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安全設計 - 最佳實踐分享 Design for Safety – Best Practices Sharing

港燈變電站 New Electricity Substation

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安全主題概覽

Safety Themes Overview



主題1: 集成設計與數字規劃 Theme 1: Integrated Design and Digital Planning

- **BIM (建築信息模擬) 實施從設計到完成**
BIM Implementation from Design to Completion
- **採用MiMEP (集成機械、電氣和管道)**
Adoption of MiMEP
- **額外的4S (安全智慧工地系統) 組件**
Additional 4S Components



主題2: 施工安全設計 Theme 2: Construction Safety by Design

- **優化挖掘和支撐工作**
Optimise ELS System
- **安全工作平台**
Reliable Working Platform



主題3: 維護作業安全設計 Theme 3: Maintenance Safety by Design

- **優化下沉樓板設計**
Sunken Floor Slab Design Improvement
- **電纜支撐安全設計**
Safe Access Routes at Cable Flat
- **架高水缸安全設計**
Elevated Water Tank
- **外立面和屋頂維護通道的安全設計**
Maintenance Access to External Façade and Flat Roof
- **採用燈喉外露設計**
Adoption of Exposed Conduit



主題4: 社區影響考慮 Theme 4: Community Impact Consideration

- **建築噪音控制措施**
Construction Noise Impact

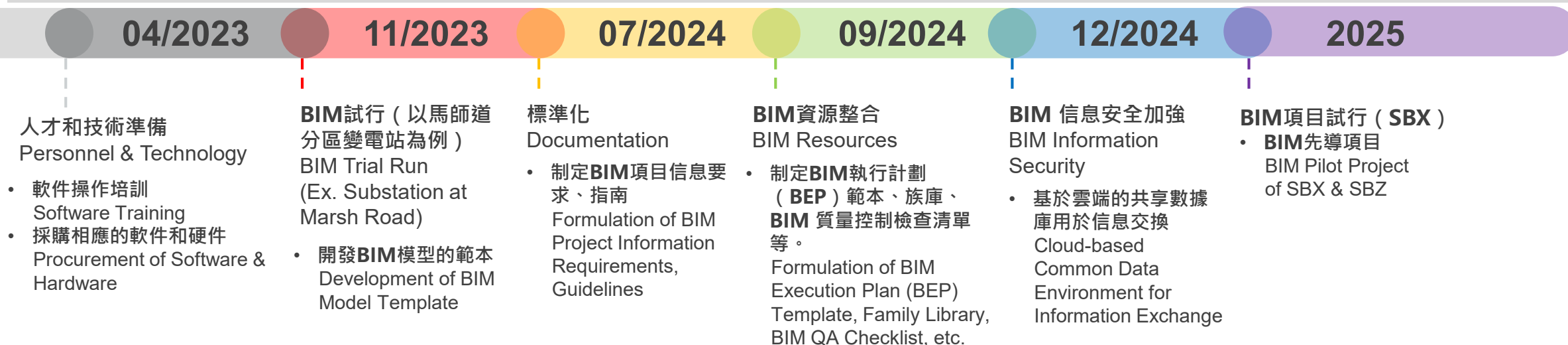
主題1: 集成設計與數字規劃

Theme 1: Integrated Design and Digital Planning

BIM(建築信息模擬) 實施從設計到完成

BIM Implementation from Design to Completion

採用BIM的過程 BIM Implementation Timeline



從準備範本到完成 From Templating to Completion



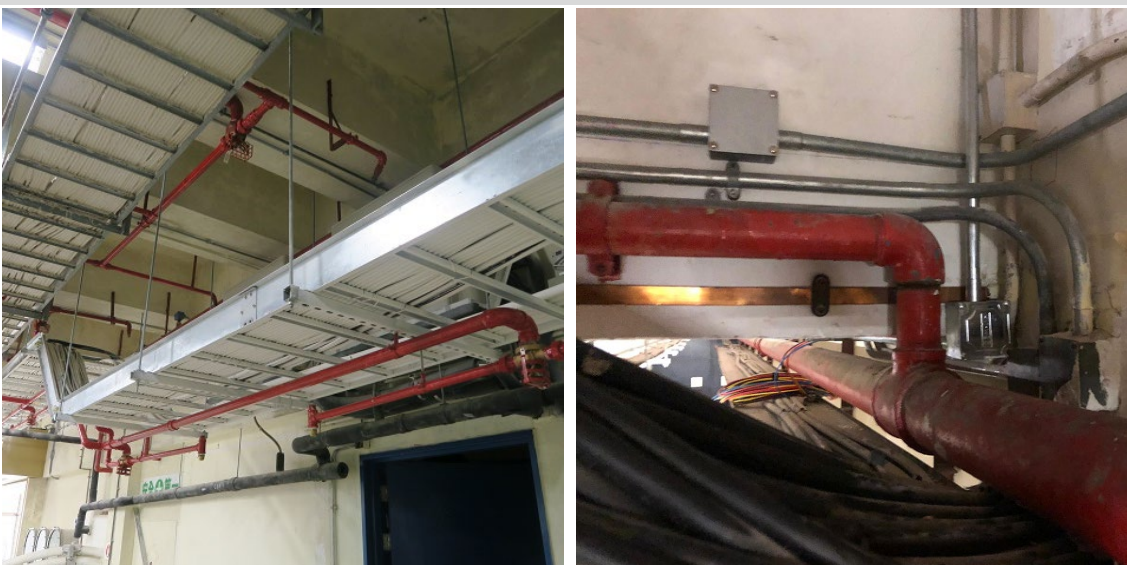
安全改善 Safety Improvements

- 更好的項目階段規劃
Better Phase Planning
- 利用**BIM-VR**虛擬現實技術進行安全培訓
BIM-VR Safety Training
- 虛擬設計和施工
Virtual design and construction (VDC)

