Hidden Aspects of Urban Planning: Utilisation of Underground Space

An Overview

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Background

EU COST Programme – Co-Operation in Science and Technology to stimulate European integration and strengthen European competitiveness

COST C7 : Soil –Structure Interaction in Urban Civil Engineering (66 experts from 17 European countries, 1997 – 2002)

Working Group D – Geotechnical & GeoEnvironmental Issues in Urban Planning

Consultations and collaboration with the Royal Town Planning Institute, UK

Urban Areas – Current Demands

- More housing
- Development of marginal land
- Improved infrastructure
- More efficient public transport
- More construction materials
- Greater energy supply & energy conservation
- Improved waste management
- Protection of greenbelt areas

Benefits of Underground Space

- More efficient land use and improvement of the surface environment
- Aesthetics: removal of unattractive structures
- Sustainable development: removing the need for cladding (typically 15% of a building's cost)
- Conservation and storage of energy
- Protection of people against extremes of weather

The Louvre, Paris

The Louvre, Paris

The Louvre, Paris

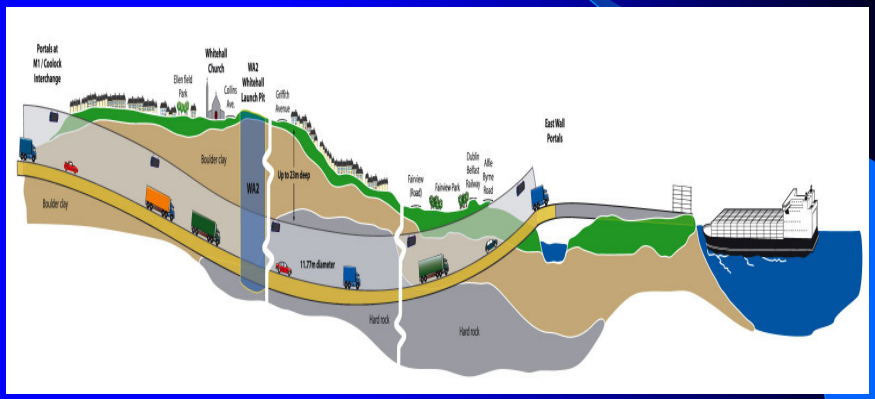
Transportation Infrastructure

- Road & Metro Tunnels
  - Dublin Port Tunnel, Ireland
  - 'Big Dig' Boston, USA
  - Jubilee Line Extension, UK
  - Copenhagen Metro, Denmark

Dublin Port Tunnel

- 1.9 km's of Cut and Cover Tunnel
- 2.6 km's of Bored Tunnel
- Motorway: 5.6 km
- New access to Dublin Port

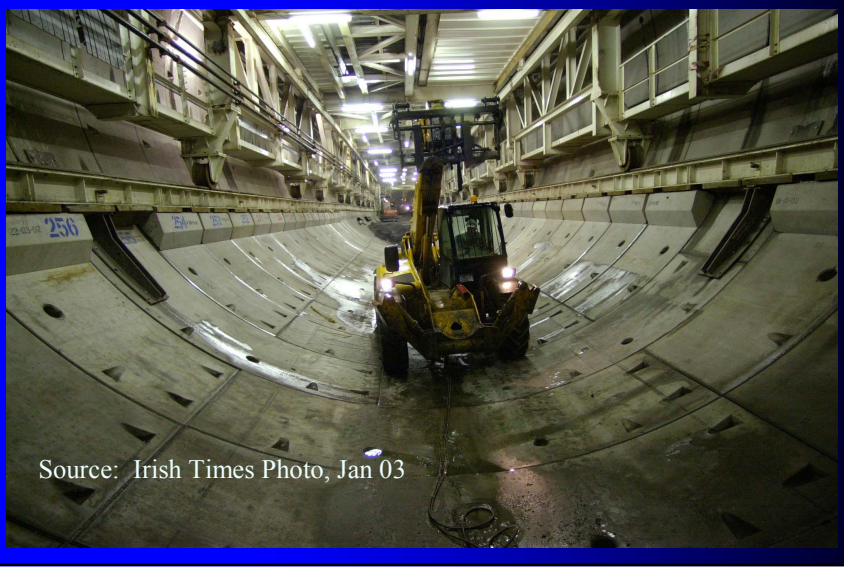
Dublin Port Tunnel Project



Dublin Port Tunnel Project
Cut & Cover Tunnel: East Wall Rd

Dublin Port Tunnel: Tunnel Boring Machine (TBM2 – 'Meghan')

Dublin Port Tunnel – Bored Tunnel: Under Griffith Ave.



Source: Irish Times Photo, Jan 03

'Big Dig' – Boston, USA

- Six lanes of elevated highway, carrying 190,000 vehicles per day
- Congestion costs estimated at US$500 million per year
- Accident rates 4 times the average
- New scheme will place highway underground, create up more than 150 acres of new parks, and reduce CO levels by 12%
- Estimated cost of US$ 12 billion

