Planned Development of Rock Caverns in Hong Kong

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Contents

- What has been done in 1990s?
- What has been done in 2000s?
- Where do we go from here?
Cavern Development – Notable Studies

- 1982 Underground Oil Storage Study
- 1988 SPUN
- 1990 Cavern Project
- 1990s Cavern Area Studies (GEO)
- 1991 HKPSG ‘Rock Cavern Development’
- 1992 Geoguide 4 – Cavern Engineering
- 1994 Fire Safety Design
- 2000 HKPSG (Revised)
- 2010 Enhanced Use of Underground Space in Hong Kong
- 2008 Cavern Area Studies (GEO)
A Study of the Potential Use of Underground Space (SPUN), 1988 - 1989

- Oil / LPG storage
- Container freight station
- Tractor & trailer park
- Commercial / GIC
- Warehouse
- Sewage treatment plant
- Refuse transfer station

Locations:
- Tsing Yi
- Quarry Bay
- Mt Davis
- Chai Wan

Map of Guangdong Province, Hong Kong Reclamation Area, and Natural Terrain.
SPUN - Comparison of Capital Costs

- Technically Feasible
- Financially viable
- Environmentally beneficial
## Suitability of Cavern Development (Hong Kong Planning Standard and Guidelines, 1991)

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>Retail</td>
</tr>
<tr>
<td>Entertainment</td>
<td>Ancillary parking</td>
</tr>
<tr>
<td><strong>Industrial</strong></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>Storage/ warehousing</td>
</tr>
<tr>
<td>Oil bulk storage</td>
<td>LPG bulk storage</td>
</tr>
<tr>
<td><strong>Government/ Institution/ Community</strong></td>
<td></td>
</tr>
<tr>
<td>Abattoir</td>
<td>Civic/ Community Centre</td>
</tr>
<tr>
<td>Incinerator</td>
<td>Indoor games/ sports hall</td>
</tr>
<tr>
<td>Market (wholesale and retails)</td>
<td>Refuse transfer facilities</td>
</tr>
<tr>
<td>Sewage/ water treatment</td>
<td>Service reservoir</td>
</tr>
<tr>
<td>Transport connections</td>
<td>Columbarium/ mortuary</td>
</tr>
<tr>
<td><strong>Utilities</strong></td>
<td></td>
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<tr>
<td>Power stations/ sub-stations</td>
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</tr>
</tbody>
</table>
Guide to Fire Safety Design for Caverns
1994

Building Authority
and
Fire Services Department

Design Guides
Rock Caverns in Hong Kong

- Part of Tunnel Networks
  - out of necessity

- Purpose-built Caverns
  - reactive and where over-riding circumstances exist

- Future Caverns
  - as part of Hong Kong’s future planning and development strategy
Cavern Development in Hong Kong

Legend
- 1980s cavern development
- 1990s cavern development
- 2000s cavern development

Island W. transfer station
Western salt water service reservoir (HKU)
Tai Koo MTR station
Sai Wan Ho MTR station
Kau Shat Wan explosives depot
Stanley sewage treatment works

WIL explosives magazine
Relocating Western salt water service reservoirs to release land for HKU Centennial Campus

“The cavern reservoir has utilized the underground space without disturbing the natural vegetation above or causing visual impacts to the neighborhood.”

(Director of Water Supplies, 14 Dec 2009)
Hong Kong Planning Standards and Guidelines (Rock Cavern Development), 2008

- Revised the planning process for cavern development and role of relevant Government departments

- New government projects require assessment of cavern option at initial planning stage while preparing Project Definition Statement for those land uses with the potential for cavern development

No Statutory Authority
✓ Natural setting
✓ Technical guidelines
✓ Institutional arrangements
✓ Proven local experience
✓ Professional resources
‘Policy Agenda’ : ......To launch strategic planning and technical studies......promoting the enhanced use of rock caverns as part of Hong Kong’s pursuit of sustainable development.

a) Review good practice elsewhere and identify opportunities for enhancing Hong Kong’s policy, strategy and procedures

b) Take stock of existing and planned facilities that could be relocated to rock caverns

c) Carry out preliminary feasibility study on three selected rock cavern development schemes

d) Develop cavern suitability map

e) Recommend follow-up actions
Overseas Examples

New Oset Water Treatment Plant
Oslo, Norway

Treats 390,000 m³ potable water daily

Municipal Facilities

Viikinmäki Wastewater Treatment Plant
Helsinki, Finland

Serves 600,000 population
Examples

Recreational Facilities

Helsinki, Finland
- 1,000 visitors capacity
- can convert to an emergency shelter for 3,800 persons

