Track 進程

T2主幹路及荼果嶺隧道
TRUNK ROAD T2 AND CHA KWO LING TUNNEL
第六期 ISSUE 6 10/2024

智能機械助建造
Next Level Efficiency : Mechanisation in Tunnel Construction 提速提效新高度

2024

1 月 JAN

安裝隧道防火板及搪瓷面板工程進行中

Works of tunnel thermal barrier and vitreous enamel panel installation in progress

3 月 MAR

西面通風大樓的建築及飾面裝修展開

Architectural Builders Work and Finishes (ABWF) of West Ventilation Building commenced

安裝隧道機電設施工程進行中

Works of tunnel Electrical and Mechanical (E&M) facilities in progress

啟用啟福道新行人天橋

New footbridge at Kai Fuk Road has been commissioned

10 月 OCT

安裝西面通風大樓機電設施進行中

Installation of E&M System in West Ventilation Building in progress

東面通風大樓結構及安裝機電設施工程進行中

Structural works and installation of E&M Systems in the East Ventilation Building in progress

機械化建造

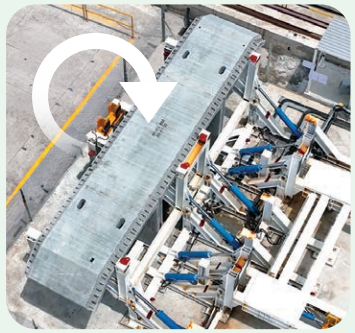
MECHANISED CONSTRUCTION IN T2

在T2主幹路項目中，**超過95%**的隧道內部結構均採用預製組件建造。透過應用定制化機械和自動化工序，我們不但提高了施工生產力，更為工友營造了更安全的作業環境。

In the Trunk Road T2 project, **over 95%** of the tunnel's internal structures are built using precast elements. By utilising tailor-made machinery and mechanised methods, the project not only boosts construction productivity but also ensures a safer environment for our workers.

翻轉桌 Flipping Table

每件重達25噸的π形預製路面組件，於內地工場經陸路運送至工地。為了確保運輸時的重心穩固，組件在車上會先以「上下倒轉」的方式擺放。抵達T2工地後，團隊會利用重型翻轉架將組件「翻正」，恢復到安裝時的角度。這個做法不僅縮短了隧道內的作業時間，也大大提升了安裝過程的安全性。



Each of these 25-tonne π-shaped road deck segments is manufactured in the Mainland and transported to the site by road. For stability during the journey, they are carried upside down to keep the weight balanced. Once they reach the T2 site, the team uses a heavy-duty flipping table to turn the components upright. By 'flipping' them before they enter the tunnel, we not only speed up the assembly process but also make the installation much safer for our workers.

多用途運輸車 Multi-Service Vehicle (MSV)

多用途運輸車承重量達120噸，而且可以前後雙向移動，能靈活和安全地運送預製組件到隧道內安裝。

The MSV has a 120-tonne loading capacity. It can move in both forward and reverse directions for flexible and safe transport of precast elements to the tunnel for installation.

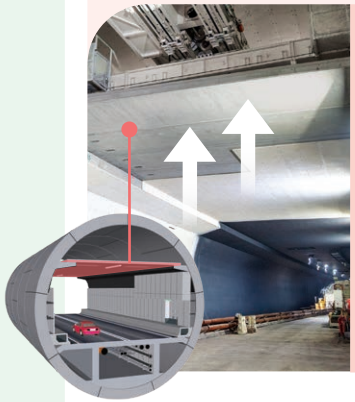
龍門起重機 Rail-Mounted Gantry Crane

預製件暫存區設有起重量達50噸的軌道式龍門起重機，可將不同種類的隧道預製組件整齊排列好，再安全地吊運至多用途運輸車上再運送到隧道內。

The segment yard is equipped with rail-mounted gantry cranes with a lifting capacity of up to 50 tonnes. These cranes ensure the systematic stacking of different precast elements and facilitate their safe loading onto multi-service vehicles for delivery into the tunnel.

工作人員會預先在工場將機動風閘安裝上通風管道面板，進一步簡化隧道內的安裝工序。

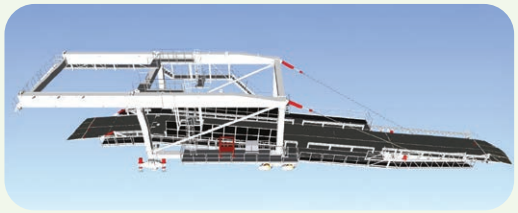
The workers will pre-install the mechanical dampers onto the OHVD slabs in the workshop, thereby further simplifying the installation process inside the tunnel.



