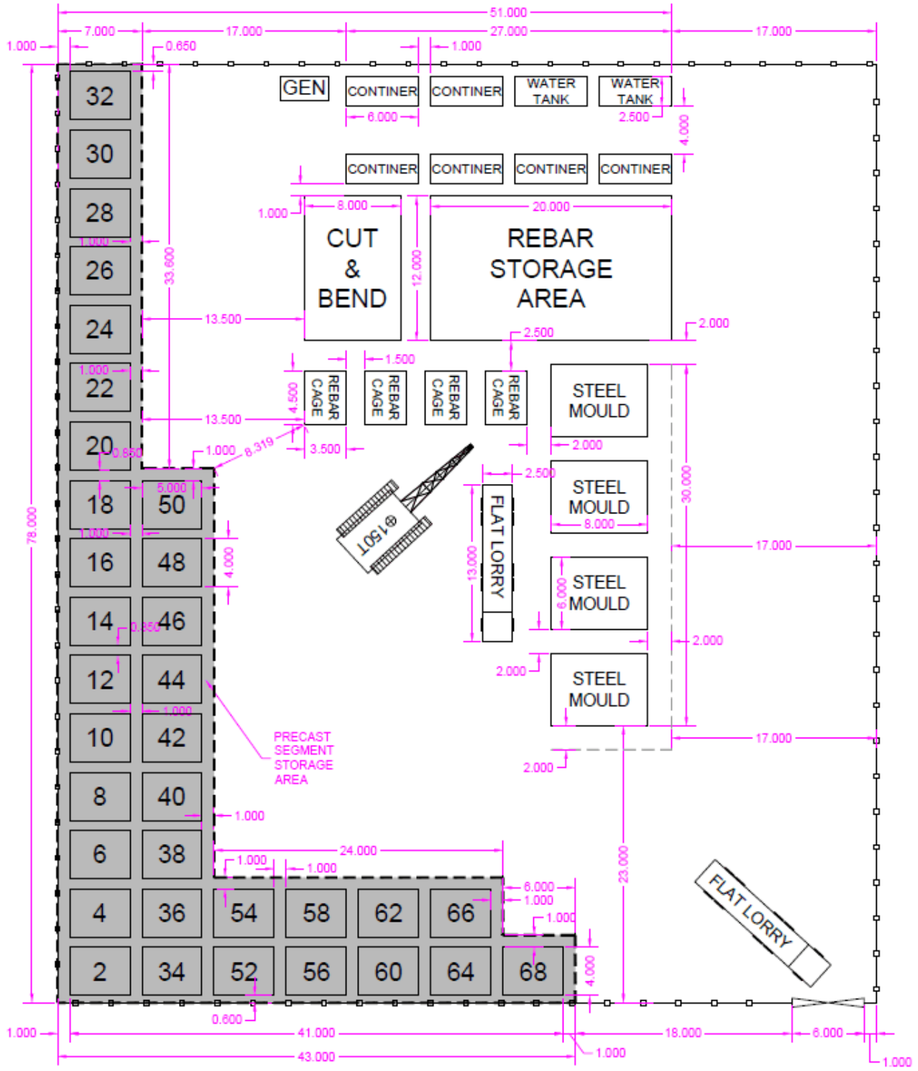
S/N	ITEM	PARAMETER
1	Total Length	145m
2	Gradient	-1.405%
3	Overburden	6.6m to 9m

S/N	ITEM	PARAMETER
4	Segment ID	4.0m x 2.9m
5	Segment Length	1,500 mm
6	Segment OD	5.00m x 4.00m