採用MiMEP（集成機械、電氣和管道）

Adoption of MiMEP (Multi-trade integrated Mechanical, Electrical and Plumbing)

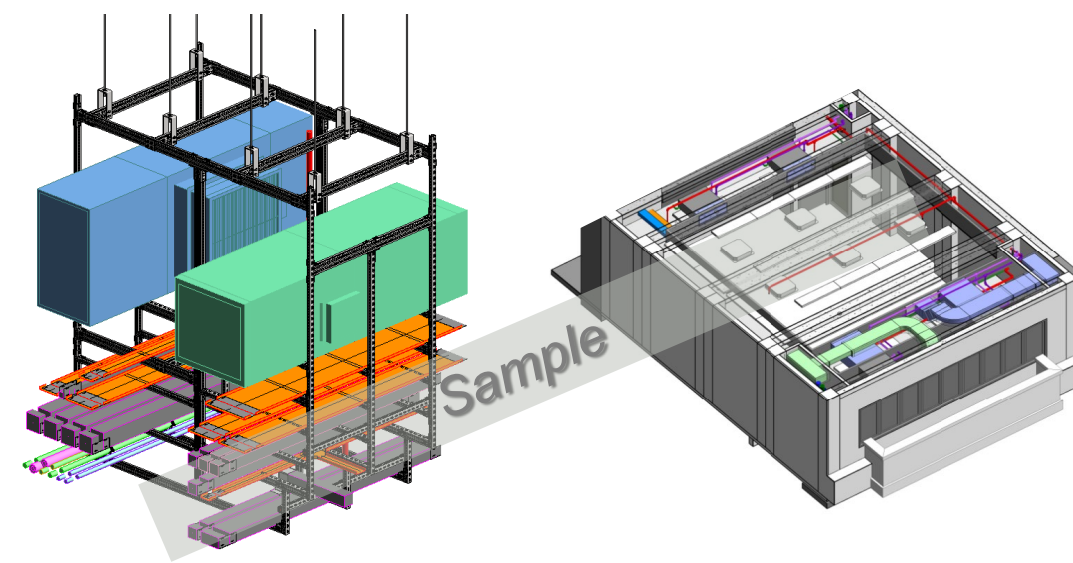
傳統的機電管道設計 Traditional Design of MEP



風險 Risks

- **壓縮的安裝時間：**緊迫的項目時間表可能會導致延誤。
Compressed Schedule: Tight project timelines may cause delays.
- **人力限制：**專業工人數量有限影響項目進度。
Manpower Shortage: Limited skilled labor impacts project efficiency.
- **環境複雜：**在受限工地環境裡協調多個產業
Complex Environment: Coordination among multiple trades in a constrained space.

採用集成機械、電氣和管道 Adoption of MiMEP



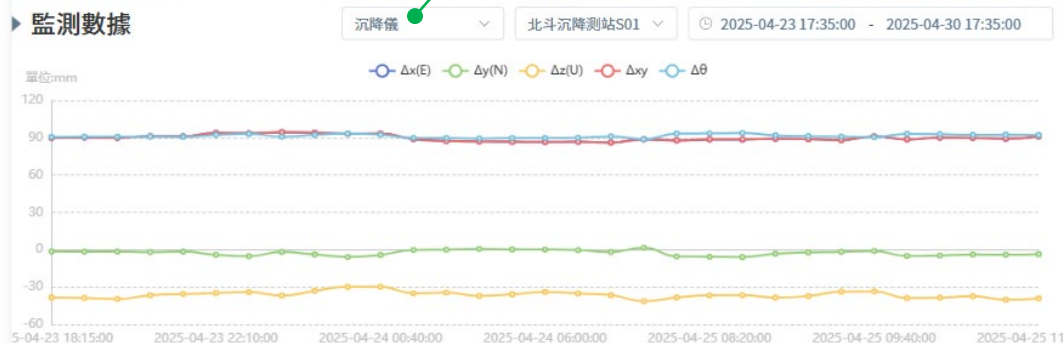
安全改善 Safety Improvements

- **減少高空工作：**工廠安裝減少了現場安裝高空工作的風險
Reduced Height Work: Off-site fabrication reduces height-related risks.
- **整潔、安全的工地環境：**工廠安裝讓工地更整潔，提升安全性
Cleaner, Safer Site: Organized off-site work minimizes hazards.
- **更好的質量控制：**工廠安裝提升了精準度和減少了缺陷
Better Quality Control: Factory-based assembly ensures precision and fewer defects.
- **縮短施工時間：**不同行業之間協同工作縮短了建設時間
Shorten Construction Time: Simultaneous work across trades shortens construction time.

