Underground Structures: The Sensible Solution to Urban Problems

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Underground Construction: The Sensible Solution to Urban Problems

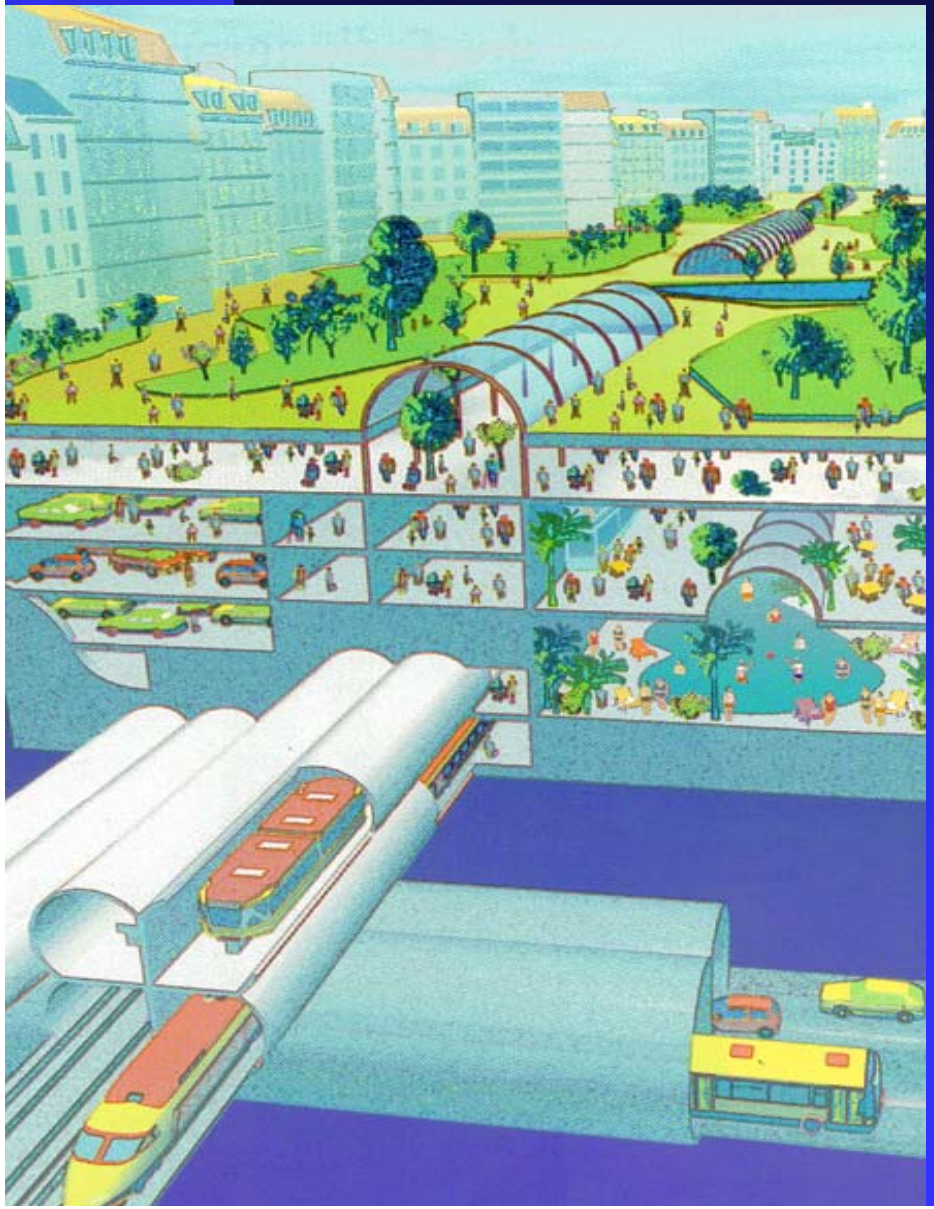
- Introduction
- Underground Solutions to Urban Problems
- Sensibilities of Underground Structures
- Final Remarks

