Underground Structures: The Sensible Solution to Urban Problems

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Underground Construction: The Sensible Solution to Urban Problems

- Introduction
- Underground Solutions to Urban Problems
- Sensibilities of Underground Structures
- Final Remarks
World Urbanization

→ Need for Infrastructure

→ Mobility and Storage
Environmental Era: Quality of Life

- Better living conditions
- Minimum environmental impacts
  - Use of the surface for more noble needs
  - Use of the underground space for infrastructure
Underground Structures: Infrastructure Combining Productivity and Quality of Life
Underground Solutions to Urban Problems

Demand of Underground Structures

- Transport
  - Mass Transit Systems
  - Urban Motorways (city rings)
  - Railway Links
- Public Utilities (water supply, sewage and cables)
- City Center Revitalization
- Storage (car parking, flood control, goods)
<table>
<thead>
<tr>
<th>Tunnels for Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>250</td>
</tr>
<tr>
<td>Switzerland</td>
<td>100</td>
</tr>
<tr>
<td>Germany</td>
<td>450</td>
</tr>
<tr>
<td>France</td>
<td>150</td>
</tr>
<tr>
<td>UK</td>
<td>250</td>
</tr>
<tr>
<td>Italy</td>
<td>200</td>
</tr>
<tr>
<td>Norway + Sweden + Finland</td>
<td>500</td>
</tr>
<tr>
<td>Spain + Portugal</td>
<td>500</td>
</tr>
<tr>
<td>Netherlands</td>
<td>100</td>
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<tr>
<td>Japan (annual average)</td>
<td>300 - 500</td>
</tr>
<tr>
<td>China (next 20 years)</td>
<td>20000</td>
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</tbody>
</table>
City Centre Revitalization
## Sensibilities of Underground Structures

### Costs

<table>
<thead>
<tr>
<th>Construction Method</th>
<th>Cost Relation</th>
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<tbody>
<tr>
<td>Surface*</td>
<td>1.0</td>
</tr>
<tr>
<td>Elevated*</td>
<td>1.5</td>
</tr>
<tr>
<td>Cut-and-cover*</td>
<td>2.0</td>
</tr>
<tr>
<td>Underground</td>
<td>3.0</td>
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</tbody>
</table>

### Safety

- Costs
- Safety
Sensibilities During Construction: 
Most Are Related to Geology

- Cost Difficulties (Estimation of support needs)
- Work Schedule
- Safety (Accidents)
Underground Structures: Favorable Factors

- Improvements of tunnel engineering
- High costs of the surface space (*)
- Difficulties, impacts and disturbances of surface works
- Devaluation of regions surrounding surface infra-structure
- Social benefits
Tunneling Engineering and Technology
Disturbances During Construction
Surface Construction Costs and Neighborhood Devaluation
Social Benefits of Urban Underground Infrastructure

- **Time Savings**
  - Time is money
- **Energy Savings**
  - Less Environmental Impacts
- **Lower Long-Term Maintenance Costs**
- **Reliability** (safety, comfort and time table)
- **Priority of the Surface Space Use for more Noble Purposes**
Global Cost Assessment

- **Construction versus Global cost analyses**
  - Social benefits
  - Urban reorganization, revitalization and revaluation of surroundings

- **Need of a feasibility model → Best cost-benefit investment**
Sensibilities During Operation: Fires

DATA
Road tunnel fires 25
Railway tunnel fires 10
Total 35

Road
Railway
Total

Safety and Security During Operation
Final Remarks on Urban Underground Infrastructure

- Increasing demand
- Feasibility depends on global cost analyses
- Construction methods and technology vary depending on geology, tunnel location, length and geometry, local tradition etc.
- Tunnel engineering and technology allow construction in any kind of environment
- Safety and security concerns during operation
Acknowledgements: