Anderson Road Quarry Joint Cavern Development

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Content

- Project Background
- Why do we use Rock Cavern
- Design Concept
- Main Challenges
- Technical Innovations
- Conclusion

Project Background

Project Background

Rock Cavern Project for ***NIMBY*** only?

What can be done NEXT?

Are we ready Now?

YES we are!

Project Background

The Anderson Road Quarry Joint Cavern Development consist ***TWO facilities***

The **Relocated** Public Works Central Laboratory

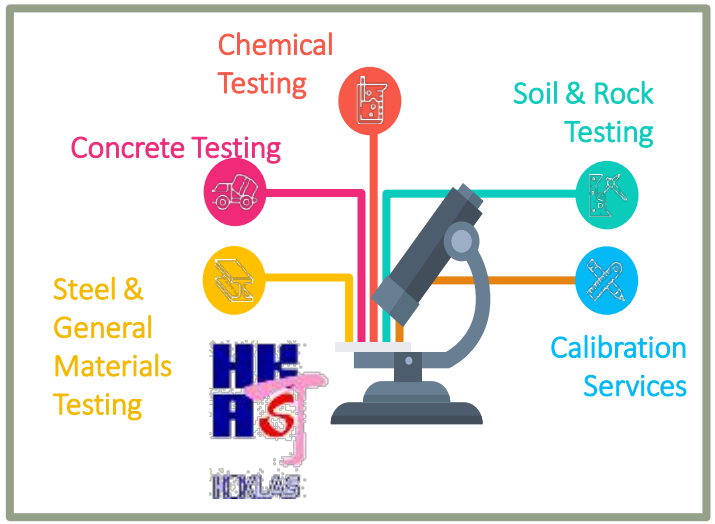
A ***New*** Government Records Service's Archives Centre

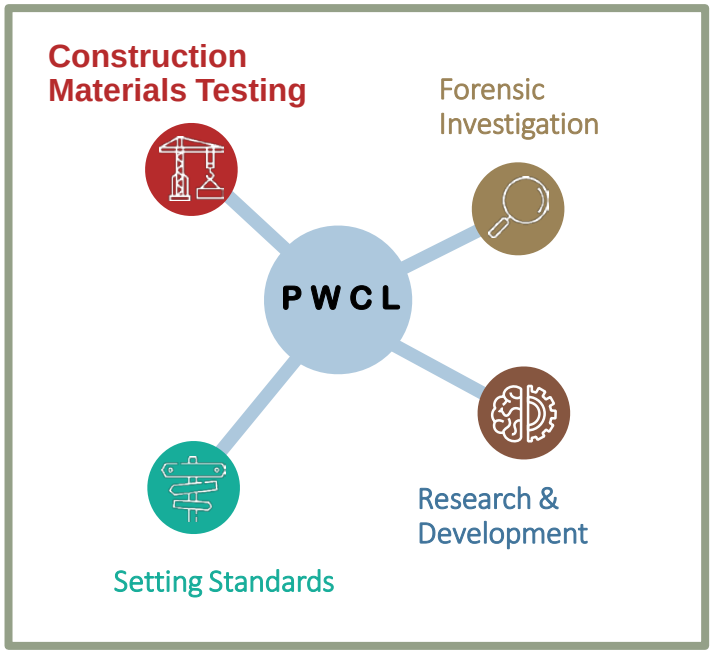
Project Background

Relocation of Public Works Central Laboratory (PWCL) into cavern

Project Background

- Ensure the construction materials for public works meet the highest standards
- Provide high quality testing services





Project Background

350 types of test

on average 400,000 test per year

Why Relocation is needed ?

I

Laboratory **No Longer Match** with the regional development plan

1. Release the *valuable surface land resource*
2. Establish a *modern and more sophisticate* laboratory

II

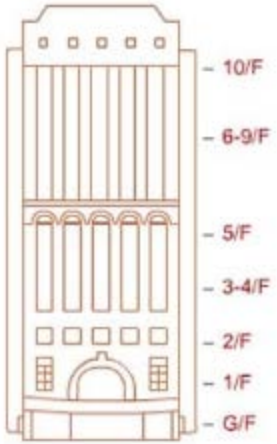
Aging facilities and inefficient design

III

Insufficient space limited development

Project Background

New Government Records Service(GRS)'s Archives Centre (AC)



Existing Hong Kong Public Records Building in Kwun Tong

Vision of the GRS

To be the leading, most insightful and resourceful public archives in Hong Kong that excels in preserving and promoting the documentary heritage of our city in the digital era.

Project Background

Archives Repositories

Paper Repositories

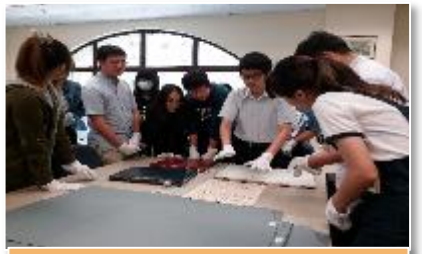
Mircofilm Repositories

Electronic Records Repositories

Appraisal and Description

- Various Records Repositories
- Search Room
- Records Preservation and conservation area
- Exhibition Room
- Lecture Room
- Office and Works Area

Conservation Workshop



Workshop and Seminar

Reference Services Counter

Search Room

Finding Aids Area

Project Background

Why a NEW Archives Centre is needed ?

- The existing Hong Kong Public Records Building commissioned in 1997. After 24 years, capacity of the Archives Repositories capacity had been fully utilized.

- Due to the specific requirements on temperature, humidity, lighting, weight, etc., for Archives Repositories, *ordinary buildings are not suitable* for storage of the documents.

Why do we use Rock Cavern

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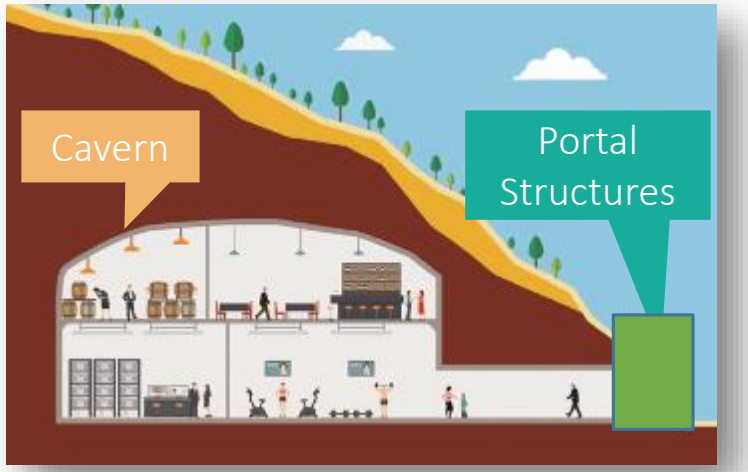
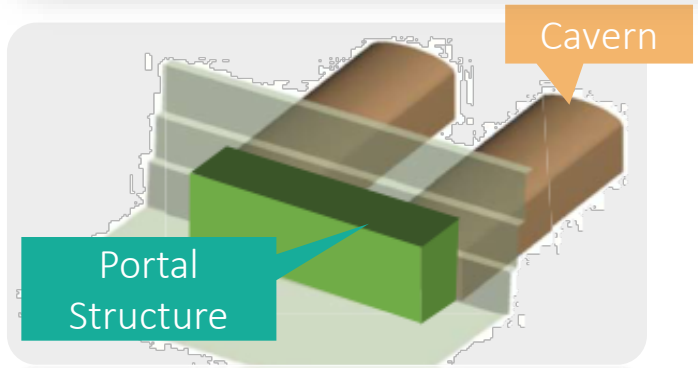
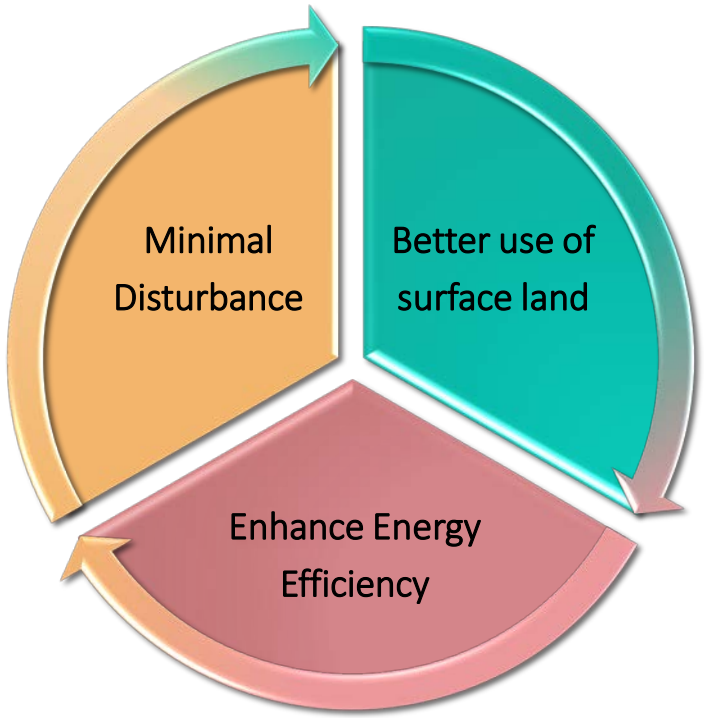
Why do we use Rock Cavern