World Urbanization

→Need for Infrastructure

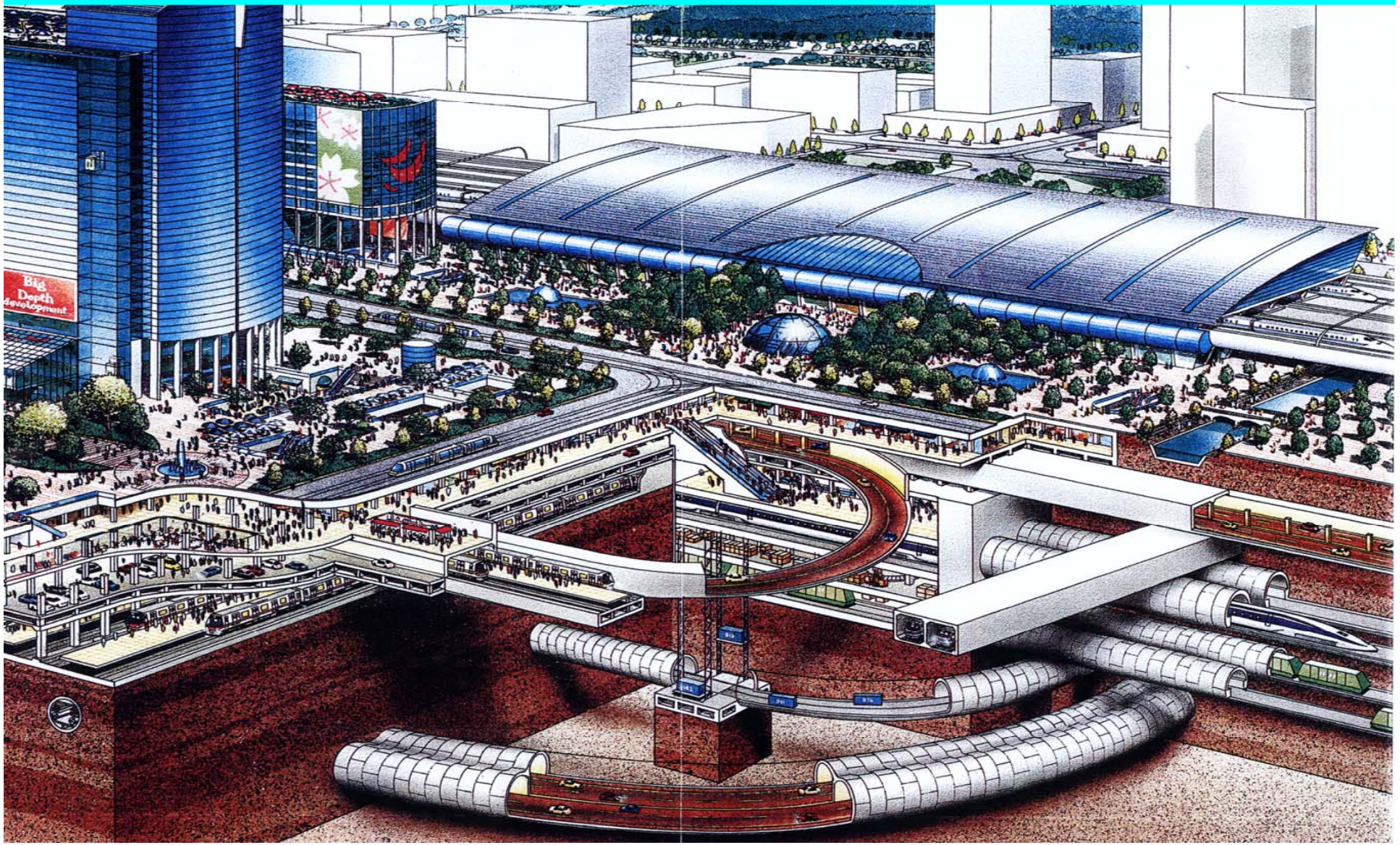
→ Mobility and Storage

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



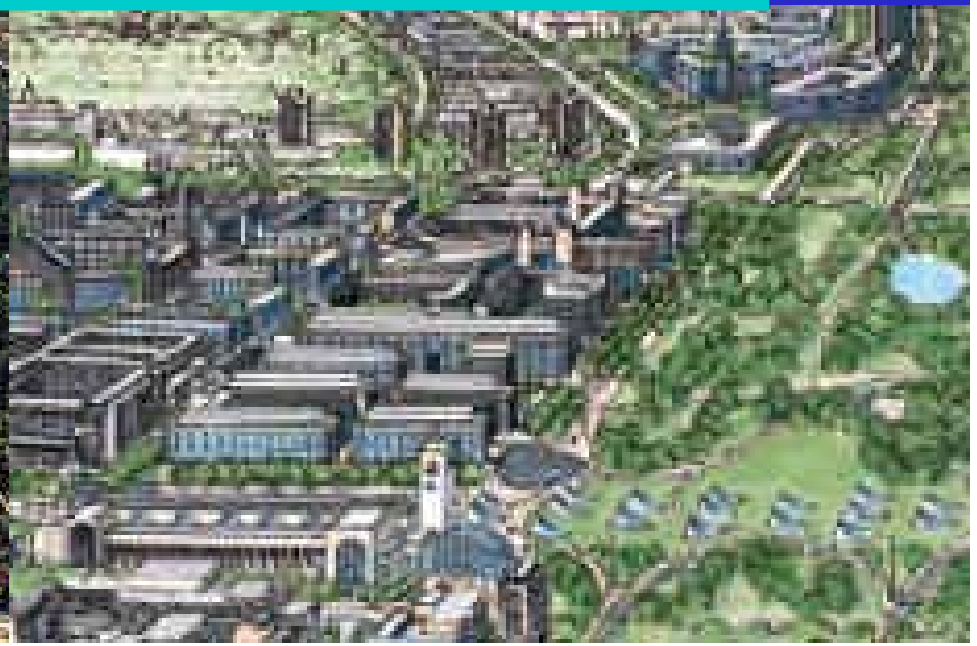
Underground Solutions to Urban Problems

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)

Tunnels for Transport	Total
Austria	250
Switzerland	100
Germany	450
France	150
UK	250
Italy	200
Norway + Sweden + Finland	500
Spain + Portugal	500
Netherlands	100
Japan (annual average)	300 - 500
China (next 20 years)	20000

City Centre Revitalization



Sensibilities of Underground Structures

Costs

Construction Method	Cost Relation
Surface*	1.0
Elevated*	1.5
Cut-and-cover*	2.0
Underground	3.0