額外的4S（安全智慧工地系統）組件 Additional 4S Components



監測數據

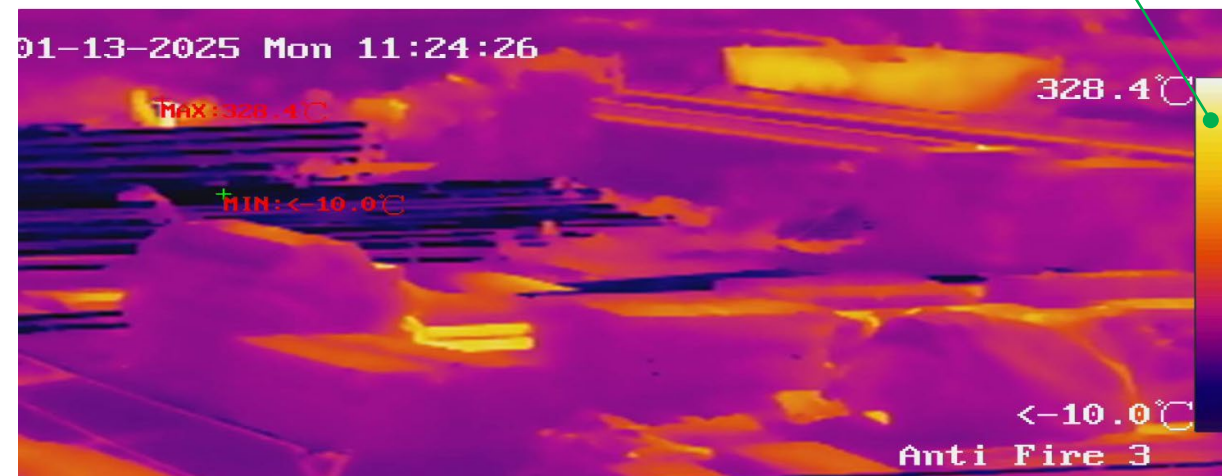


24小時全天候監控系統 24-7 Monitoring System

- 深基坑/地基工程期間建築物傾斜、地面沉降和振動監測系統
 Building tilting, ground settlement and vibration monitoring system during deep excavation/ foundation works

防火監控圖片

溫度監測
Temperature Monitoring



火警煙霧監測系統 Fire and Smoke Detection System

- 結合人工智能的熱成像、感測器、警報和通知系統
 AI and thermal imaging, Sensors, alarm and notification system