Benefits of using Rock Cavern

Reserving surface land for **Better land use**

Benefits of using Rock Cavern

Rock Cavern provides **Stable Environment** which could enhance **Energy Efficiency**

Paper Repositories (18°C/50%)

Microfilm Repository (13°C/35%)

Curing tank (27°C)

Triaxial Test (19-24°C)

Key consideration:

- ✓ Environmental Friendly – Less energy consumption
- ✓ Economy – Less cost for E&M equipment to maintain stable environment
- ✓ Sustainability – Increase design lift span of the facilities

Benefits of using Rock Cavern

- Rock Cavern could easily blend into Natural Environment
- Rock mass could effectively isolate the nuisance
- Do not constrain future development outside cavern

Example

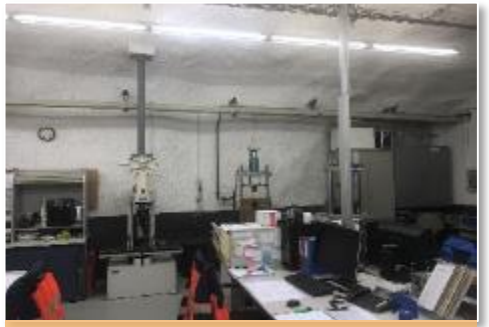
✓ Isolation of potential Noise and Emission

Concrete pipe load test

Tension test for steel

Benefits of using Rock Cavern

- Foreign Successful Cases



Material Lab – Switzerland

National Archives - Norway

WE WILL BUILD

- FIRST MATERIAL LABORATORY IN CAVERN IN THE WORLD
- FIRST ARCHIVES CENTRE IN CAVERN IN ASIA

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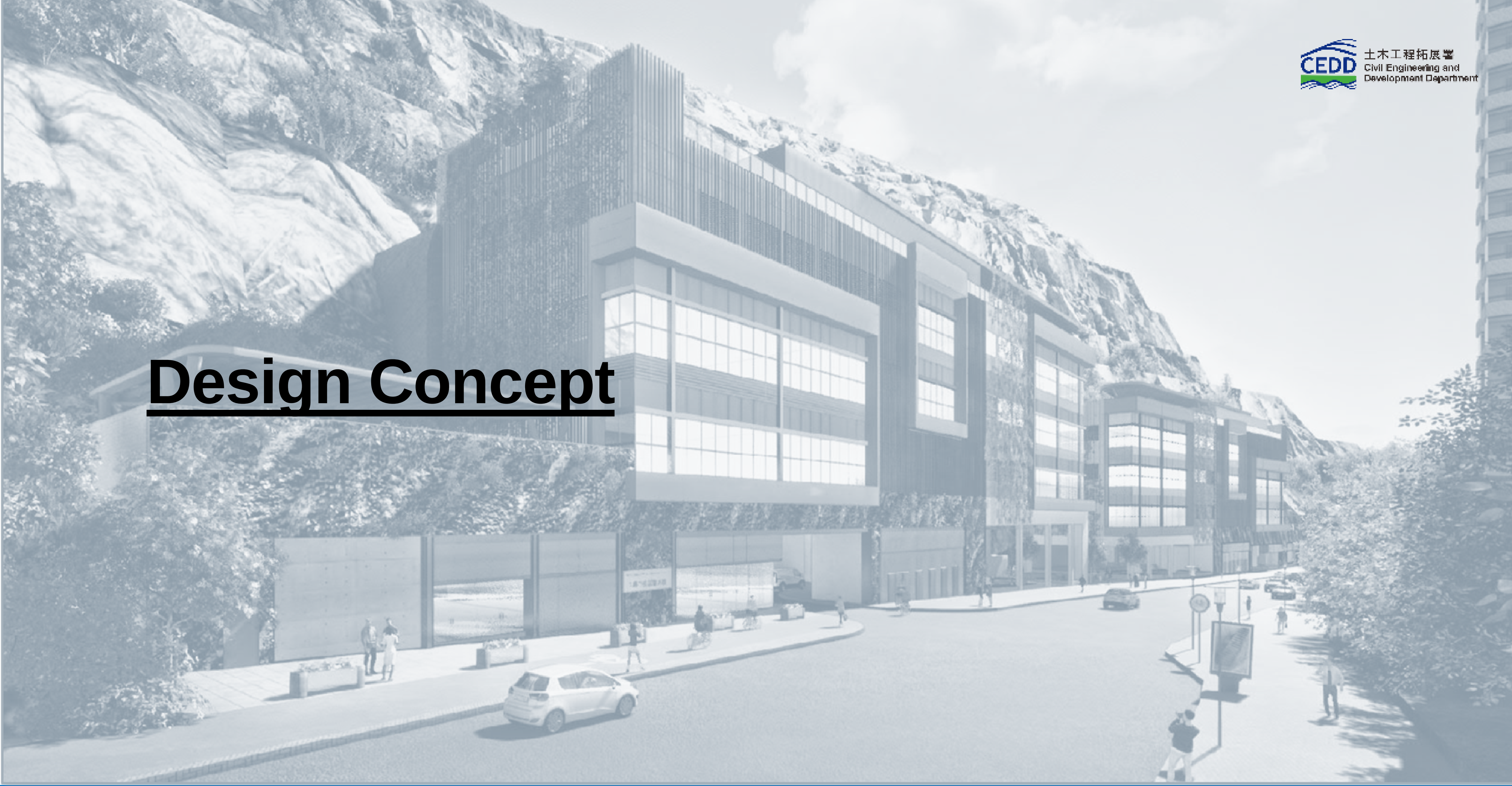
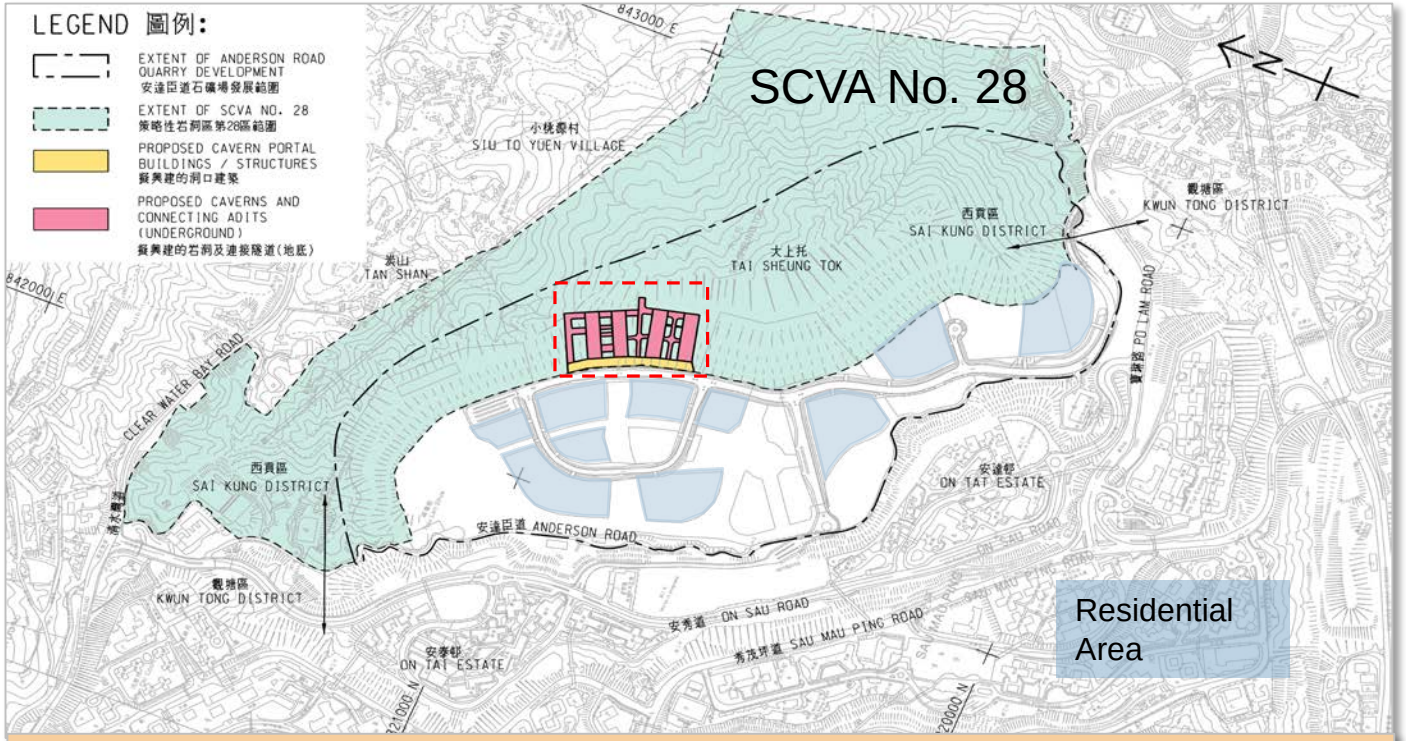
Design Concept



