Long-term Strategy for Cavern Development - Feasibility Study
Executive Summary
Land is a scarce resource in Hong Kong and there is a pressing need to increase land supply in sustaining our social and economic development. Cavern development is a viable source of long-term land supply, which can provide solution space for a broad variety of land uses and help address problems encountered in the congested urban environment. The hilly terrain with strong rocks in Hong Kong is highly suitable for developing rock caverns, particularly on the urban fringe (Figure 1).

Civil Engineering and Development Department (CEDD) had carried out studies to explore the opportunities of enhancing rock cavern development in Hong Kong in recent years. Subsequent to those studies, a few pilot projects on relocation of existing Government facilities to caverns have been initiated and now being pursued by respective departments (Figure 2). To follow up the findings of the previous studies, CEDD commenced the “Long-term Strategy for Cavern Development – Feasibility Study” (the Study) in September 2012 to formulate a long-term strategy for cavern development. In brief, the Study has prepared a Cavern Master Plan to delineate Strategic Cavern Areas for cavern development, drawn up a list of suitable Government facilities for relocation to caverns, proposed measures to facilitate cavern development for both public and private sectors, and investigated a number of technical matters relating to rock cavern development.
Benefits and Limitations of Cavern Development

The benefits of cavern development are manifold. Developing rock caverns strategically can bring about planning and development gains, including but not limited to the following:

(i) Release surface sites for other beneficial uses by relocating existing government facilities to rock caverns;
(ii) Remove incompatible land uses by housing unpopular facilities in caverns for minimizing their nuisance to the community whilst increasing the development potential of the released land and its surrounding areas;
(iii) Reduce surface land take by placing new facilities (including suitable new public and private sector facilities) in caverns;
(iv) Reserve developable land for other priority uses [such as open spaces, community/residential uses] by accommodating suitable new facilities in caverns; and
(v) Recycle excavated rocks arising from cavern construction, to be used as aggregates to support the local construction industry.

Some notable overseas examples on various uses of caverns are shown in Figure 3.

Cavern development would however have its limitations. Given that the development of rock caverns usually involves considerable capital investment and relatively long implementation timeframe, the pace and scale of land creation would not be comparable to other land development approaches such as rezoning, reclamation and site formation. The technical issues encountered could be more complicated. Cost-effectiveness may also vary significantly among cases. As such, the use of cavern development alone could not resolve the imminent problem of shortage of developable land.

Cavern Master Plan

The Cavern Master Plan (CMP) [Figure 4] has been prepared under the Study with the aim of providing a broad strategic planning framework to guide and facilitate territory-wide cavern development, and to promulgate essential information for project proponents to identify suitable cavern sites for their development projects.

The CMP delineates forty-eight (48) Strategic Cavern Areas (SCVAs) in the territory that are well placed for developing rock caverns to meet the existing or future needs of the adjoining districts. An SCVA is defined as an area that is easy to access and can accommodate multiple facilities in rock caverns to meet the need of development. The area should be sufficiently large and located at the urban fringe with supporting infrastructure network. The sizes of individual SCVAs range from approximately 30 to 200 hectares. The area of an SCVA does not represent the actual developable cavern space because provisions have to be made for features like buffer zones between individual facilities, intervening rock pillars for support and adits for portal access and inter-connection.

The CMP is accompanied by an Explanatory Statement and a set of Information Notes. The Explanatory Statement is intended to provide the key information on the CMP. The Information Note is to describe the characteristics, development potential, constraints, potential land uses and the extent of potential portal locations of the SCVA. A reference drawing is appended to each Information Note to illustrate the spatial context of the information provided. The complete set of CMP is available in the websites of the CEDD (http://www.cedd.gov.hk/eng/cavern/index.html) and Planning Department (http://www.pland.gov.hk/pland_en/info_serv/cmp/index.html).

Figure 5 illustrates the possibilities within an SCVA.
Legend
- Strategic Cavern Area
- Existing Cavern Facility
- Cavern under Investigation / Planning

Figure 4 - Cavern Master Plan

Strategic Cavern Area (SCVA)

Sewage Treatment Works
Warehouse / Logistics Centres
Archives / Sell / Wine Storage Facilities
Data Centres
Columbarium

Figure 5 - Possibilities within an SCVA
The proposed measures to facilitate cavern development are summarised as follows:

(i) Promulgating cavern development information through the promulgation of the CMP and other relevant Government guidelines and circulars;

(ii) Proactively considering cavern option when proposing new refuse transfer station, sewage treatment works and service reservoir, and carrying out cavern option assessment;

(iii) Rezoning land for cavern development by launching planning and engineering (P&E) studies of suitable cavern areas to rezone land for land uses with identified needs or strong private sector interest, to reduce project lead-time;

(iv) Integrating cavern development in area-based P&E studies to capitalise strategic benefits and synergy effect of integrating cavern development with surface development where there are suitable SCVAs nearby; and

(v) Developing cavern by means of underground quarrying to bring about benefit in enhancing the long-term land supply by creating a cavern land bank.

Various technical matters for cavern development have been investigated under the Study. The following are the major tasks that have been carried out:

(i) Updating Geoguide 4: Guide to Cavern Engineering;

(ii) Revising the list of land uses with the potential for development in rock caverns in the Hong Kong Planning Standards & Guidelines;

(iii) Conducting Strategic Environmental Assessment on cavern development; and

(iv) Developing conceptual fire safety schemes for cavern developments.
Recommendation and Way Forward

The Study has prepared the CMP to provide a strategic planning framework to guide and facilitate territory-wide cavern development in Hong Kong. The CMP should be referenced to alongside the Hong Kong Planning Standards & Guidelines in the course of planning and engineering studies, preparation/revision of town plans and development control for surface, subsurface and cavern developments in the territory.

The Study has broadly reviewed a list of suitable Government facilities with potential for relocation to caverns. The Government should further formulate a priority list for launching feasibility studies on relocation of suitable facilities, taking into account various factors including resource implications, relocation programme and any earmarked schedule for releasing the land.

Various measures have been proposed under the Study to facilitate cavern development for both public and private sectors. The Government should follow up and develop guidelines to implement the measures and promulgate the requirements through relevant technical circulars. The Government is also recommended to launch further studies to rezone suitable areas for cavern development and explore the technical feasibility and financial viability of underground quarrying-cum-cavern development in Hong Kong.

The Government should continue the current effort and seek further opportunities to enhance the promulgation of the use of cavern development as an innovative option to increase the long-term land supply of Hong Kong.

Epilogue

The CMP has gained international recognition and was awarded by the International Tunnelling and Underground Space Association (ITA) as the winner of the Innovative Underground Space Concept of the Year in the ITA Tunnelling Awards 2017 on 15 November 2017. The details of this award are available in https://awards.ita-aites.org/.

The CMP was also awarded of a Certificate of Merit by the Hong Kong Institute of Planners in 2016 given its merit in unlocking the hidden land resources in Hong Kong. The details of this award are available in http://www.hkip.org.hk/Editorfile/files/ipipawards.pdf.

Enquiry

For enquiry, please contact the Geotechnical Engineering Office of the Civil Engineering and Development Department:

Planning Division
Geotechnical Engineering Office
Civil Engineering and Development Department
11/F, Civil Engineering and Development Building
101 Princess Margaret Road
Homantin, Kowloon
Hong Kong

Or by e-mail: cavern@cedd.gov.hk

Related Information

1. Long-term Strategy for Cavern Development Website
www.cavern.gov.hk/home.htm

2. Cavern Master Plan