Boston – ‘Big Dig’ : Before

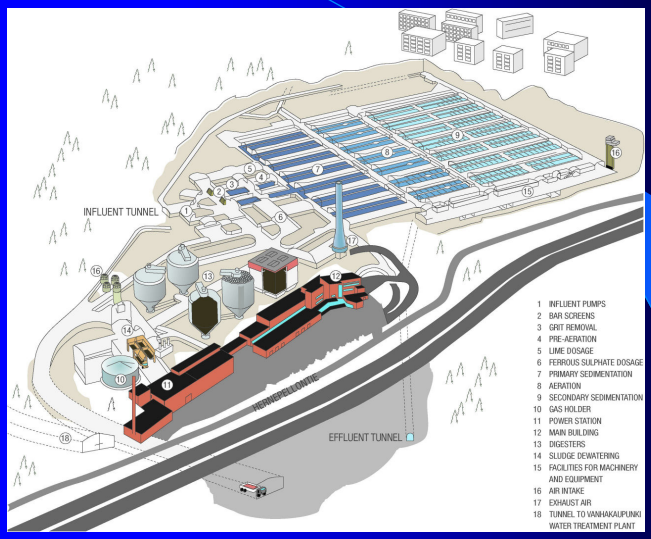
Boston – ‘Big Dig’: After

Underground Cities - Montreal

'City under the City' – commenced in the 1960's: protection from extreme climate.

- The world's largest underground city
- 31km passageways
- 10 metro stations, railway station, bus terminal
- 1600 shops
- 200 restaurants
- 40 banks
- 30 cinemas

Viikinmaki Wastewater Treatment Plant, Helsinki



Sustainable Development of Underground Space

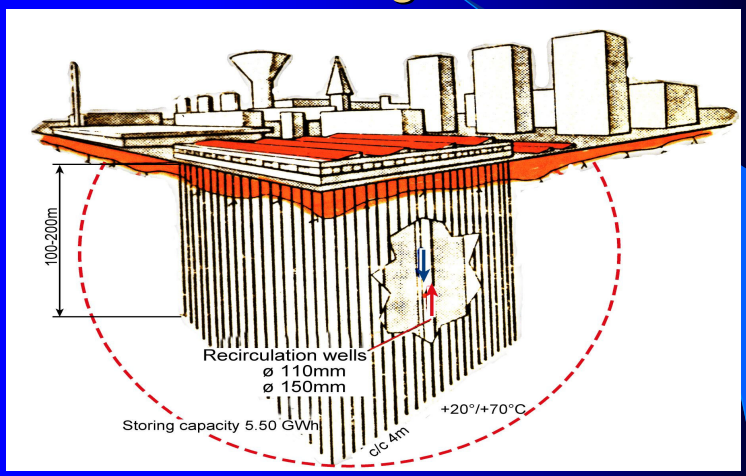
- Many cities suffer from an historic uncoordinated underground proliferation in underground development, ranging from buried utilities and infrastructure tunnels to building foundations and basements
- Requirement for development policy and plans for underground space in the same manner as surface development

Helsinki – Development Plan for Underground Space

Underground Thermal Energy Storage (UTES)

- Sustainable development – require more efficient systems for the storage of energy
- UTES allows renewable energy (e.g. solar) to be stored, reducing wastage and distribution demands
- Most common UTES systems use aquifers, man-made underground caverns, and underground ducts
- Development of UTES in Europe since 1990's especially for heating and cooling systems (use of heat pumps and cooling plant)

Underground Thermal Energy Storage



Scandinavian Airlines HQ, Stockholm

- Building has a floor area of 64,000m2
- Uses an underground aquifer to store thermal energy
- During Summer building is cooled
- During Winter building is heated
- Uses five wells with heat exchangers
- 65% energy saving (€55,000 per year)

Reuse of Existing Foundations

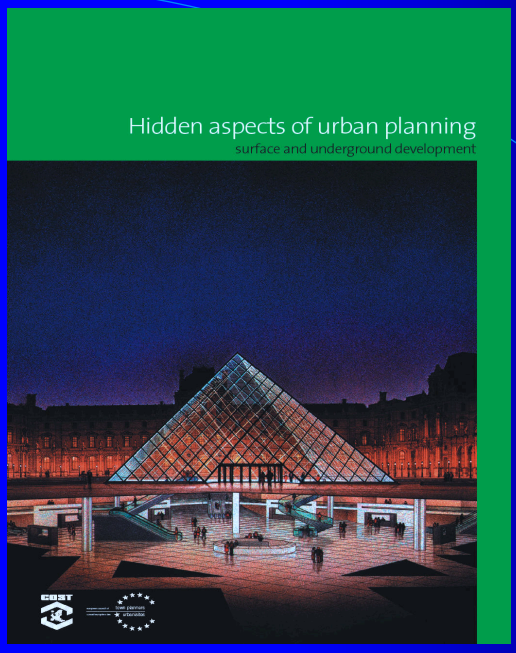
- As cities undergo several generations of development, the foundations systems remaining in the ground progressively reduce the underground space available for new foundations or basements
- Recent trend is to reuse existing foundations with significant cost benefits
- Preservation of archaeological features in the ground.

Future Directions

- Utilisation of underground space in Ireland's cities has increased significantly over the past 10 years, and will continue on a larger scale.
- As part of our approach to sustainable development planning authorities should implement policy objectives and planning guidelines to encourage utilisation of underground space in urban areas.
- There is a requirement to co-ordinate use of underground space by utility companies in order to avoid sterilisation for future development

Future Directions contd.

- Future development of underground space requires multi-disciplinary approach from urban planners, developers, architects, engineers and geologists.
- There is a requirement for geological and geotechnical information for urban areas to be collated, managed and made available to planners and developers in a format that addresses key development issues.



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Further Information:

Hidden Aspects of Urban Planning: Surface & U/G Development

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