Design Concept

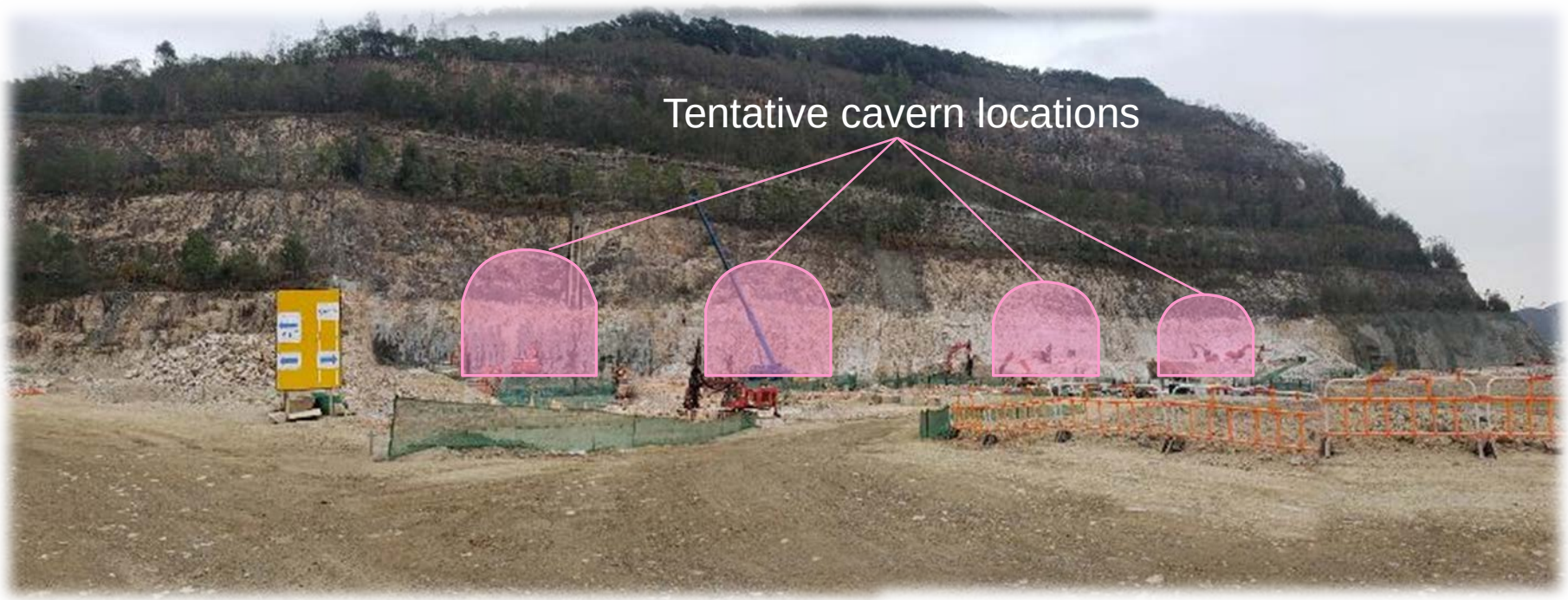
Selected Location – Anderson Road Quarry (ARQ) Site



Tai Sheung Tok Strategic Cavern Area (SCVA) No. 28

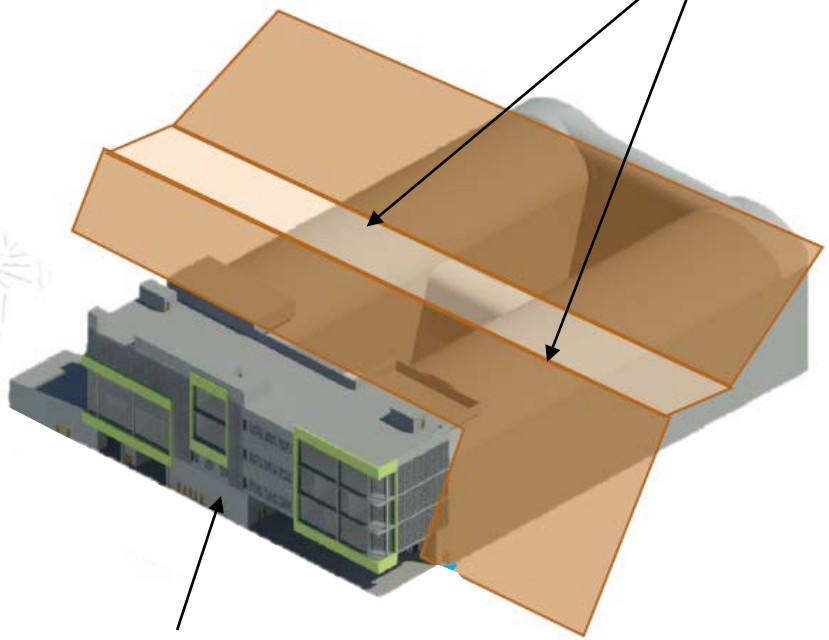
Design Concept

Existing Site Condition of ARQ



Design Concept

Cavern Structure (laboratory testing area, records repositories)



Portal Structure (for general office, E&M plants, conference room, etc.)