隧道頂部設有軌道式龍門起重機用作安裝通風管道面板，每件組件的安裝時間**只需15分鐘**，對比傳統方法（現場模板工程、鋼筋屈紮及澆灌混凝土）：**節省80%時間及降低10%成本**

Inside the tunnel, rail-mounted gantry cranes are deployed to install the tunnel internal structures, such as Overhead Ventilation Ducts (OHVD) slabs. This specialised method limits the installation time of each OHVD slab module to **just 15 minutes**. Compared with the traditional method (in-situ formwork, fixing of reinforcement and concrete casting), **this approach saves about 80% of installation time and reduces costs by around 10%.**

內部結構安裝龍門架 Internal Structure Installation Gantry (ISIG)

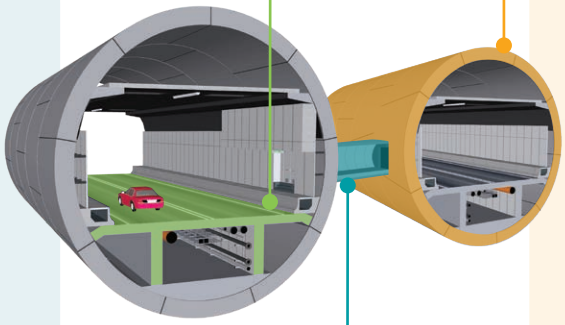


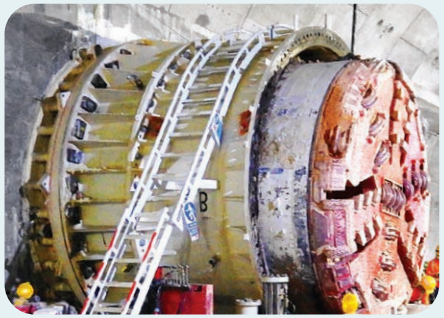
π 形路面組件運抵隧道內，會利用特製的內部結構安裝龍門架完成吊裝工序。
Once the π-shaped road deck segment is delivered into the tunnel, it is installed in place by a specially-designed ISIG.

小型隧道鑽挖機 Mini TBM

隧道每100米設有一條長約14米，闊3米的跨管通道。跨管通道施工時利用重約60公噸的小型隧道鑽挖機進行挖掘，並在其後方以頂管方法安裝預製跨管通道結構組件。

A cross passage measuring about 14 metres in length and 3 metres in width is provided at 100-metre interval. A 60-tonne mini tunnel boring machine is used to excavate these cross passages. Precast cross passage structural segments are installed from the rear by pipe jacking method.





隧道壁組件架設器 Tunnel Lining Segment Erector

隧道鑽挖機配備了專用的預製組件架設器。每當隧道掘進約2.2米，環形隧道壁的安裝工程便會進行。工人先將預製組件放在運輸車上送到鑽挖機前方，再透過設置真空吸盤的架設器，將組件逐一吊起並準確安裝到預定位置。完成環圈拼裝後，再由專業技工進行最終固定。

The Tunnel Boring Machine (TBM) features a specialised segment erector. Each time the tunnel excavation progresses by about 2.2 metres, installation of the tunnel lining ring commences. Precast segments are transported to the front of the TBM using MSV. The segment erector, integrated with a vacuum suction head, then lifts and accurately positions each segment. After the ring assembly is completed, skilled technicians carry out the final bolt fastening to secure the structure.

機械臂

ROBOTIC ARM

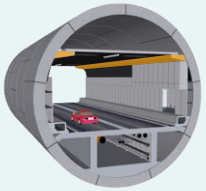
要在隧道內建造支撐通風管道的樑托，必須先在隧道壁進行打花處理及鑽孔。為此，T2隧道鑽挖機特別增設了一組智能機械臂，利用先進的掃瞄定位與自動化程式，取代以往勞動力高、風險大的手動工序。這項創新應用不僅讓施工更準確，還能保障工友免於粉塵及體力勞損的健康風險。

To construct the corbels for the overhead ventilation ducts inside the tunnel, the tunnel walls must first undergo surface roughening and drilling. For this purpose, the T2 TBM has been fitted with intelligent robotic arms that leverage advanced scanning and automated software to replace the traditional, high-risk manual methods. This innovative application enhances construction accuracy while protecting workers from health hazards such as dust inhalation and physical exhaustion.