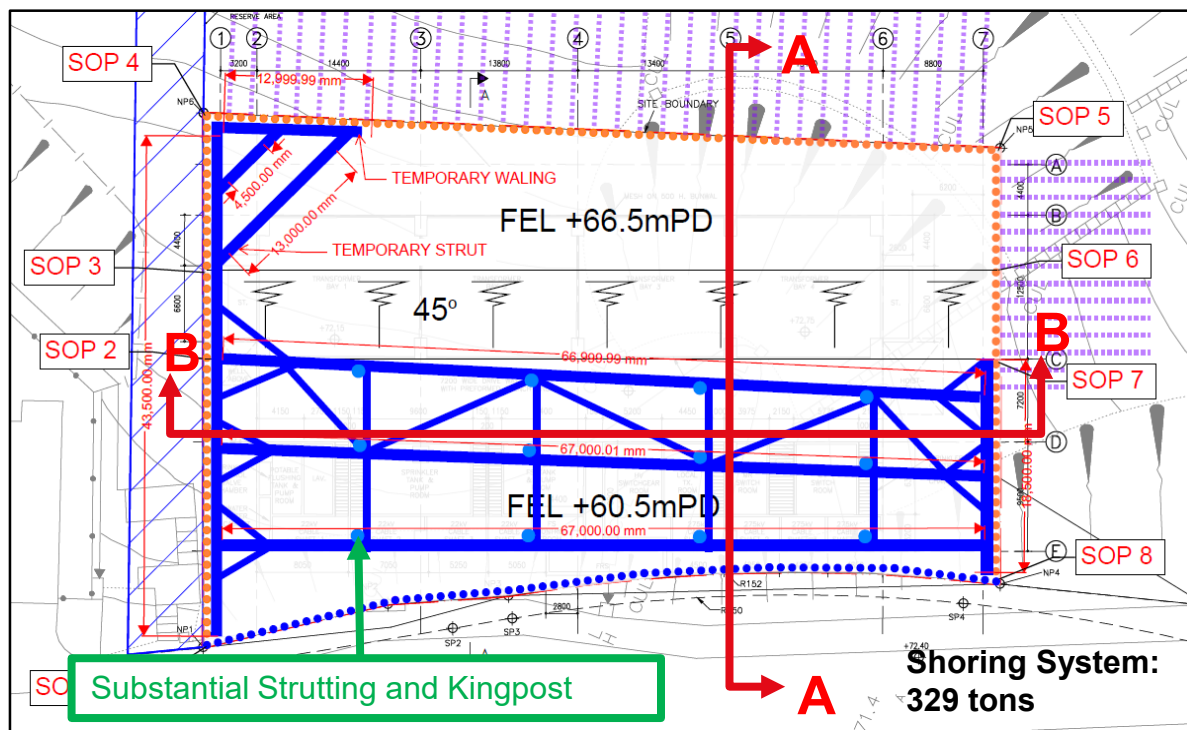
主題2: 施工安全設計

Theme 2: Construction Safety by Design

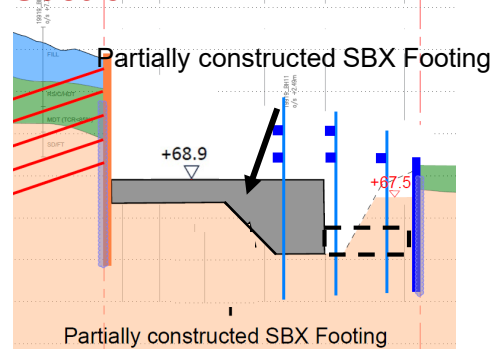
大規模挖掘和側向支撐工程

Extensive Excavation and Lateral Support Works

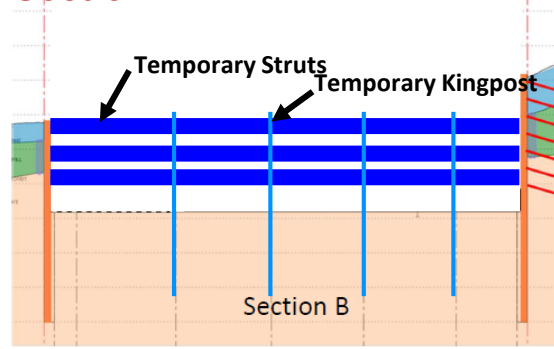
原有設計 Original Design



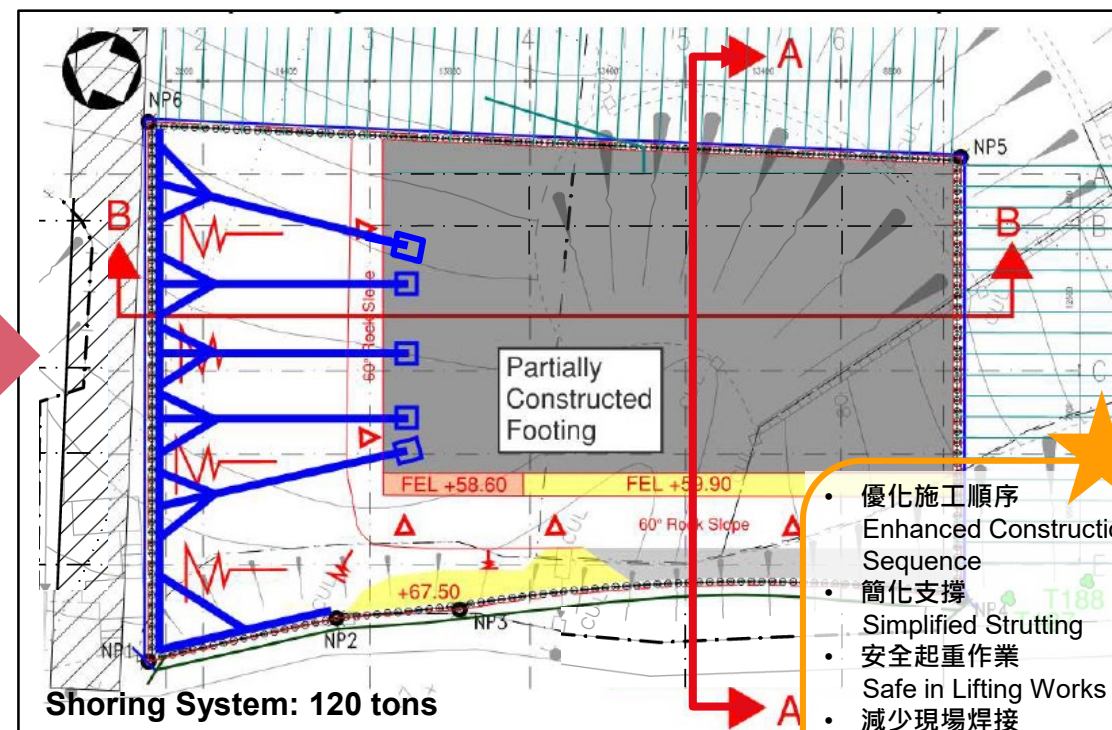
Section A



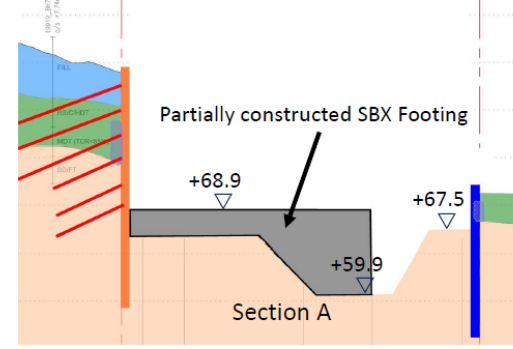
Section B



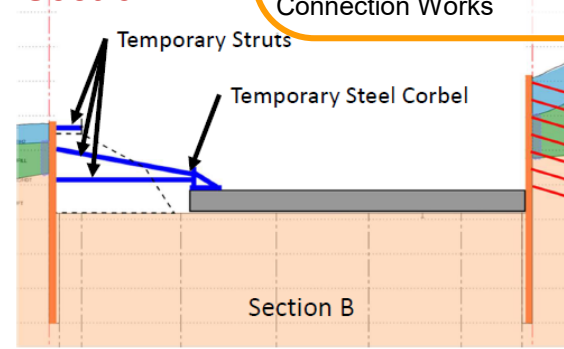
優化設計 Optimised Design



Section A



Section B



- 優化施工順序
Enhanced Construction Sequence
- 簡化支撐
Simplified Strutting
- 安全起重作業
Safe in Lifting Works
- 減少現場焊接
Minimize On-site Connection Works

安全的工作平台 Reliable Working Platform

油漆機械人 Paint Spray Robot



- 節約時間
Time Saving
- 減少高空工作
Reduce Working at Height
- 適合層高高的建築
Suitable for Large Floor Height