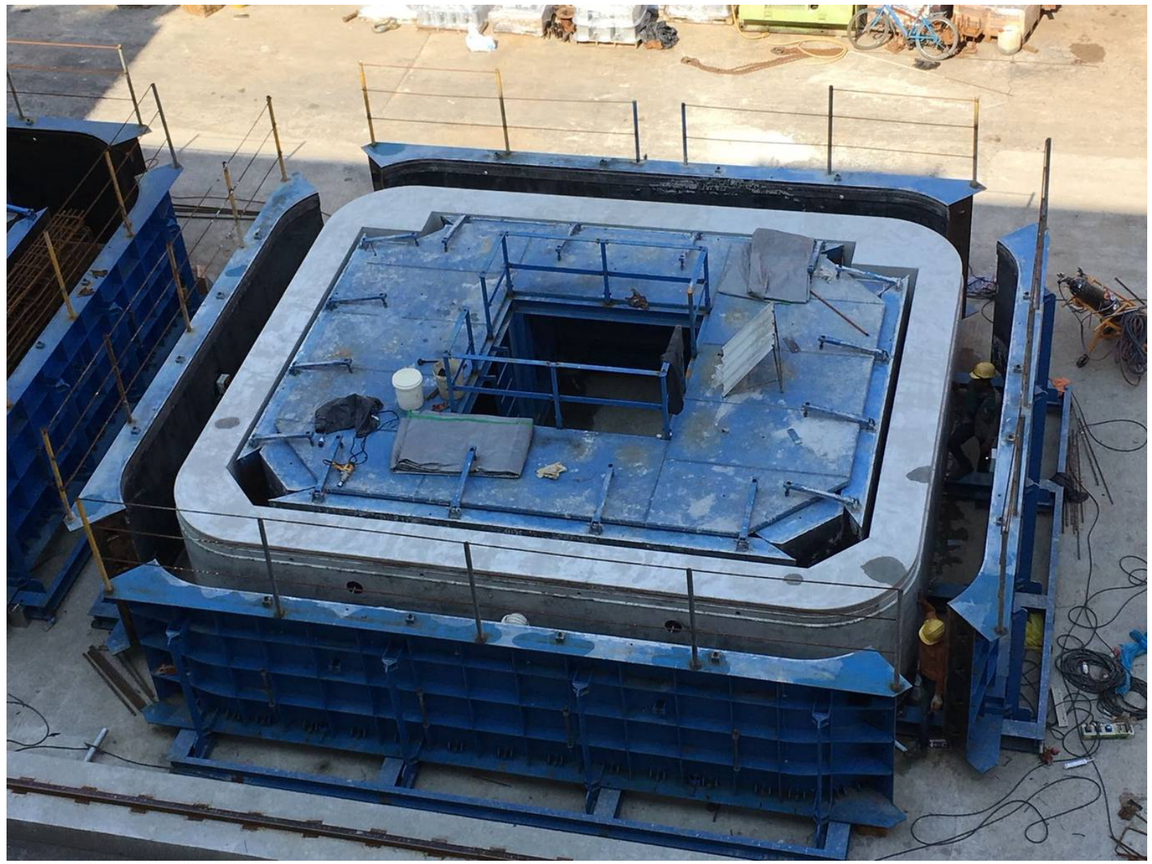
Site Operation – Location of Casting Yard and Delivery Route for Concrete Segment