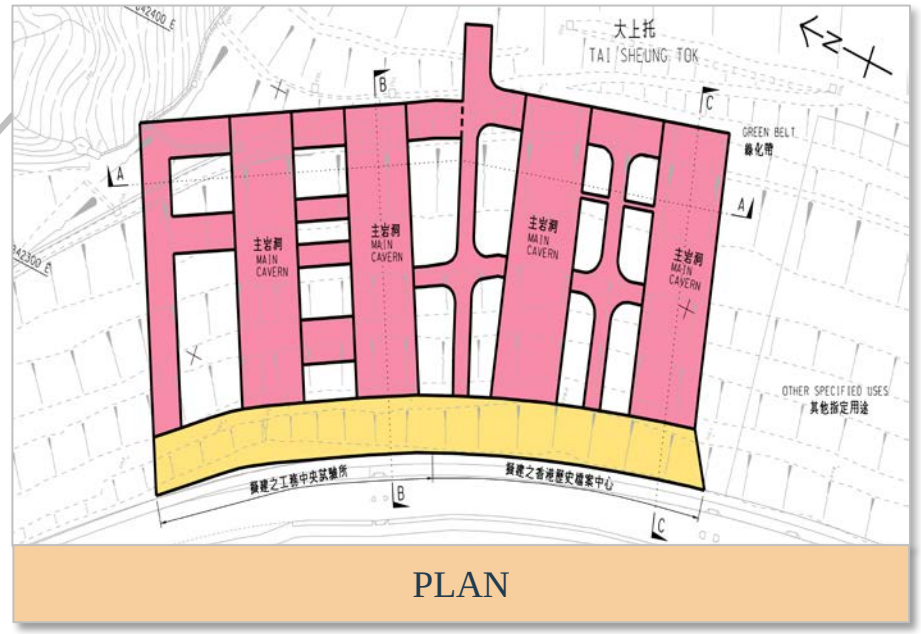
Portal Structure

\+ = **Integrated Structure**

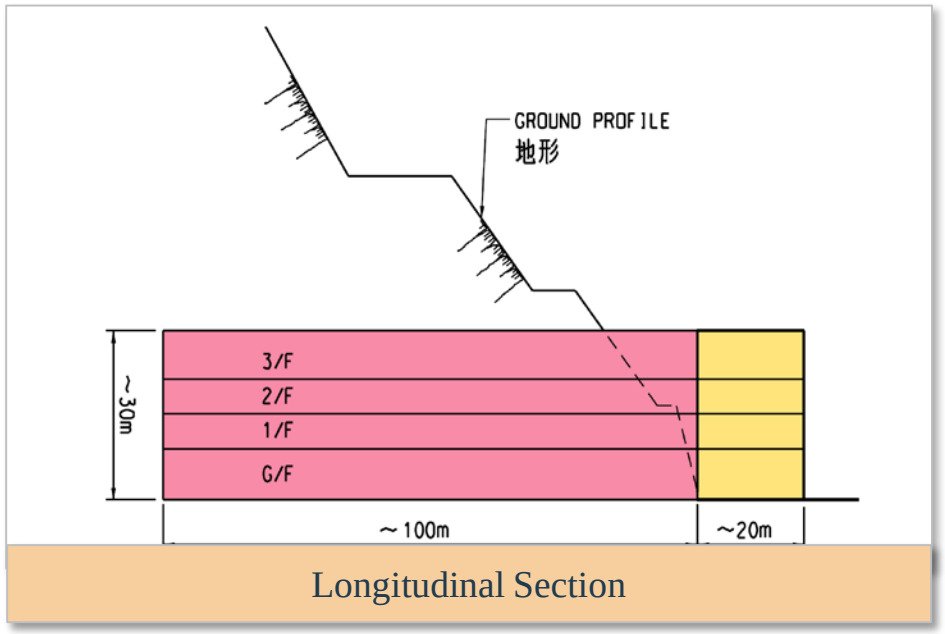
Cavern Structure

Design Concept

- Preliminary Dimensions in accordance with Feasibility Studies, will be further OPTIMIZED
- Multi-storey structure inside caverns



PLAN



Longitudinal Section

Design Concept

Coherent Architectural design

- ✓ Astonishing structure Outside
- ✓ Functional area Inside for effective Isolation

Design Concept

Blending into Environment

- ✓ Greening Provision to tie-in with the adjacent natural environment
- ✓ Match with community's development plan
- ✓ Reserved Space for public event