金屬棚架 Metal Scaffolding



- 使用金屬棚架替換竹棚架
Replacement of bamboo scaffolding

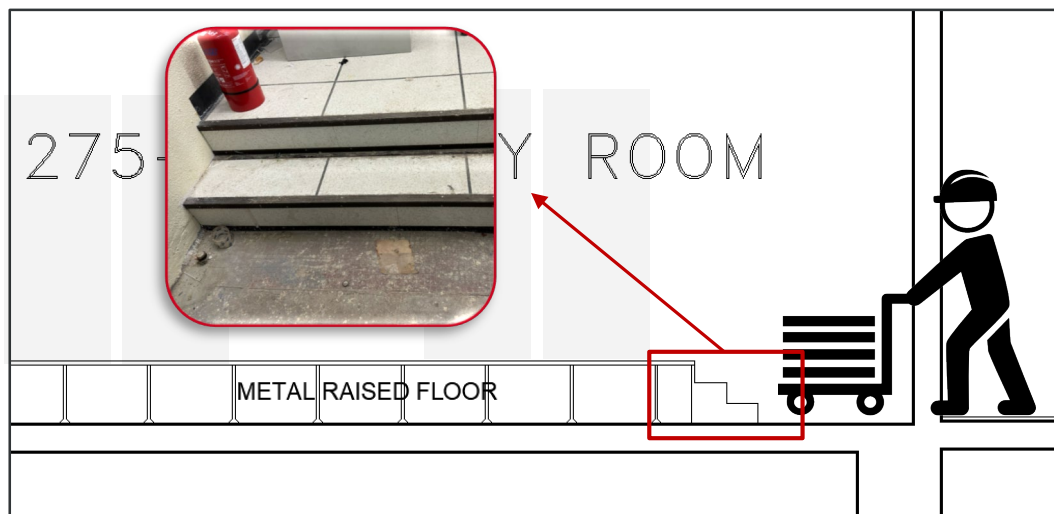
主題3: 維護作業安全設計

Theme 3: Maintenance Safety by Design

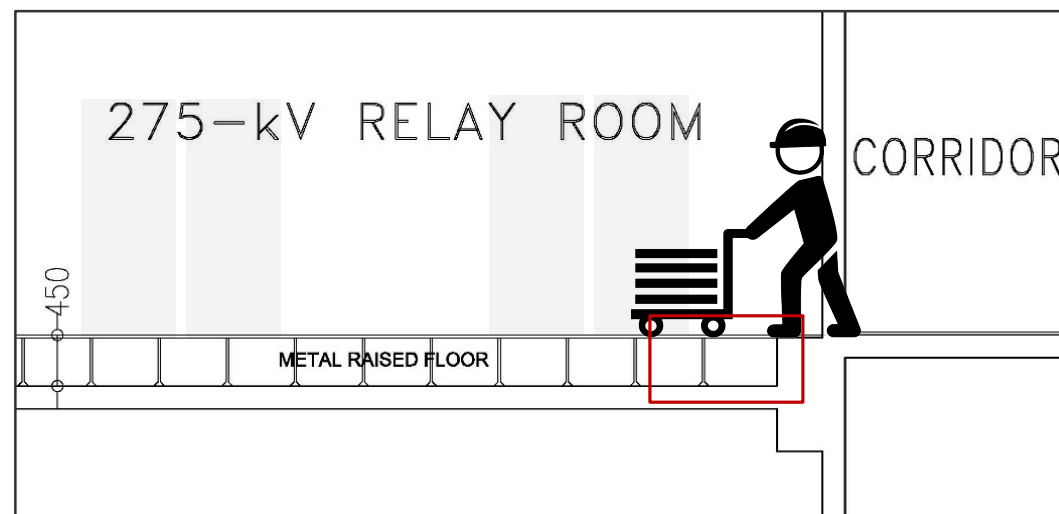
繼電器室的地板下沉式設計優化

Sunken Floor Slab Design Improvements at Relay Rooms

現有變電站設計 Original Design in Existing Substation



優化設計 Optimised Design



安全設計方法 Design for Safety Approach

- 下沉以滿足架空地板下所需的空間。房間的裝修樓層與外部走廊齊平。
Sunken for the void required under raised floor. Finishing floor level of the room would level with external corridor.

275千伏電纜的維護位置優化設計

Maintaining Safe Access Routes at 275-kV Cable Flat

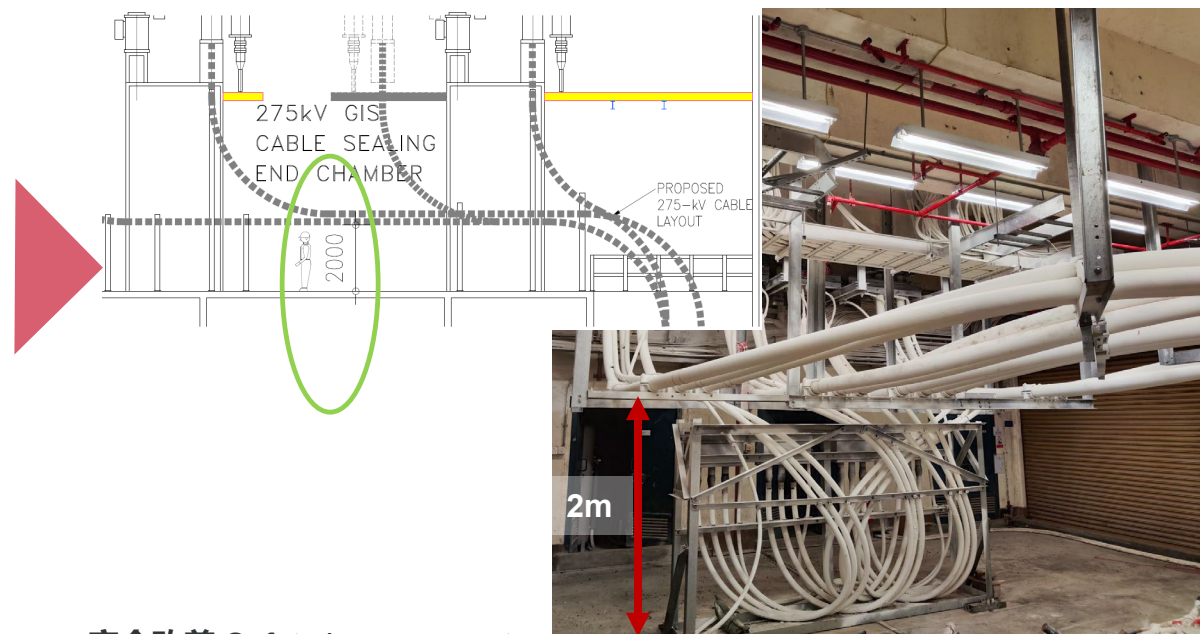
現有變電站設計 Original Design in Existing Substations



