ABSTRACT

Underground caverns can be found all over the world, in different geological formations, and in countries with different stages of economic and technical development. These rock caverns and tunnels are very durable and are built to last for more than a lifetime. For instance in Japan, a large area of underground space especially around the urbanized area had been used within the past few decades.

This dissertation provides at first an overview of the main geological formation in Singapore. The geological and geotechnical properties of each of the geological material are described and discussed. It then discusses the feasibility of popularizing underground space development in a large scale with respect to the essential engineering properties especially from the three aspects of geological information, technology, and cost.

Breakthrough in technological advancement increases the speed of excavation and shortened the time needed to construct underground caverns. However the high capital investment of tunnel boring machines (TBMs) had deterred many users. The results from the interviews nevertheless revealed that these TBMs helped companies achieve economies of scale, and improve the company’s balance sheet.

Underground construction is often associated with high initial cost. This research document is targeted at uncovering the cost aspects of underground cavern development through comparing similar projects from other countries. Statistics had shown that land value contributes significantly to the cost and thus makes underground cavern facilities
more attractive. The benefits of using underground caverns in Singapore were also touched.

This dissertation attempts to discover the potential of popularizing underground space utilization in Singapore and determine that the key factors for its feasibility lies on three aspects; namely, the geological conditions, technology and development costs, thus proving the hypothesis.

From the findings, the size, shape, and depth of the proposed underground structures are some factors that will also affect the potential of popularizing underground space utilization. These are the micro factors that will influence the design phase after deciding to proceed with developing the structure underground, and thus will not affect the potential of popularizing underground space utilization. As yet to be tested, the reactions of finance and insurance companies may delay acceptance of underground space building unless education procedures are expedited.

This dissertation should be useful and informative for those who are intending to make a shift from developing aboveground to underground.

Key Words:
Underground space utilization
Geotechnical features
Technology
Development costs