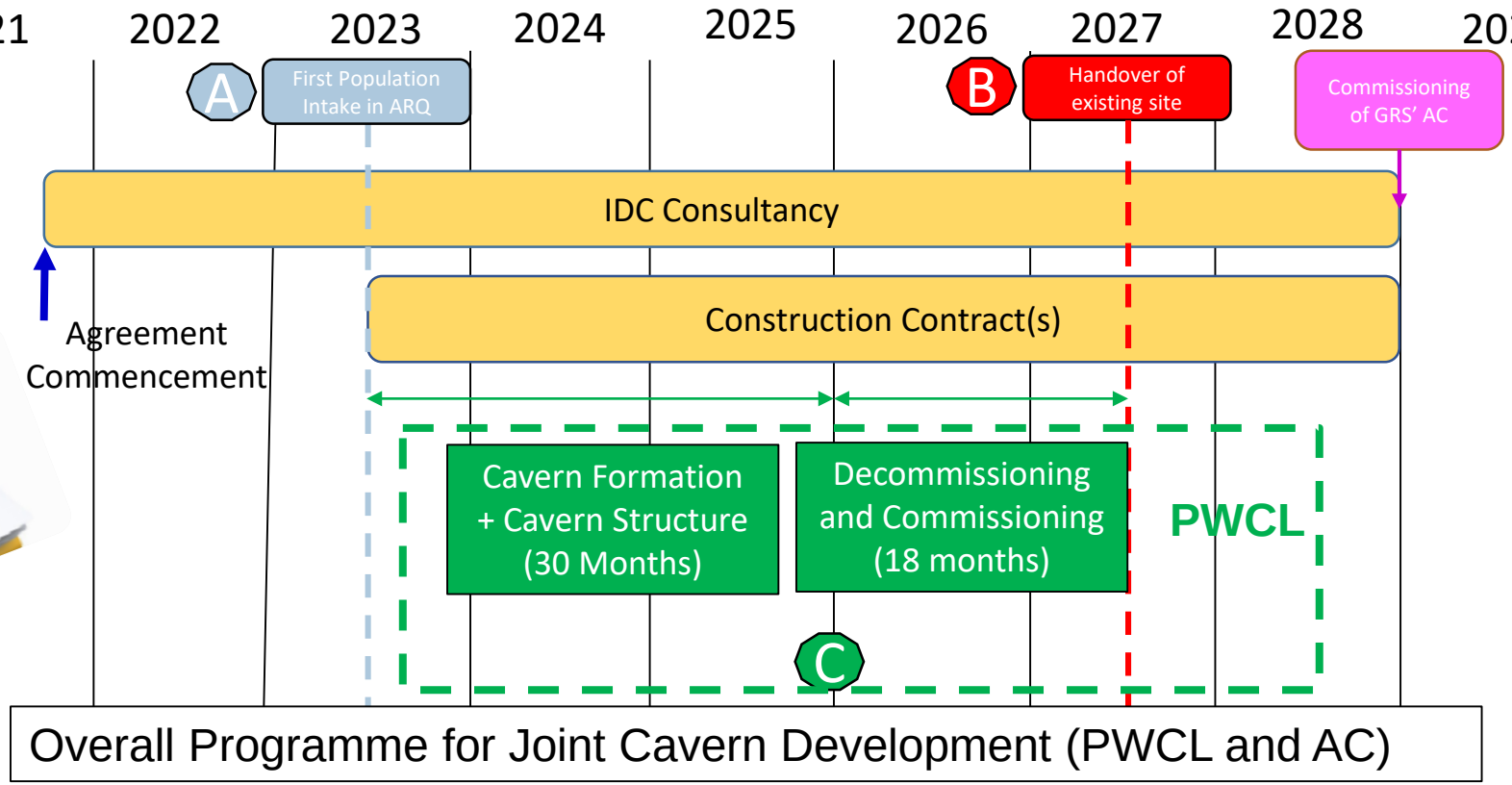
Display Panels for Hong Kong Geology

Covered Open Area

Major Challenges

Major Challenges

1. Extremely Tight Programme for Commission of New PWCL



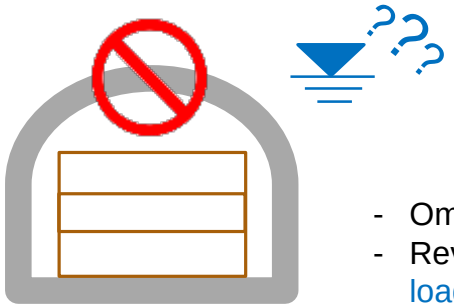
Major Challenges

2. Design Challenges for New Types of Cavern facilities (laboratory and warehouse) of relatively high population

- No applicable design guideline for this types of facilities in caverns

Guide on Fire Safety Design for Cavern 1994 (for small cavern with low population)

- More Cost-effective Design

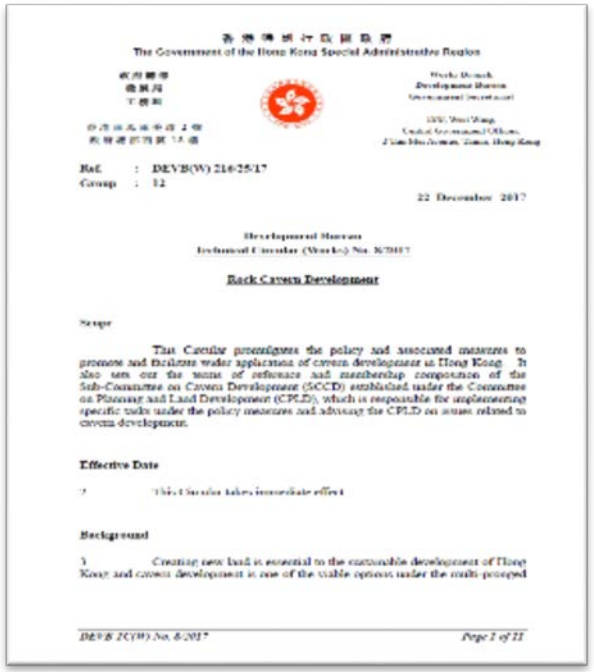


- Omission of Permanent Lining
- Review of design ground water loading

Major Challenges

3. Safeguarding the Development Potential of the SCVA No. 28

DEVB TC(W) No. 8/2017



The Government of the Hong Kong Special Administrative Region

Ref. : DEVB(W) 216/25/17
Group : 12

22 December 2017

Development Bureau
Technical Circular (Works) No. 8/2017

Back Canvas Development

Scope

This Circular promulgates the policy and associated measures to promote and facilitate wider application of canvas development in Hong Kong. It also sets out the terms of reference and membership composition of the Sub-Committee on Canvas Development (SCCD) established under the Committee on Planning and Land Development (CPLD), which is responsible for implementing specific tasks under the policy measures and advising the CPLD on issues related to canvas development.

Effective Date

3. This Circular takes immediate effect.

Background

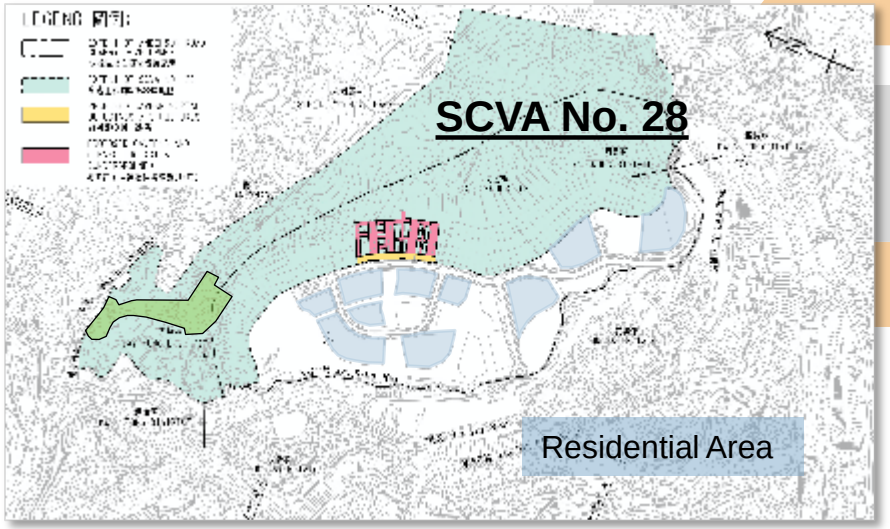
4. Creating new land is essential to the sustainable development of Hong Kong and canvas development is one of the viable options under the multi-pronged

DEVB TC(W) No. 8/2017 Page 1 of 11

Policy

8. All new Government projects[4] and land disposal/alienation proposals (including lease modification and land exchange) that wholly or partly fall within SCVAs delineated in the CMP shall be submitted for vetting by the SCCD. The SCCD will make comments and, where appropriate, recommendations on suitable provisions to safeguard the development potential of the SCVAs and optimise their utilisation.