使用機械臂進行牆身樑托的鑽孔和「打花」工序
Using robotic arms in preparation works for OHVD corbels

- 於混凝土表面進行「打花」工序
  Bush hammering of concrete surface
- 在安裝結構鋼筋錨定前進行鑽孔工序
  Drilling for installation of corbel anchors

機械臂影像
Robotic Arm Image



牆身樑托 Corbel

現場澆築的混凝土結構，以承載上方的抽風管道面板。
A cast in-situ concrete structure to serve as structural support for the Overhead Ventilation Ducts (OHVD) slab.

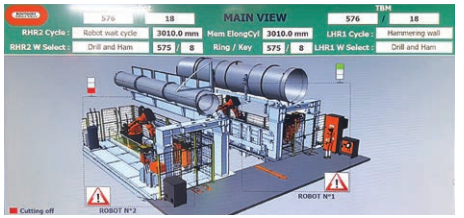
傳統鑽孔工序
Traditional preparation works for OHVD corbels

- 使用升降台進行高空工作
  Work at heights with lifting platforms
- 於沙塵和嘈音環境下手持電鑽鑽孔
  Perform drilling works using handheld tools under dusty and noisy environment

使用機械臂的好處
Advantages of using robotic arm

「打花」及鑽孔工序快 **60%!**
60% faster in Drilling and Bush-hammering!

- 不需要進行高空工作
  Eliminates the need to work at height
- 設有實時監控，除塵系統及全封閉和聯鎖系統
  Equips with realtime monitoring & control, dust collection system and fully-enclosed & interlock system
- 全封閉設計可有效防止人員接觸運作中的機械部件，而聯鎖系統可在防護裝置未關閉時自動停止運作，大大提升施工安全。
  The fully enclosed design prevents direct contact with moving mechanical parts, while the interlock system automatically halts operation if safety guards are not properly secured, significantly enhancing site safety.



實時監控
Realtime monitoring control

自動化工序
Automated operation

除塵系統
Dust collection system

機電裝備合成法

MULTI-TRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MiMEP)

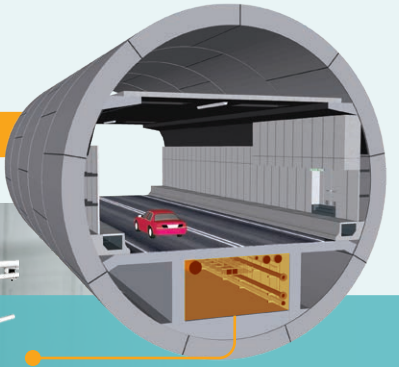
T2主幹路的隧道工程廣泛應用機電裝備合成法(MiMEP)。團隊將消防喉、電線槽及排水管等設施，設計成掛牆及天花兩款機電模組，總數約1,400個。所有組件會先在工地工廠完成組裝，才運送到行車道下方的隧道設施走廊安裝。這種「先預製、後安裝」的方法，不僅提升了施工安全與品質，更結合了BIM和IoT技術，將驗收記錄數碼化，提升管理效率。

The Trunk Road T2 project adopts an extensive application of the MiMEP (Multi-trade Integrated Mechanical, Electrical, and Plumbing) method. The team designed around 1,400 E&M modules for fire services, electrical wiring, and drainage, categorised into wall and ceiling modules. All components are prefabricated at an on-site factory before being sent to the service gallery beneath the tunnel carriageway for installation. This methodology not only enhances safety and workmanship but also integrates with BIM and IoT technologies to digitalise the inspection records, streamlining project management efficiency.

縮短工地安裝時間達
Reducing on-site installation time by up to
↓ 40%

減少工地人手超過
Cutting on-site manpower by more than
↓ 60%

減少高空工作工序
Lowering working-at-height activities by
↓ 70%



天花組件
Ceiling-mounted Modules

牆身組件
Wall-mounted Modules

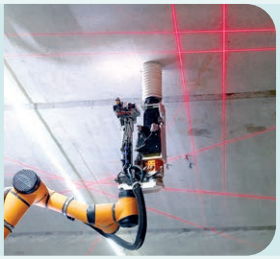
隧道設施走廊（行車道下方）
Service Gallery (Beneath the carriageway)

1 於場外完成主要組裝及測試工序
Conducting major assembly and testing works off-site

避免在隧道工地逐件安裝，提升整體生產及檢驗效率。
Avoiding installation inside the tunnel area to enhance overall production and inspection efficiency.

