Underground Cemetery in Tunnels

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Urban Problems – Underground Solutions

1 >> Introduction

For centuries, mankind has used underground space. The International Tunnelling and Underground Space Association (ITA) was created in 1974 with a mission to encourage the use of the subsurface for the benefit of the public, environment and sustainable development, and to promote advances in the planning, design, construction, maintenance and safety of tunnels and underground space. Working groups within ITA provide special studies and publications to address the use and construction of underground space. Working Group No. 30 was formed to provide an overview of the typical challenges of urban city planning and the solutions which are offered by the use of underground space. In this report we provide an overview of typical urban issues and an appendix of examples where the use of the underground and modern technology has been taken advantage of to provide overall benefits to the urban environment.

Given increasing population growth world-wide, and continued aging of existing infrastructure, this publication elaborates on previous ITA work such as “Why Go Underground?” (ITA, Godard, 2002), and provides new project examples to illustrate both traditional and creative uses of the underground to assist with beneficial urban space planning and preserving surface land for future use.

To understand why we use underground space, one must analyze the use of underground space versus the surface area above. The underground may provide a setting that is difficult to build in, environmentally undesirable, and more costly to construct than surface facilities. On the other hand, it may offer better natural protection against environmental elements, including destructive weather, noise, and seismic events. At the same time, the space created for underground structures has the advantages of allowing use of the surface for other functions.

Over time, the uses for underground structures have developed from primarily shelter to space for infrastructure and a wide range of functional facilities. The uses may be categorized into several primary uses: infrastructure for transit and utilities, storage, and protection of the environment. Increasingly, the public, especially in larger cities, demand a higher quality environment with respect to:

- Reliable and safe transport of people and goods,
- Water distribution and sewage systems,
- Sustainability of the environment and containing it from pollution,
- More green spaces and recreational areas,
- Reduced use of fuel, and fuel emissions,
- Noise control,
- Aesthetics,
- Efficient use of real-estate.

All of these demands call for continuous improvement of sustainable and resource efficient urban planning and development, and is and can be facilitated by the use of underground structures.

Advanced underground construction technologies can provide solutions for reducing congestion and other environmental problems while contributing to energy efficiency. However one of the greater aims of underground use in an urban environment may be to free surface space for other human needs and to improve the living conditions of cities.

This paper is divided into three sections to present beneficial uses of the underground.

- The first section reviews typical urban problems for which use of underground space may offer a better alternative than use of the surface. Subject areas include architectural quality, safety and security, traffic congestion, noise, air quality, water distribution, flood control, and synergy effects.
- The second section describes typical solutions the underground can offer such as subway systems, road tunnels, underground manufacturing space, water and sewerage transport systems and storm water relief systems.
- The final section illustrates the
“Lifeless Islands”

Rio De Janeiro

Hong Kong

Tokyo

Paris

New York

Prague
Current Solutions

Santos

Barcelona

Modena

Iraq

Jerusalem
Burial in caves and tunnels

- Italy
- Egypt
- Israel
- Ukraine
- Malta
Underground cemetery – Jerusalem

Cemetery “Har Hamenuhot”
Old City
Mount Olives
The Jerusalem underground cemetery - Architecture

22,000 tombs

Typical cross sections based on quality of Rock
The Jerusalem underground cemetery - Architecture

Typical cross section

3,000 tombs
The Jerusalem underground cemetery - Illustration

Types of Burial

Shaft Entrance

Museum
The Jerusalem Project – Shaft
The Jerusalem Project – Tunnels & Caverns
The Jerusalem Project – Tunnels & Caverns
The Jerusalem Project – Tunnels & Caverns
Why go underground?

Environmental aspects
- Land use/location – Close to the city
- Natural – Preserving the landscape
- Topographic – Usage of mountains

Social aspects
- Religion – Rites and customs
- History – Retrieving ancient tradition
- Social – Reusing cemeteries

Economical aspects
- Cost – Similar to buildings
- Maintenance – Preserving the tombs
- Size - Suitable for cremation as well
- Future – Eliminating “lifeless island”

Reviving Burial in Tunnels
Can be the solution for many urban communities
Tunnel Business Relevance

3 >> Decision Making Process

3.3 Aesthetics

The visual and aesthetic impact is often the major quoted reason for deciding to relocate infrastructure to the underground. Compared to above ground solutions, like elevated structures, an underground structure would not impact on the visual image and character of the environment. This may be important to hide unattractive technical facilities in sensitive locations or when industrial facilities must be sited adjacent to residential areas. This might also be important for the preservation of natural landscapes. The increasing requirement for all utility services to be placed underground stems essentially from visual impact considerations and concerns about protection against the elements. Underground solutions can also fulfill architectural requirements as shown in Figure 61. The Cansaya Wheat Station.

is a good example how underground structures and architectural features can meet. With proper design an underground solution can be an aesthetic highlight in itself.

3.4 Ecological and Environmental Aspects

Underground space utilization can help solve environmental and resource dilemmas in several ways. Underground facilities are typically energy efficient in their own right. The natural insulation provided by the soil regulates the temperature within the construction and thereby reduces the need for heating or cooling, lowering the energy consumption when compared to surface constructions. Over time the higher cost of construction may be compensated for by savings in power and the alternative use of the surface.

More importantly, by using underground space, higher urban densities can be supported with less impact on the local environment. In addition to the obvious benefit of preserving green space and agricultural land, higher urban density can lower fuel resource consumption by containing sprawl. Underground development will be an important tool in reshaping our urban areas to meet the challenges of the future without destroying the heritage or scarring the surface environment. (Erskine, 2009)

During the construction phase, however, underground construction can have an influence on the environment, including effects on soil, water, air, climate, fauna, flora and their living space, cultural assets as well as on human beings. In the decision making process, the stakeholders need information on the environmental consequences of their decisions. It is therefore necessary to assess environmental effects of underground structures in the decision making process and observe them during the construction and operation phases.

Some of the environmental impacts of underground structures are:

- Air pollution due to construction equipment
- Effects on the groundwater levels
- Pollution and treatment of groundwater
- Excavation of polluted material
- Waste water originating from the construction
- Pollution of surface water
- Use and displacement of (natural) resources

Of these effects, only air pollution and effects on the groundwater are discussed in detail, as these are of ongoing importance. The other effects are mostly limited to the construction phase and differ little for above-ground or underground construction techniques. A brief discussion of cut-and-cover methods is mentioned further below as this method may be particularly disruptive.
Stakeholders

Entrepreneur & Contractor – Rolzur Tunneling LP
Client – Chevra Kadisha Kehilat Jerusalem Burial Society
Design Coordinator – Projects Planning & Mng.
Prime Architect – Peleg Architects
Tunnel Design – A. Rozen Eng.
Structural Design – Danny Inbar Structural Eng.
Fire Protection Design – JFPE Consultants
Electricity Design – Ramor Consulting Eng.
Elevator Design – V.I.S Eng.
Geology – M. Levin G.G.S

Thank You