Gjovik, Norway
- 5,500 persons capacity
- Not occupying valuable land
- No impacts on cityscape
- Year-round use

Helsinki, Finland
Examples

Underground Oil & Gas Storage

India
1.6 million m³

Singapore
1.5 million m³

Finland
2.7 million m³
Examples

Singapore – Columbarium (basement)

Finland – Maintenance Depot

Norway – National Archives

Norway – District heating and cooling system

Finland – transportation network hub cum shopping centre

Sweden – Data centre
Examples

Underground Street Retail / Shopping, Japan

Underground Bicycle-Park and Ride at the Suburban Railway Station
Overseas Underground Planning

Helsinki Underground Master Plan (Dec 2009)

Singapore Government will develop an underground masterplan to ensure that underground and above ground spaces are synergised and optimised (Feb 2010)
Singapore Cavern Projects

- **Oil Storage, Jurong**
  - 1.5 Mm$^3$
  - saving 60 ha of land
  - ready by 2014

- **Science City, Kent Ridge**
  - engineering feasibility study commenced in Dec 2009
  - potential floor area >200,000 m$^2$

- **Warehousing and Logistics, Tanjong Kling**
  - preliminary feasibility study commenced in July 2010
  - free up 45 ha of land
Stock-taking of Government Facilities

Legend

18 District Boundary

- Government Facilities (c. 400+)
### Selection Criteria for Preliminary Ranking of Relocating Facilities to Rock Caverns

<table>
<thead>
<tr>
<th>Environmental Consideration</th>
<th>- Environmental benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Consideration</td>
<td>- Facility status</td>
</tr>
<tr>
<td></td>
<td>- Site area</td>
</tr>
<tr>
<td></td>
<td>- Multi-facility opportunities</td>
</tr>
<tr>
<td></td>
<td>- Location requirements</td>
</tr>
<tr>
<td></td>
<td>- Ground condition</td>
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<td>- Past experience</td>
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<tr>
<td>Social Consideration</td>
<td>- Existing location</td>
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Natural Setting for Rock Cavern Development

Hilly areas in urban fringes

- Significant urban growth on limited land area
- Steep terrain limiting future growth
- Strong granitic & volcanic rocks
- Stable underground environment
Cavern Suitability Map

- High to Medium (64%)
- Low to Very Low (30%)
- Not Suitable (6%)
Potential Cavern Areas

- Plan area >20 hectares
- Potential multi-cavern development
- Land uses with community needs
- Transportation link
Sha Tin Potential Cavern Area (2)

- Sha Tin Sewage Treatment Works
- Sha Tin Refuse Transfer Station
- A Kung Kok
- Shek Mun
- THEES Tunnel
- Ex - Nui Po Shan Quarry
- Mui Tsz Lam
Preliminary Feasibility Assessment

Preliminary technical and financial assessments for relocating the following facilities:

- Sha Tin Sewage Treatment Works
- Mount Davis and Kennedy Town Fresh Water Service Reservoirs
Sha Tin Sewage Treatment Works

- Release 28 ha waterfront land
- Reduce impacts to residents
- Enhance land value
- Allow expansion underground

Feasibility subject to detailed studies
**Mt Davis & Kennedy Town Fresh Water Service Reservoirs**

- Release 2 ha of prime land
- Minor impacts to nearby residents as works mainly underground
- Expansion without cutting of hillsides

- Feasibility subject to detailed studies
## Other Potential Land Uses for Cavern Development

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<tr>
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<tbody>
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<td>Food/Wine storage, Warehousing</td>
</tr>
<tr>
<td><strong>Industrial</strong></td>
<td>Industry</td>
<td>Dangerous goods, Data centre, Research laboratories, Science park</td>
</tr>
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<td>Storage/Warehousing</td>
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<td><strong>Public Utilities</strong></td>
<td>Power station</td>
<td>Substation</td>
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Benefits of Planned Development of Rock Caverns