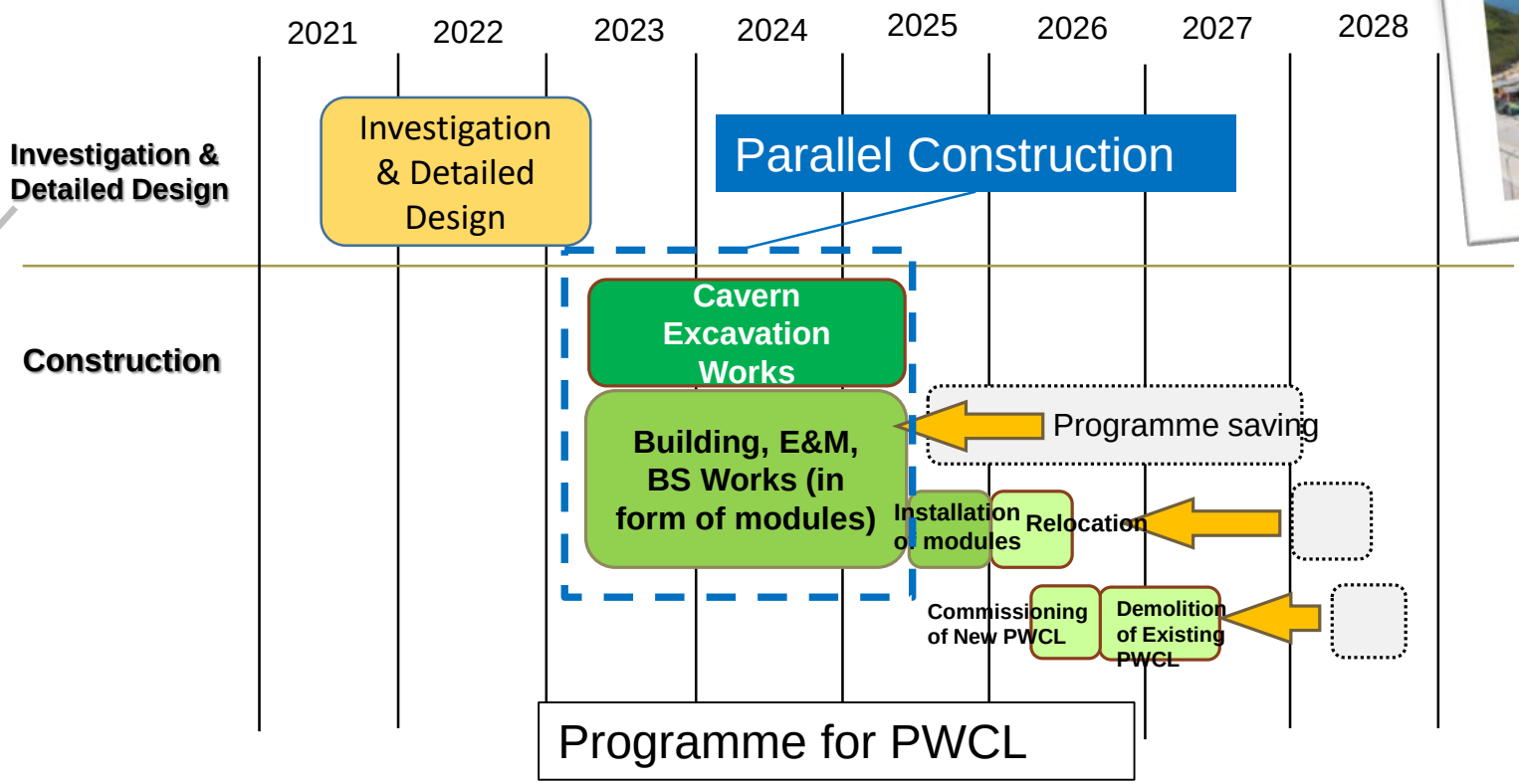
- After the commissioned PWCL and AC, they become sensitive receivers which may prohibit future development
- ARQ full population intake in 2026



Technical Innovations

Technical Innovations

1. Modular Integrated Construction (MiC) in Cavern

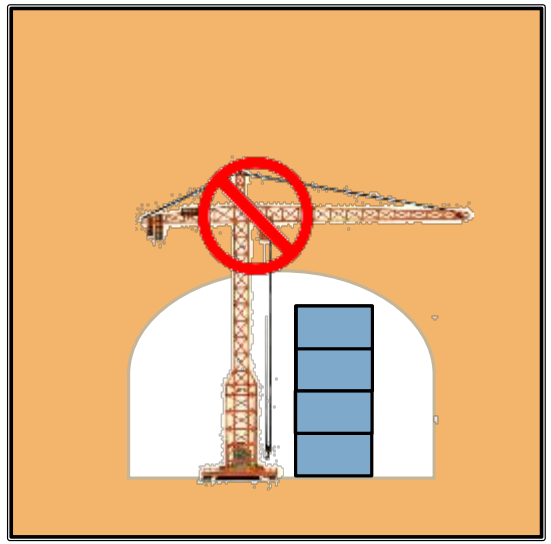


Quarantine Camp in Penny Bay – Phase 1A
110 units built in **56** day

Quarantine Camp in Penny Bay – Phase 4
306 units built in **41** day

Technical Innovations

1. Modular Integrated Construction (MiC) in Cavern

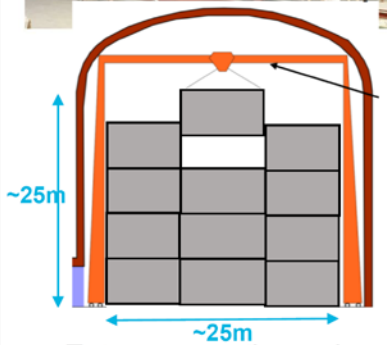


- Spatial constraint inside cavern – Atypical assemble method
- Unprecedented case worldwide

Technical Innovations

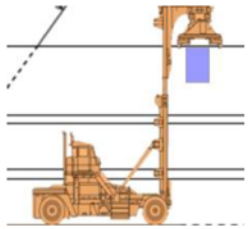
1. Modular Integrated Construction (MiC) in Cavern – Possible ways of assemble

Option 1 – by Gantry Crane



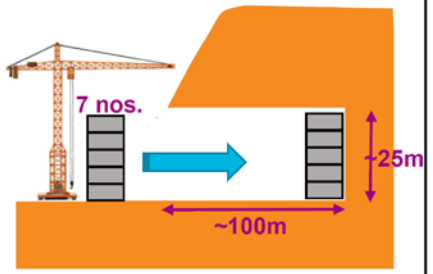
- Extra excavation volume are required for the space occupied by the gantry

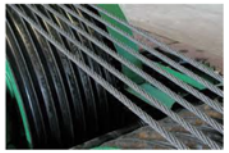
Option 2 – by Forklift



- Limited loading height and capacity

Option 3 – by Cable Pulling System





- Difficult to maintain the verticality and prevent overturning
- Longer time for installation and testing of the system before use

Technical Innovations

2. Early Contractor Involvement (ECI)

- NEC4 New Clause X22 the Early Contractor Involvement
- Modified version to suit HKSAR contract procurement
- To capture **CONSTRUCTOR'S EXPERTISE ON MiC CONSTRUCTION** at early stage

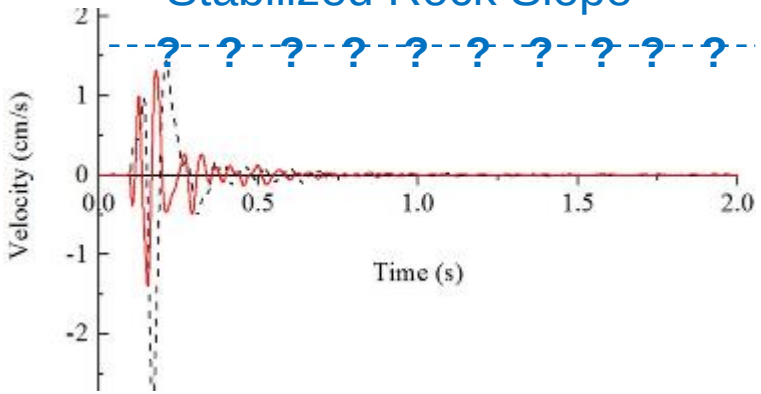
Technical Innovations

3. Increase of rock slope vibration Resistance

- To expedite the rock excavation rate, charge weight would be maximized

- Stabilized Rock Slope form under ARQ are the main sensitive receivers to the blasting vibration