2 結合BIM及智能標籤系統追蹤安裝及驗收進度
Using BIM and smart tags to track the installation and inspection progress

清晰識別及記錄組件狀況，促進資產管理數碼化
Identifying the completed component and facilitating digitalisation of asset management



3 採用遙控模組運輸車及自動化機械設備協助運輸、安裝及鑽孔工作
Using remote-controlled module transporter and automated robotic arm for transport, installation and drilling works

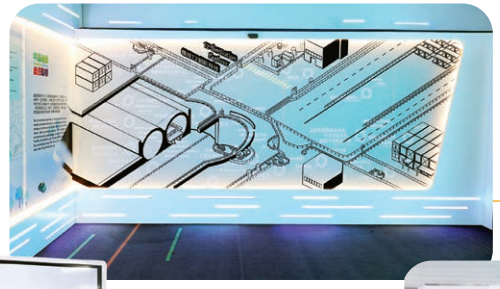
提升安裝效率及減少高空作業風險
Enhancing installation efficiency and reducing working-at-height risk

啟德社區聯絡中心

KAI TAK COMMUNITY LIAISON CENTRE

全面翻新的T2主幹路及茶果嶺隧道啟德社區聯絡中心現已開放！我們增設了更多元化的互動展品，讓公眾人士可以更深入了解T2主幹路工程及在其中的創新科技應用。

The renovated Kai Tak Community Liaison Centre for Trunk Road T2 and Cha Kwo Ling Tunnel Project (the T2 Project) is now open! The upgraded centre features an expanded range of interactive exhibits designed to give visitors an immersive look into the T2 Project and the innovative technologies adopted in its construction.



尋找T2創新科技
T2 Innovations Explorer

隧道結構大檢閱
Tunnel Internal Structure Puzzle

隧道沉浸式體驗2.0
Tunnel Immersive Experience 2.0

隧道壁組裝
Tunnel Lining Construction

工程進度

PROJECT PROGRESS

1 進口車道 Approach Road

- 防水工程 Waterproofing works
- 內部結構工程 Internal structure works

2 西面通風大樓 West Ventilation Building

- 建築及飾面工程 ABWF works

3 海底隧道 Sub-sea Tunnel

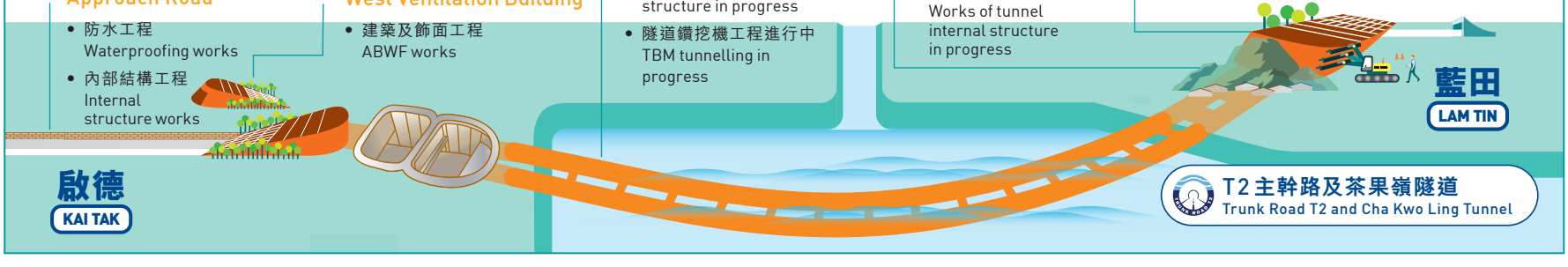
- 隧道內部結構工程進行中 Works of tunnel internal structure in progress
- 隧道鑽挖機工程進行中 TBM tunnelling in progress

4 茶果嶺隧道 Cha Kwo Ling Tunnel

- 隧道內部結構工程進行中 Works of tunnel internal structure in progress

5 東面通風大樓 East Ventilation Building

- 建築及飾面工程進行中 ABWF works in progress
- 機電工程進行中 E&M works in progress



如欲查閱更多有關T2主幹路及茶果嶺隧道的資料，請瀏覽網站：

Please visit the Trunk Road T2 and Cha Kwo Ling Tunnel project website for more project information:

感謝閣下瀏覽《進程》。
若對我們工程有任何意見，請將意見電郵至：

Welcome to our newsletter Track.
If you have any views on our project, please email us at:

www.trunkroadt2.hk 6130 8155 enquiry@trunkroadt2.com

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