Safety

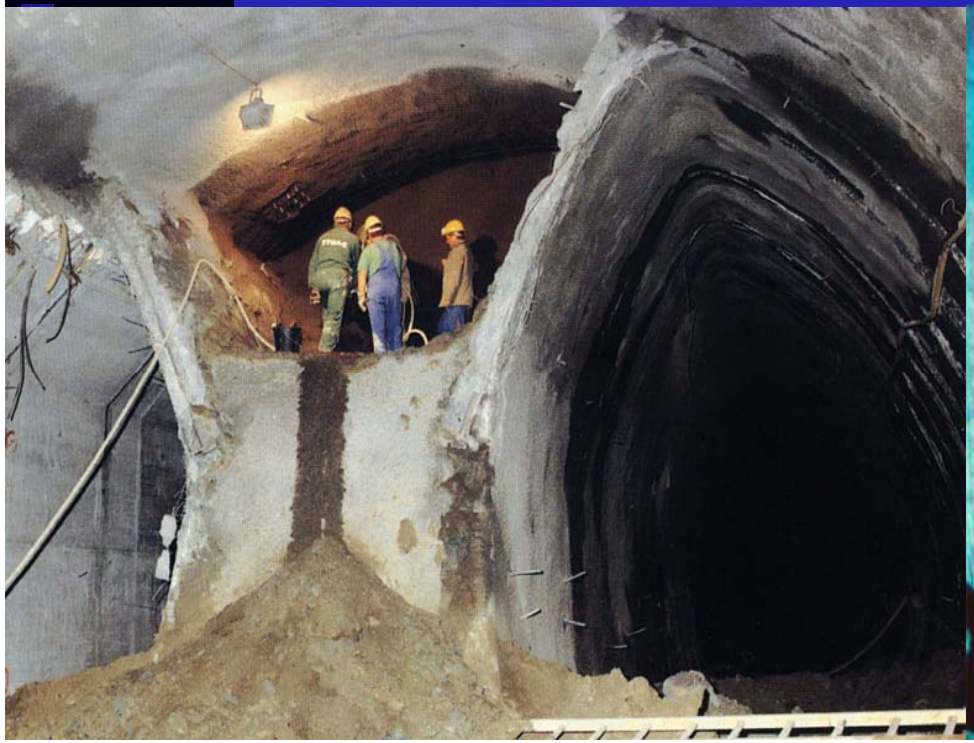
Sensibilities During Construction: → Most Are Related to Geology

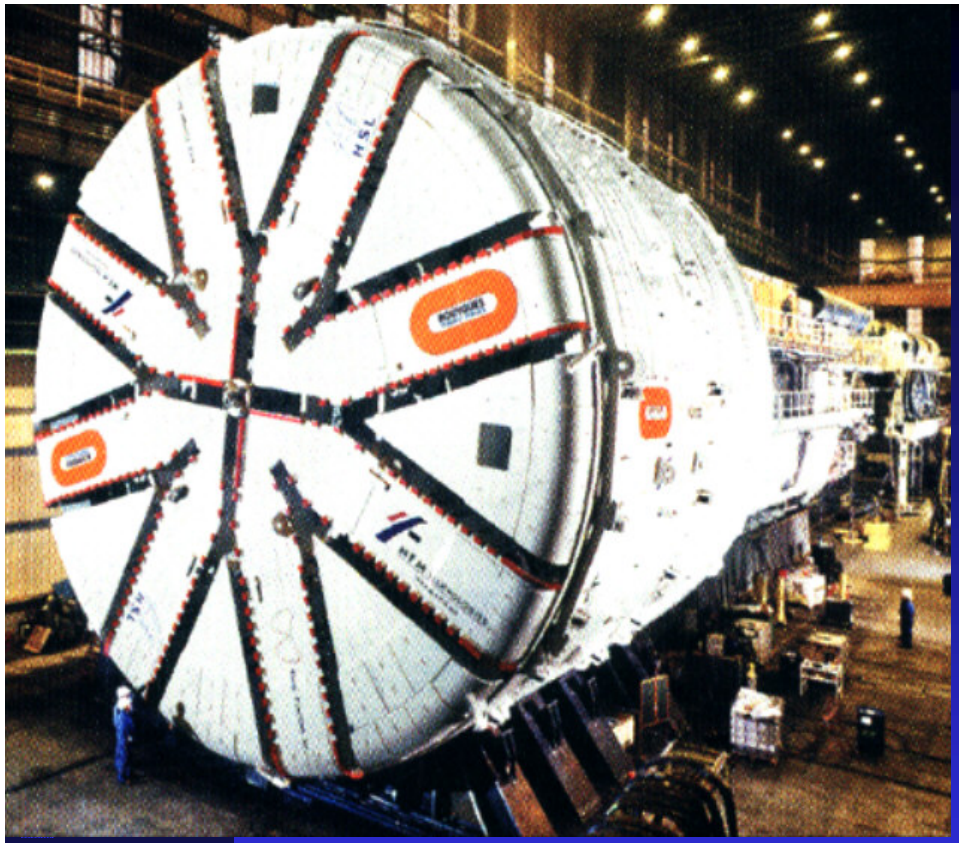
- Cost Difficulties (Estimation of support needs)
- Work Schedule
- Safety (Accidents)