- Release valuable surface land through relocation of suitable existing facilities to rock caverns
- Reduce surface land take by housing new facilities to rock caverns
- Reserve strategic cavern areas for future sustainable development
- Allow future expansion underground
- Re-use excavated materials as rock products
- Intangible benefits: e.g. remove incompatible land uses, provide additional open space – help improve government/community relationships
Constraints on Rock Cavern Development in Hong Kong

Unfavourable regulatory mechanism
- Policy guidelines
- Planning and zoning policies
- Framework for stratal ownership
- Mechanism for valuation
- Project-based benefits may not reflect overall benefits to the community
- Intangible benefits (e.g. public image for govt’t)

Unfavourable financial assessment
- Cost of land formation
- Value of the land
- Value of sterilised land nearby
- Enhancement of land value in the vicinity of NIMBY
- Opportunity cost of the allocated land
- Ease of future expansion
- Intangible cost (e.g. less complaint handling)
Financial Secretary’s 2011-12 Budget Speech

Increasing Land Supply

• …..to explore new ways to increase the supply of land. Two possible ways are reclamation….. and rock cavern development.

• …..allocate about $300 million…..to initiate public discussion….. engineering feasibility, cost-effectiveness and public acceptability…..

• On enhancing the use of rock caverns…..We will consider formulating long-term strategic planning for reserving potential sites for cavern development. We will also explore the feasibility of relocating such government facilities as sewage treatment works and service reservoirs to rock caverns in order to release land for housing and other uses. Further planning and engineering studies will commence in due course.
(i) To release about 60 hectares of industrial land.....
(ii) To explore the option of reclamation.....
(iii) To actively explore the use of rock caverns to reprovision existing public facilities and release such sites for housing and other uses. Tentative projects include the relocation of the Sha Tin Sewage Treatment Works and Mount Davis and Kennedy Town Fresh Water Service Reservoirs
(iv) To look into the use of green belt areas.....
(v) To examine GIC sites to avoid the under-utilisation.....
(vi) To explore the possibility of converting.....agricultural land.....
Follow-up Work

- Public consultation of rock cavern development:
  - commenced in 4\textsuperscript{th} quarter of 2011 (CEDD)

- Signature rock cavern schemes:
  - Sha Tin sewage treatment works (DSD)
  - Mount Davis & Kennedy Town service reservoirs (WSD)

- Study on Long-term strategy for cavern development (CEDD)
Enhancing Land Supply Strategy
Reclamation Outside Victoria Harbour and Rock Cavern Development - Public Engagement Exercise

- Public generally support cavern development
- Capital investment should be weighed against public gains
- Intangible benefits, e.g. environmental improvement
1. Formulate policy guidelines to facilitate cavern development for public and private sectors.

2. Prepare Cavern Master Plans.

3. Formulate a long-term strategy to systematically relocate government facilities.

4. Review technical issues related to cavern development.

5. Consult relevant stakeholders.

(1) Formulate policy guidelines to facilitate cavern development for public & private sectors

Policy directives to facilitate cavern development
Examples of private sector cavern development

- Wine storage
- Data centre
- Warehouse
- Underground shopping street
- Car park
(2) Formulate a long-term strategy to systematically relocate government facilities

Legend

- District Boundary
- Government Facility

Sha Tin Sewage Treatment Works

Tentative cavern site

- Social benefits
- Environmental Improvement
- Land value
- Relocation cost
(3) Prepare Cavern Master Plans

- Reserve potential cavern areas
- Not to be compromised by other developments
- Synergise surface and underground developments
Content of Cavern Master Plans

- Cavern areas for re-housing existing government facilities
- Reserve space for future government facilities
- Protection zone and space for future expansion
- Existing or planned surface and underground facilities or development projects
- Suitable private sector uses
(4) Review Technical issues related to cavern development

- Fire safety design for high-population density facilities
- Strategic environmental assessment
- Update guide to cavern engineering
(5) Consult relevant stakeholders

Long-term Strategy for Cavern Development

Cavern Master Plans

Relocation of government facilities

Private sector involvement
Rock Caverns – as part of Hong Kong’s planning and development strategy

- Sewage Treatment
- Refuse Transfer Station
- Service Reservoir
- Oil & Gas Storage
- Logistics / Data Centre
- Indoor Games / Sports Hall
- Integration with underground quarrying
Thank You