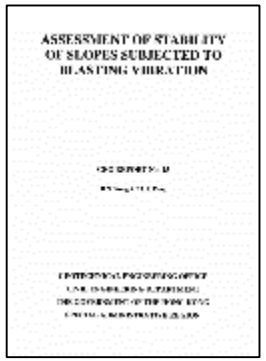
Determination of PPVc for Stabilized Rock Slope



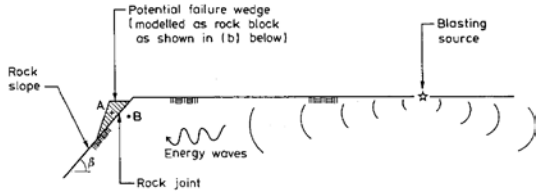
Technical Innovations

3. Increase of rock slope vibration Resistance

- **GEO Report No. 15** provided guideline to determine ppvc for (i) rock slope without stabilization measures and (ii) Soil Slope

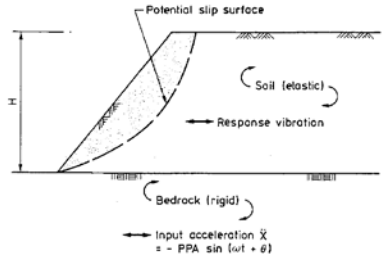

ASSESSMENT OF STABILITY OF SLOPES SUBJECTED TO BLASTING VIBRATION

(i)



(a) Section through Blasting Source and Rock Slope

(ii)



(a) Slope with Horizontal Bedrock under Shear Vibration

- **GEO TGN No. 28** stipulated the Control Frameworks for Soil Slopes subjected to blasting vibration

NEW CONTROL FRAMEWORK FOR SOIL SLOPES SUBJECTED TO BLASTING VIBRATIONS

Type of Slope	Slopes that pose negligible risk to life	Consequence-to-life (CTL) category 1 & 2 slopes that meet current standards	All other slopes
PPV Limit	25 mm/s (Notes 1 & 2)	25 mm/s (Notes 1 & 2)	Analysis or other justified approach

Technical Innovations

4. Use of Advance Sprayed Concrete

- Successful application of Sprayed Concrete Lining worldwide

Crossrail – Stepney Green junction's Eastbound SCL cavern

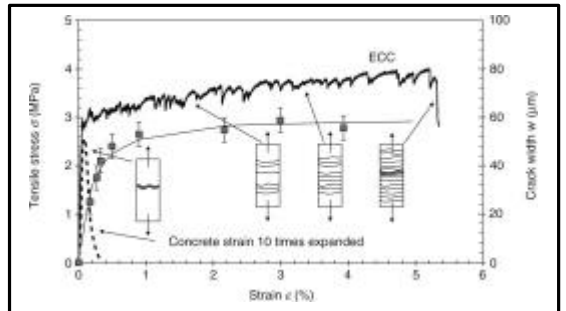
High quality concrete could be produced

Technical Innovations

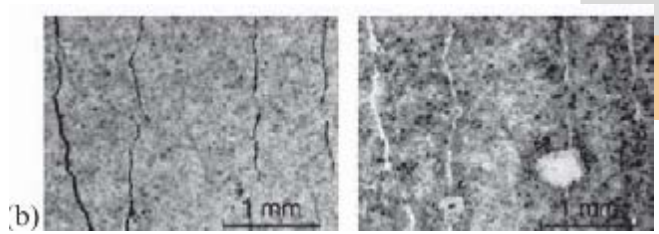
4. Use of Advance Sprayed Concrete

- Recent Advancement in Concrete Technology
- Example Engineering Cementitious Composites (ECC) by Prof. Victor Li, University of Michigan

Bendable Concrete



High strain



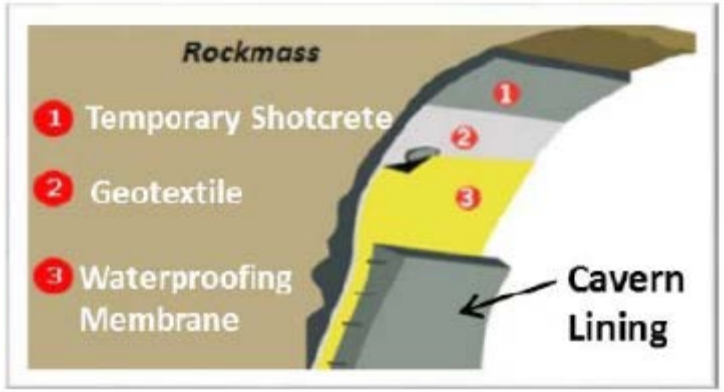
Self Healing Properties

Technical Innovations

4. Use of Advance Sprayed Concrete

- Composite Lining Design – More Cost Effective

Option	Primary Lining	Secondary Lining	Waterproof	Composite Action
1	Temporary	Yes	Yes	No
2	Permanent	Yes	Yes	Load Sharing
3	Permanent	Yes	No	Load Sharing
4	Permanent	Yes	Yes	Composite
5	Permanent	Yes	No	Composite
6	Permanent	No	No	Single Pass



← Traditional Design (Hong Kong)

↓

← Crossrail (2009)

↓

← Tideway West (2016)

Technical Innovations

5. Adoption of Latest BIM Technology for Asset Management

- Full use of BIM technique throughout

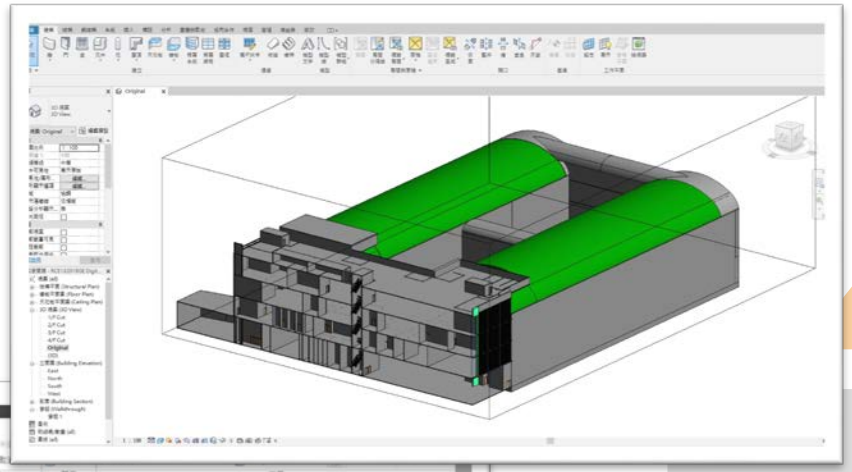
DESIGN

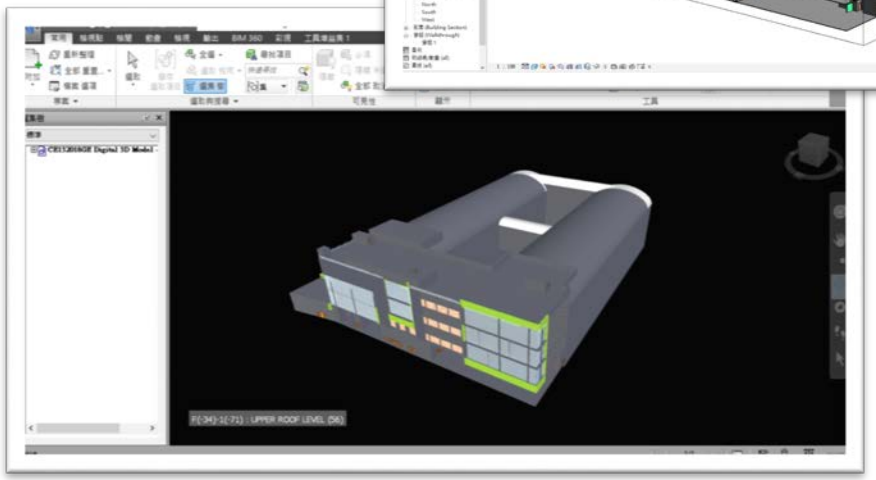
↓

CONSTRUCTION

↓

ASSET MANAGEMENT (AM)