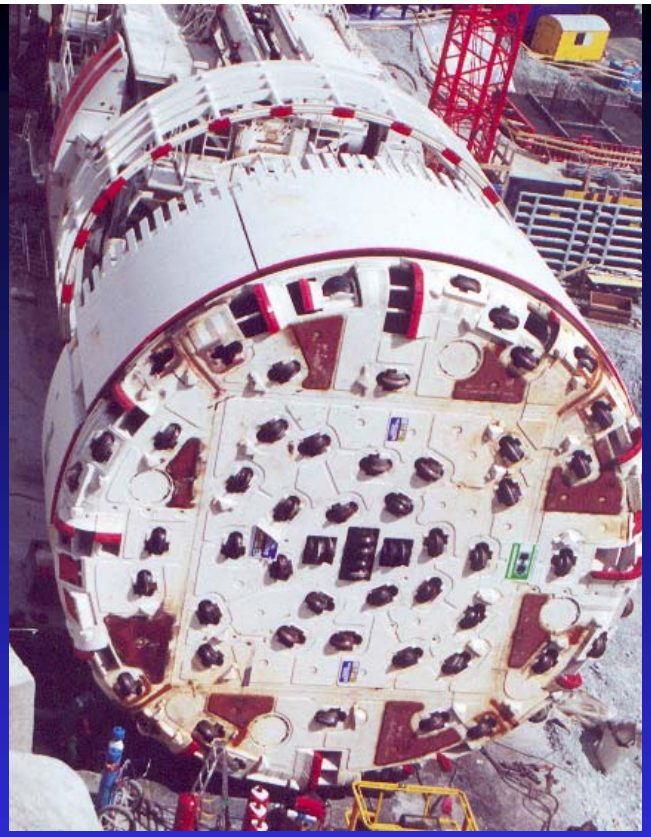
Underground Structures: Favorable Factors

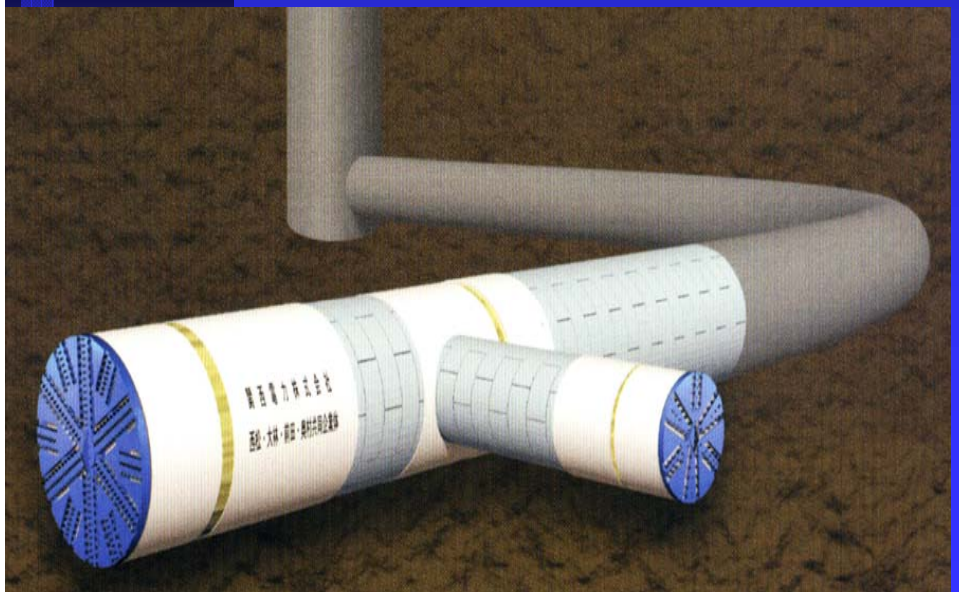
- Improvements of tunnel engineering
- High costs of the surface space (*)
- Difficulties, impacts and disturbances of surface works
- Devaluation of regions surrounding surface infra-structure
- Social benefits