現有控制措施 Current Control Measure

- 在輸電電纜上安裝金屬平台作為維護通道
Installation of metallic platforms over transmission cables to maintain access routes
- 風險：無法保持平坦、暢通的地面通道**
Risk: Cannot maintain a flat and clear access routes at ground level

優化設計 Optimised Design



安全改善 Safety Improvements

- 新建電纜安裝高度高於地面約 2 米
Improved cable installation above ground at about 2 m for new-built
- 在有限的樓層高度及維修保養要求下取得平衡
Striking a balance between limited height of floor and maintenance requirements
- 保持地面更安全、更暢通的通道
Maintaining a more safe and clear access routes at ground level
- 為未來電纜改道、維修保養和升級提供更多空間
Providing more space for future cable diversion, maintenance and enhancement

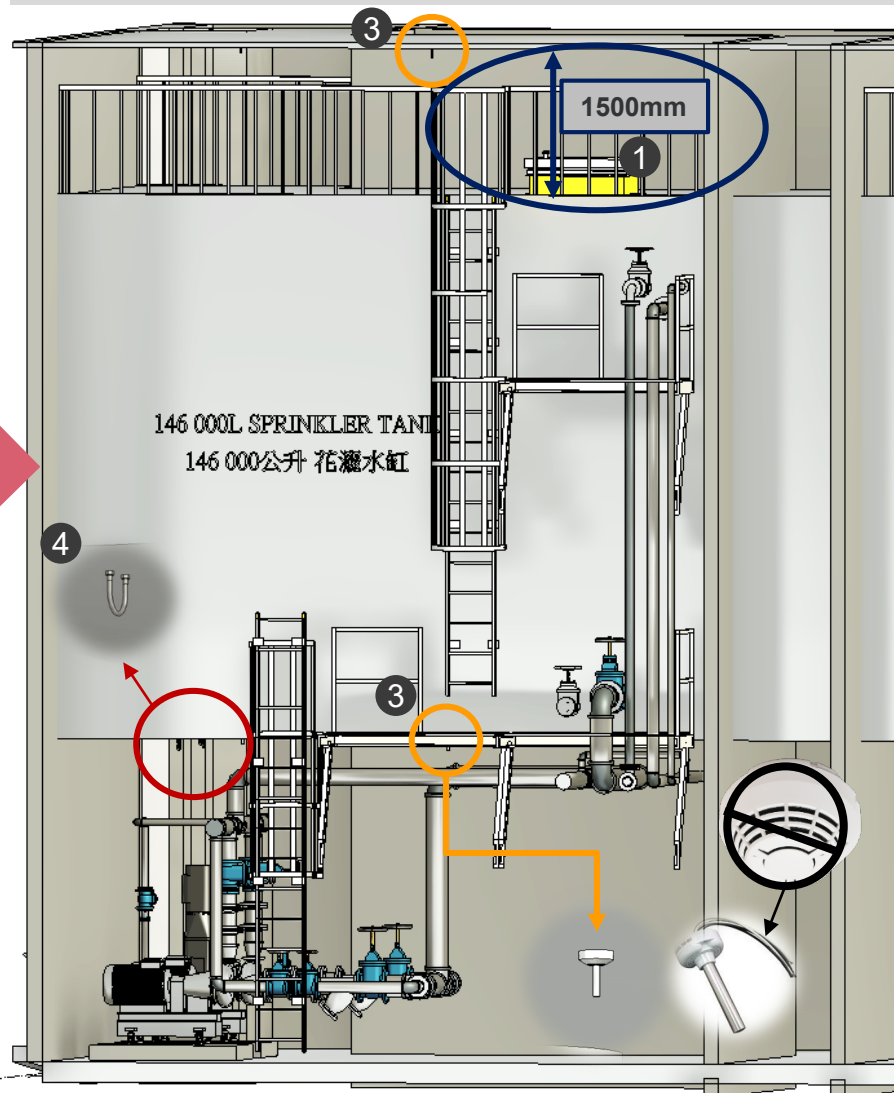
架高水缸的安全設計

Elevated R.C. Water Tank

現有設計 Original Design



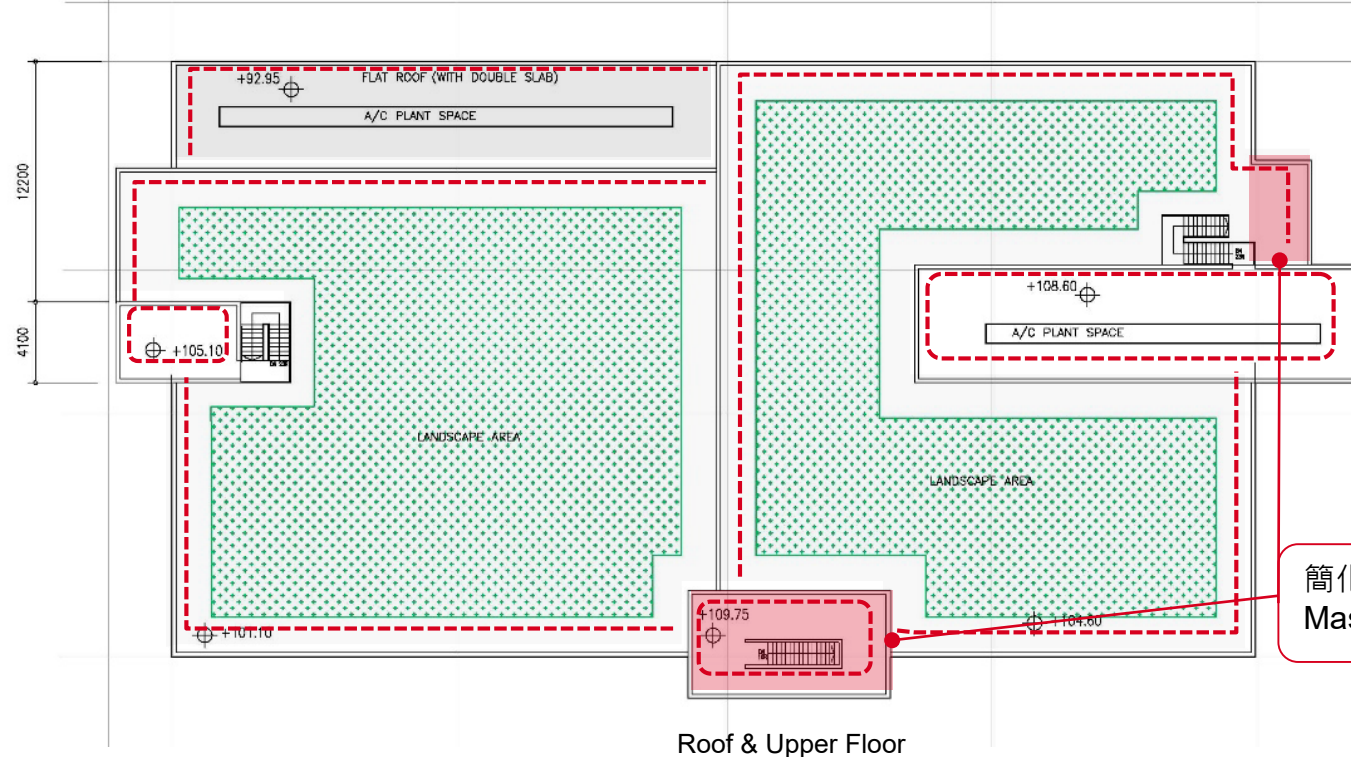
優化設計 Optimised Design



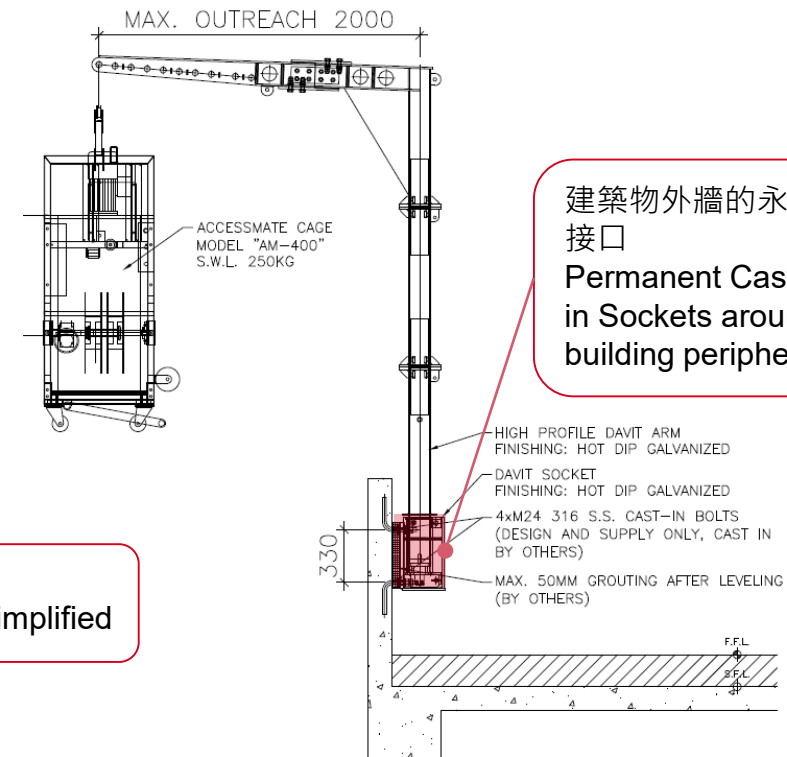
- 1 安全進入高架儲水箱頂部**
Safe Access to the Top of Elevated Water Storage Tank
- 2 提供維修平台，也可作為中間休息平台**
Provision of Maintenance Platforms, also serving as Intermediate Rest Platforms
- 3 提供密封熱探測器**
Provision of Hermetically Sealed Heat Detector to Detect Overheating
- 4 所有泵組上方均設有 U 型螺栓**
Provision of U-bolts located above all Pump Sets