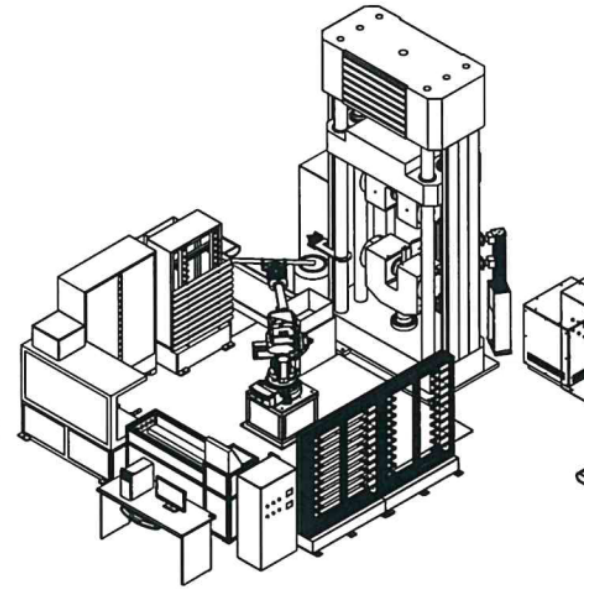
Technical Innovation

6. Automation system

- Increase operation efficiency, improve occupation safety, minimize human error

Robotic Arm

Automated Storage and Retrieval System



Automated Steel Testing (prototype)

Conclusion

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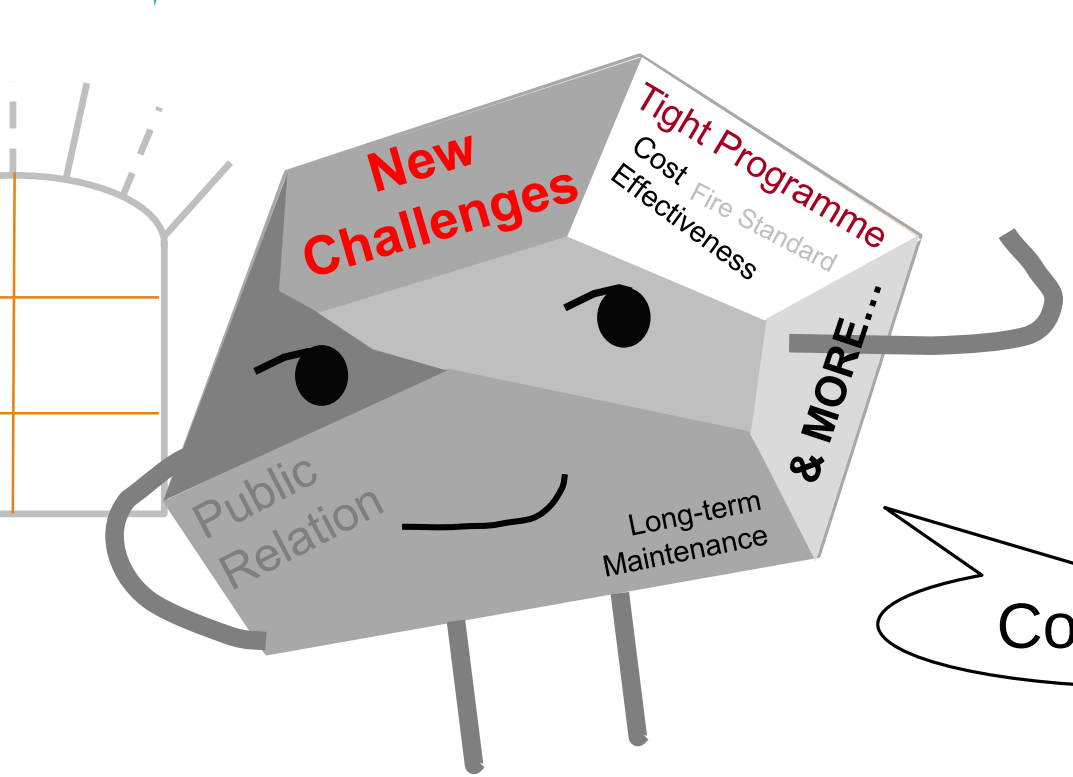
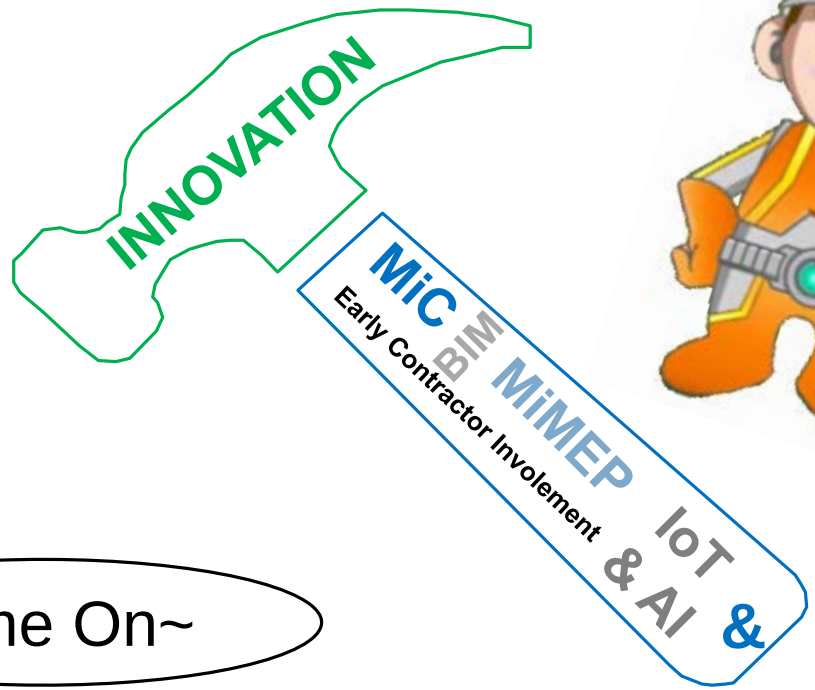
Civil Engineering and Development Department

Conclusion

- New Cavern Development brings New Challenges
- and INNOVATION is the tool to overcome Challenges





Conclusion

More Important ! Your Ideas and Support are NEEDED !

Conclusion

Only with Our Collaborative Effort, Full Potential of Rock Cavern could be unleashed

To create **MORE** Rock Caverns

for **WIDER** applications

and **BETTER** connect to the Community


CEDD
土木工程拓展署
Civil Engineering and
Development Department
End
Thank you for your attention