Tunneling Engineering and Technology

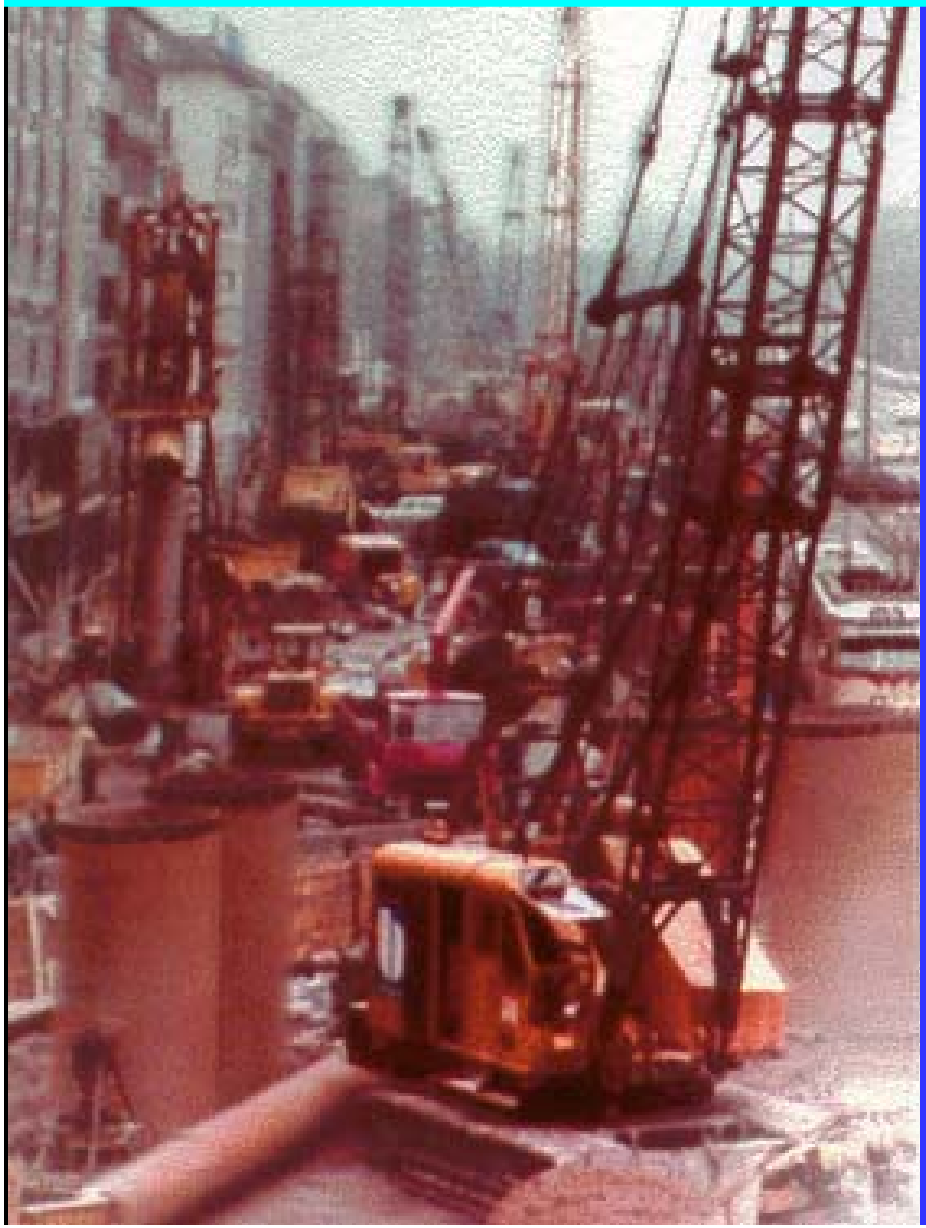