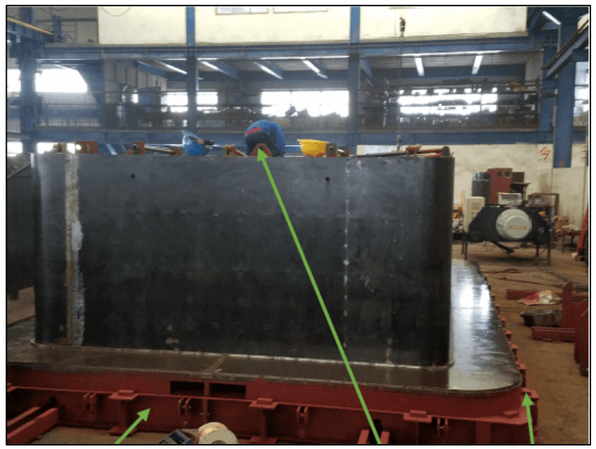


Site Operation – Casting Yard Layout Plan



Site Operation – Concrete Casting

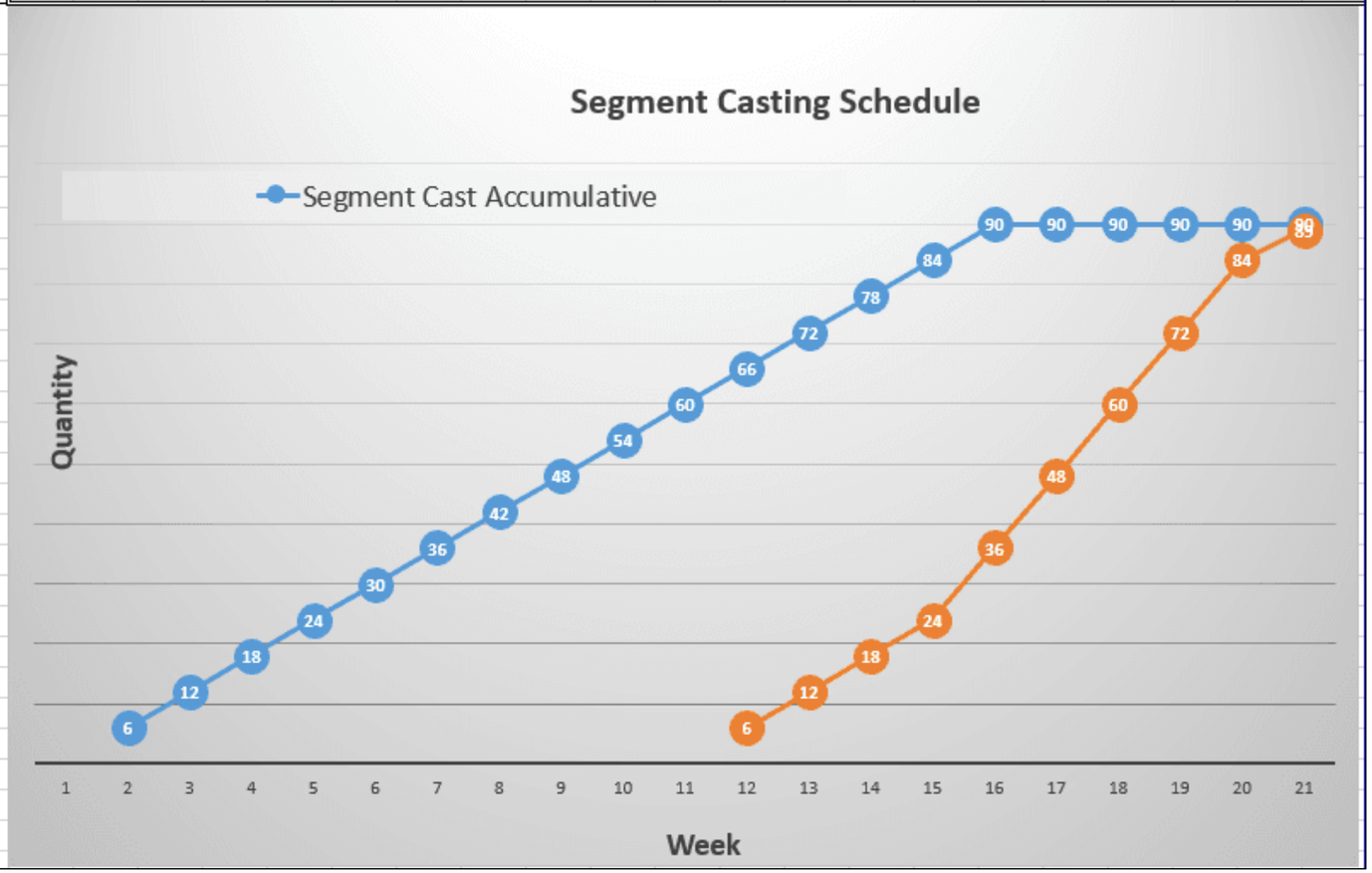




Site Operation – Casting Schedule

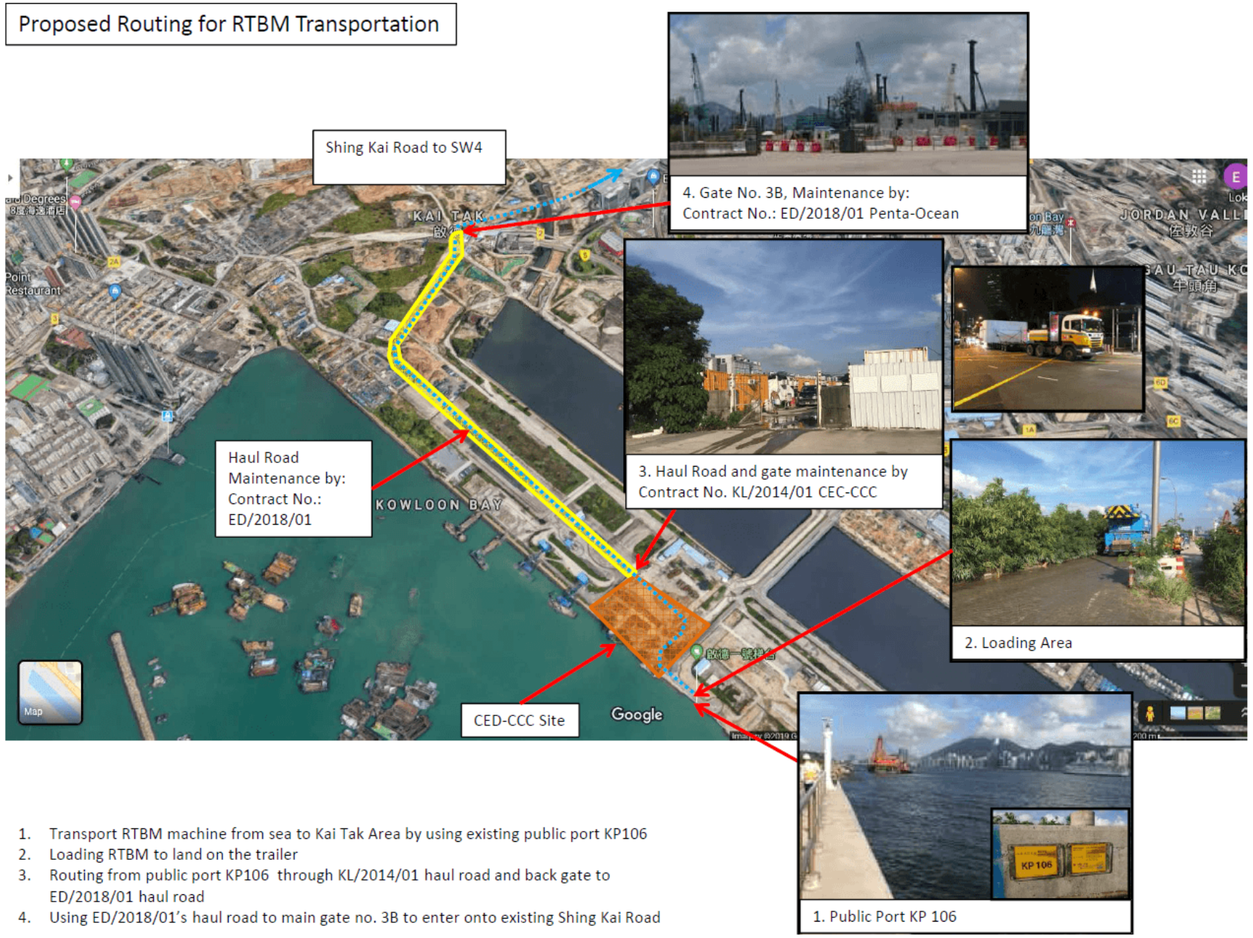
Expected Production Rate: 6 nos/week

Week	W0	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20
Segment Cast		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0	0	0	0	0
Segment Cast Accumulative		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	90	90	90	90	90
Segment Consumption												6	6	6	6	12	12	12	12	12	5
Segment Consumption Accumulative												6	12	18	24	36	48	60	72	84	89
Segment Casting Yard Stockpile		6	12	18	24	30	36	42	48	54	60	60	60	60	60	54	42	30	18	6	1