外牆的安全維護通道

Maintenance Access to External Facade



簡化設計
Massing simplified



WALL-MOUNTED HIGH-PROFILE DAVIT ARM SECTION DETAIL

安全改善 Safety Improvements

- 統一所有外牆維護的系統
Unified system for all the façade maintenance
- 吊臂系統全覆蓋，並配有永久鑄造接口
Full coverage provision of davit arm system with permanent cast in sockets
- 簡化建築體量，減少高差，盡量減少難以接近的凹牆角
Simplification of building massing, reduce level differences and minimize concave wall angles difficult to be accessed

屋頂的安全維護通道 Maintenance Access to Flat Roofs

傳統設計 Traditional Design

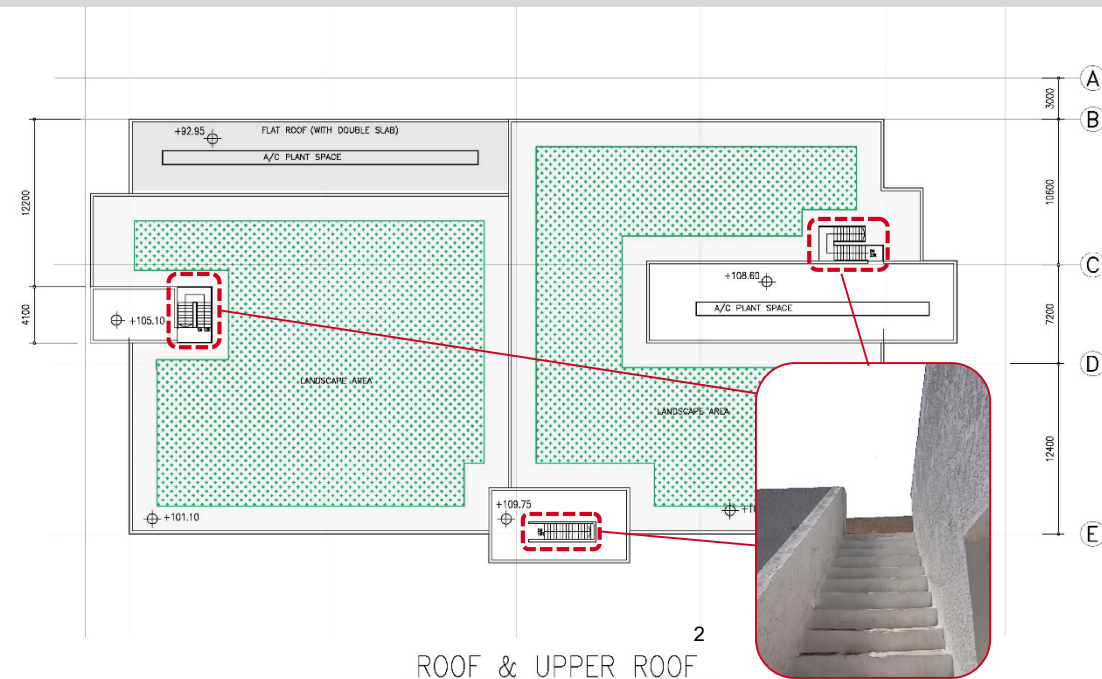


Cat Ladder¹

常見通道設計 General Control Measure

- 不定期檢查、清潔和維修排水溝、植物、光伏板和屋頂飾面
Occasional inspection, cleansing and repair for drains, plants, PV panels and roof finish
- 帶有安全罩的貓梯，可通往上層屋頂和樓梯頂部
Cat-ladder with safety hood for access to upper roofs and top of staircase-hood

優化設計 Optimised Design



安全改善 Safety Improvements

- 提供開放式樓梯，取代貓梯
Provision of open staircases instead of cat ladder

採用燈喉外露設計 Adoption of Exposed Conduit

傳統設計 Traditional Design



存在潛在危險的設計 Design with Potential Hazard

- 在現有變電站改造工程中鑽孔地板/牆壁開口，用於新電纜的鋪設。在牆壁/地板開孔工作期間損壞隱蔽的燈喉/電纜

Drilling floor/wall opening at existing Substation for new cable laying under modification work. It's hard to avoid concealed conduits/cables during wall/floor opening work

優化設計 Optimised Design



安全改善 Safety Improvements

- 採用外露燈喉佈線/電纜
Adopting surface-mounted conduits with wiring/cables
- 使用BIM設計輔助電纜敷設位置
Designing the laying locations of auxiliary cables in BIM model

主題4:社區影響考慮

Theme 4: Community Impact Consideration

建設過程中噪音對社區的影響

Noise Impact to Neighbor During Construction

傳統方法 Traditional Method



Sound pressure level in dB(A) at 7m from equipment

距離爆破物 7 米處的聲壓級

Excavator Mounter Breaker

使用挖土機破碎錘

60	70	80	90	100	110
				■	

傳統方法 Traditional Method

- 使用挖土機安裝的破碎錘
Use of excavator mounted Breaker

優化方法 Optimised Method



Sound pressure level in dB(A) at 7m from equipment

距離爆破物 7 米處的聲壓級

Busting System 爆破系統

Chemical Expansion Agent

化學膨脹劑

60	70	80	90	100	110
	■				
■					

安全改善 Safety Improvements

- 探索爆破系統的使用
Explore the use of bursting system
- 探索化學膨脹劑的使用
Explore the use of bursting system

* Information from EPD



謝謝
Thank You