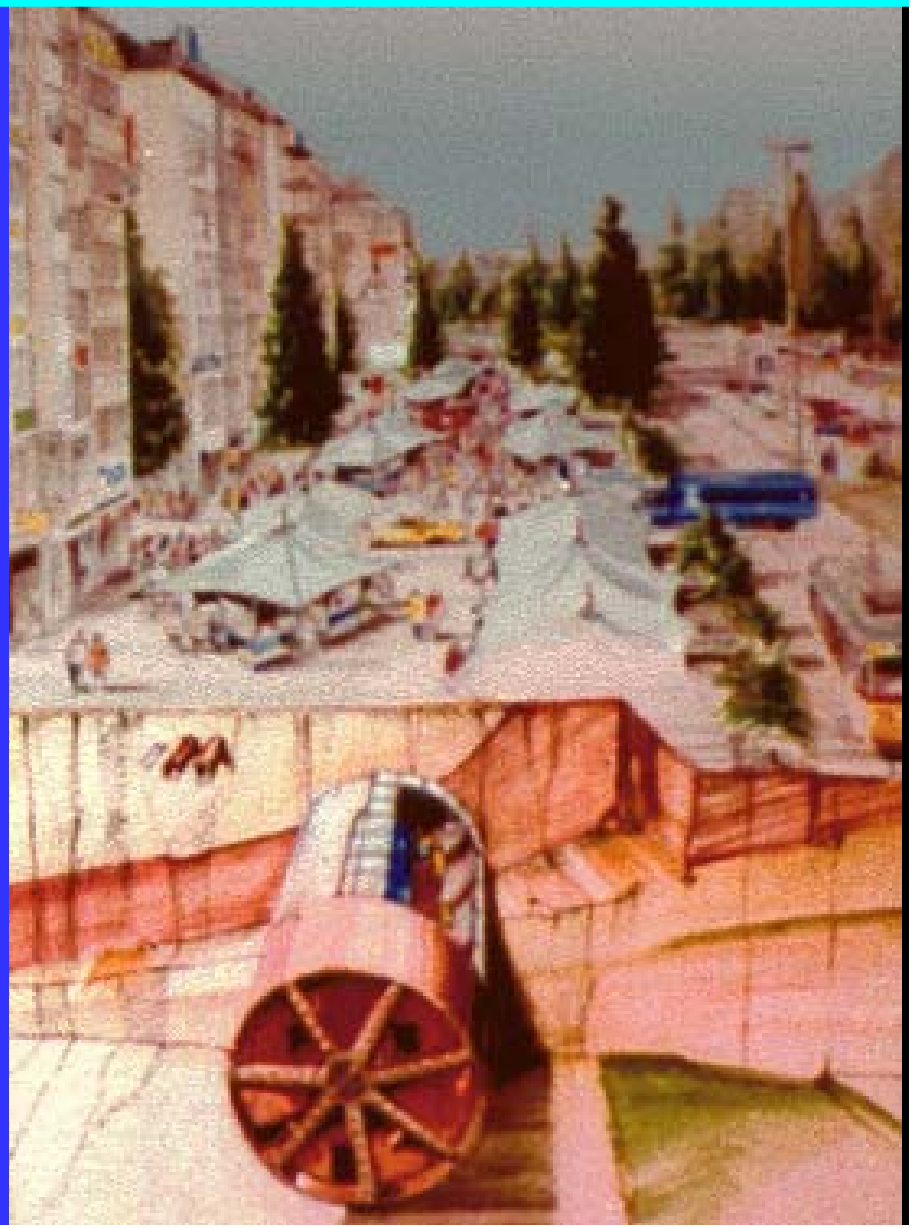