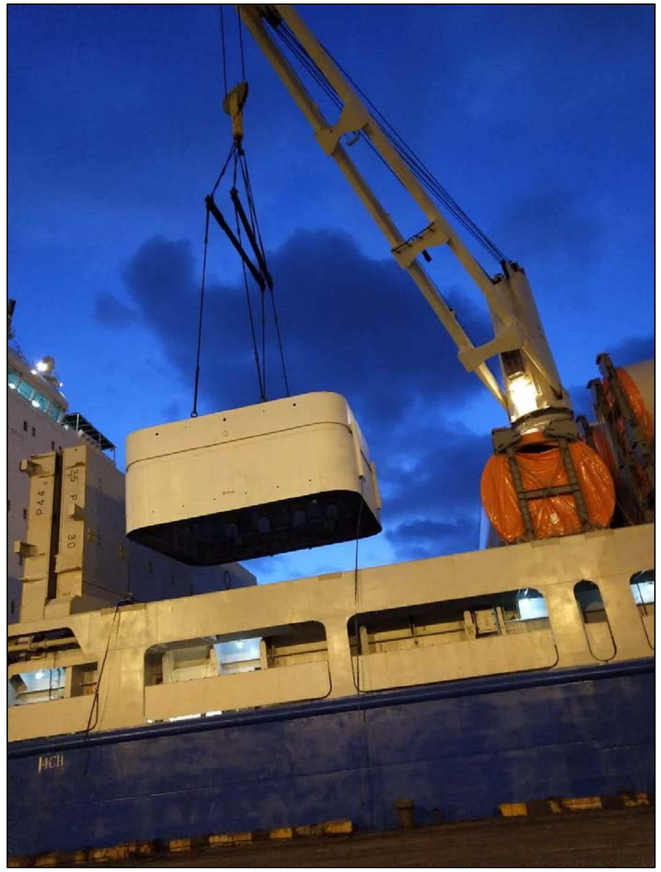


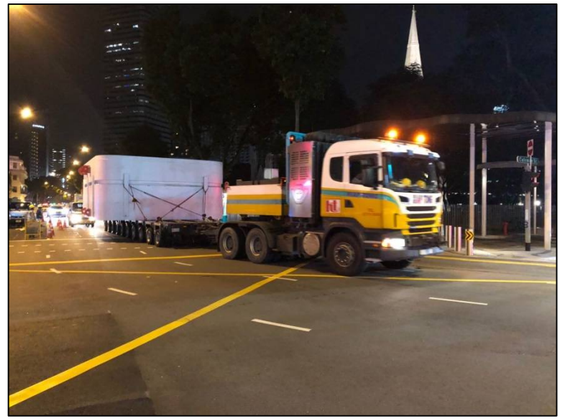
Site Operation – Delivery Route for RTBM

Proposed Routing for RTBM Transportation



1. Transport RTBM machine from sea to Kai Tak Area by using existing public port KP106
2. Loading RTBM to land on the trailer
3. Routing from public port KP106 through KL/2014/01 haul road and back gate to ED/2018/01 haul road
4. Using ED/2018/01's haul road to main gate no. 3B to enter onto existing Shing Kai Road





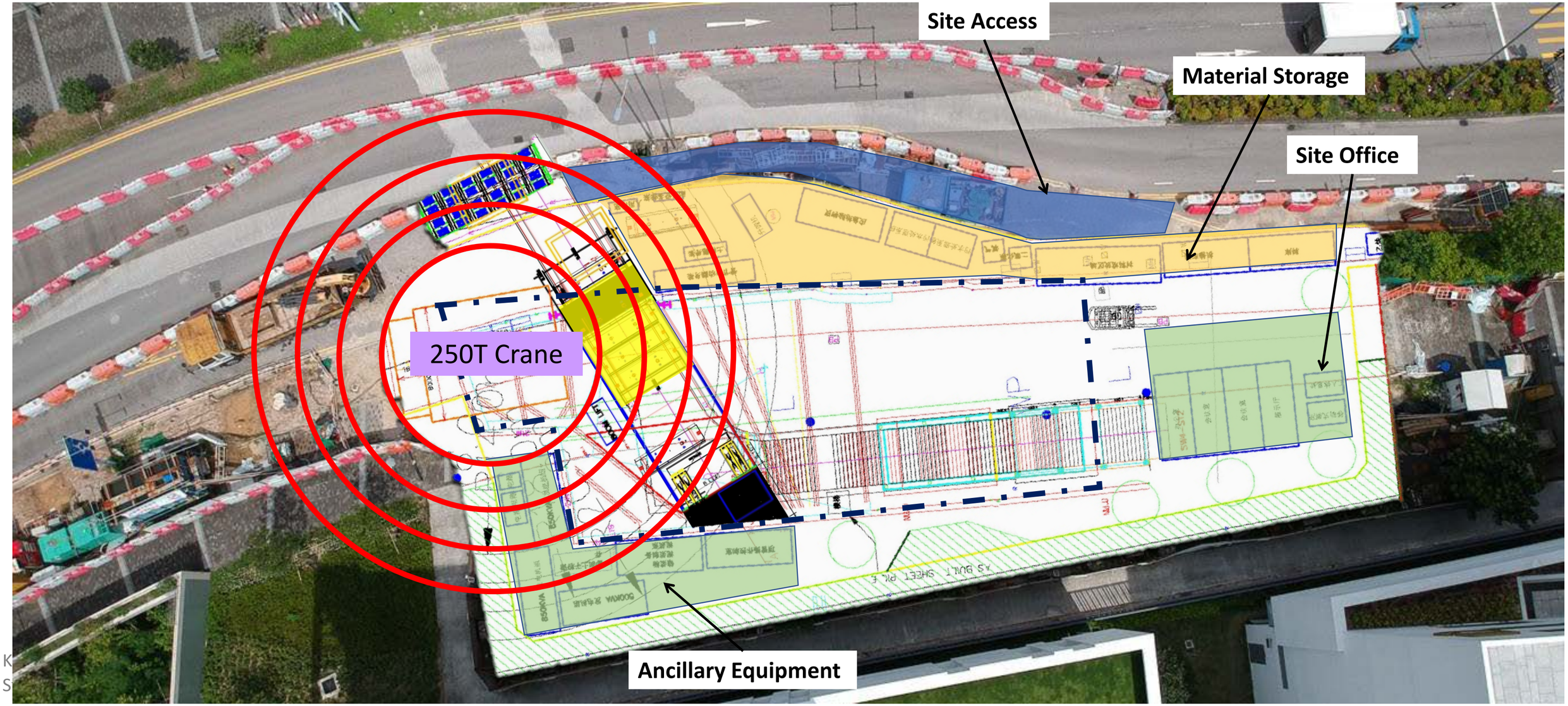
Similar to other project, all RTBM Cutter Head will deliver from Sea to nearby jetty and transport to Site Area

Site Layout Plan – Launching Shaft @ Shing Kai Road

K
S

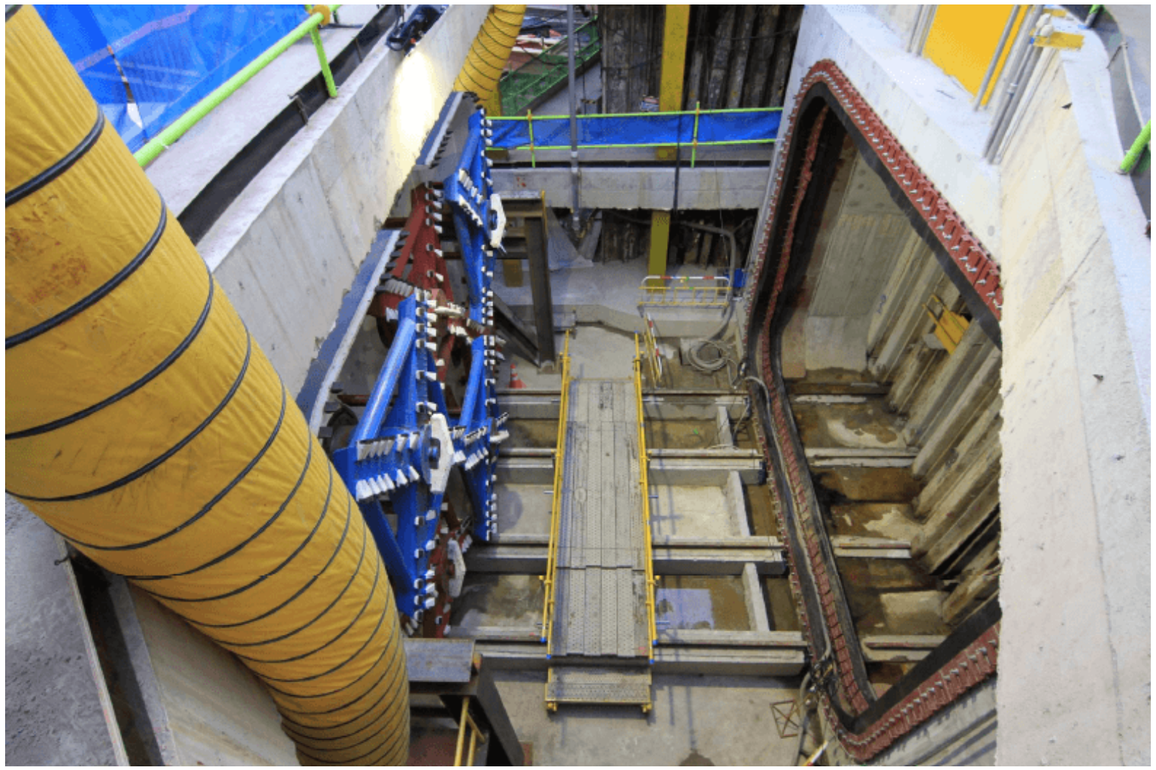
Site Layout Plan – Launching Shaft @ Shing Kai Road

ELS of Launching Shaft



Site Operation – Tunnelling Methodology – Break-in Arrangment

Tunnel Eye Seal



Tunnel Eye Seal

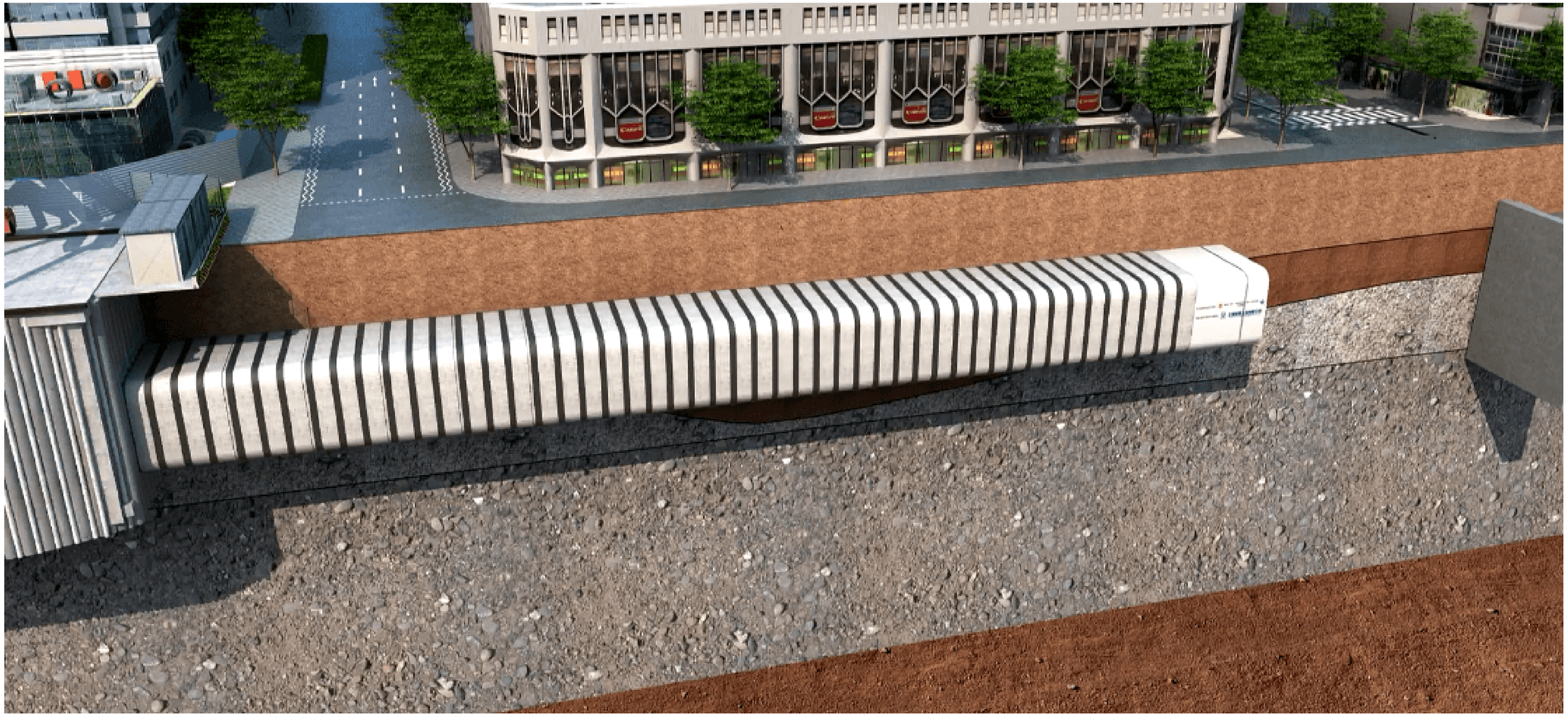
Site Operation – Tunnelling Methodology

- Shaft bottom setup ready for launching
- Lowering down of segment
- Extension of main thrust cylinder
- Discharge of excavated soil

Site Operation – Tunnelling Methodology

***The actual site set up will be different from this typical one to cater for site conditions.*

Site Operation – Tunnelling Methodology



Site Operation – Tunnelling Methodology

Grouting to the External Areas of the Subway after completion of Tunnelling

Site Operation – Internal Finishes

Build King RW REL 顯豐工程

Q & A

THANK YOU