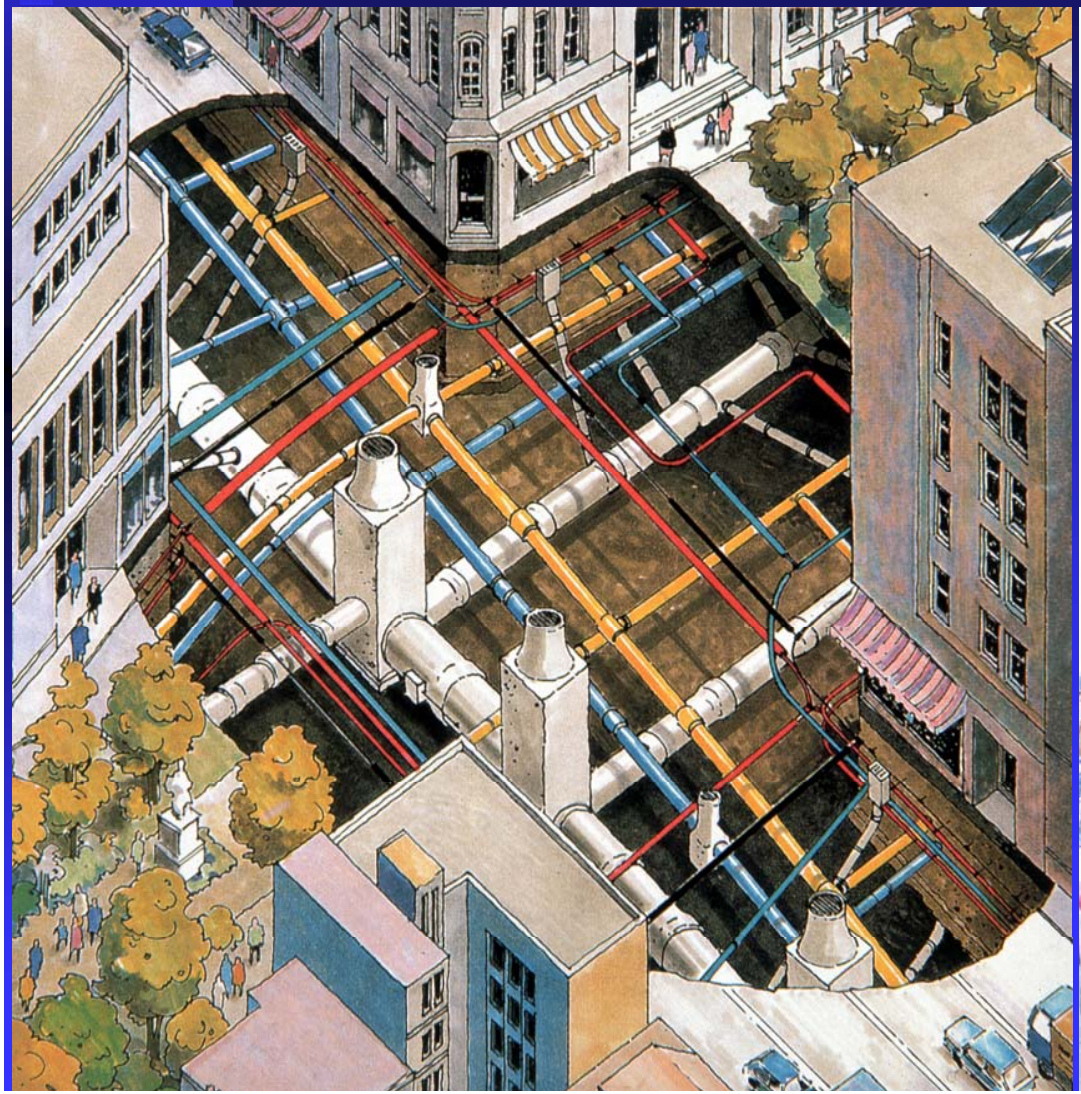


Disturbances During Construction

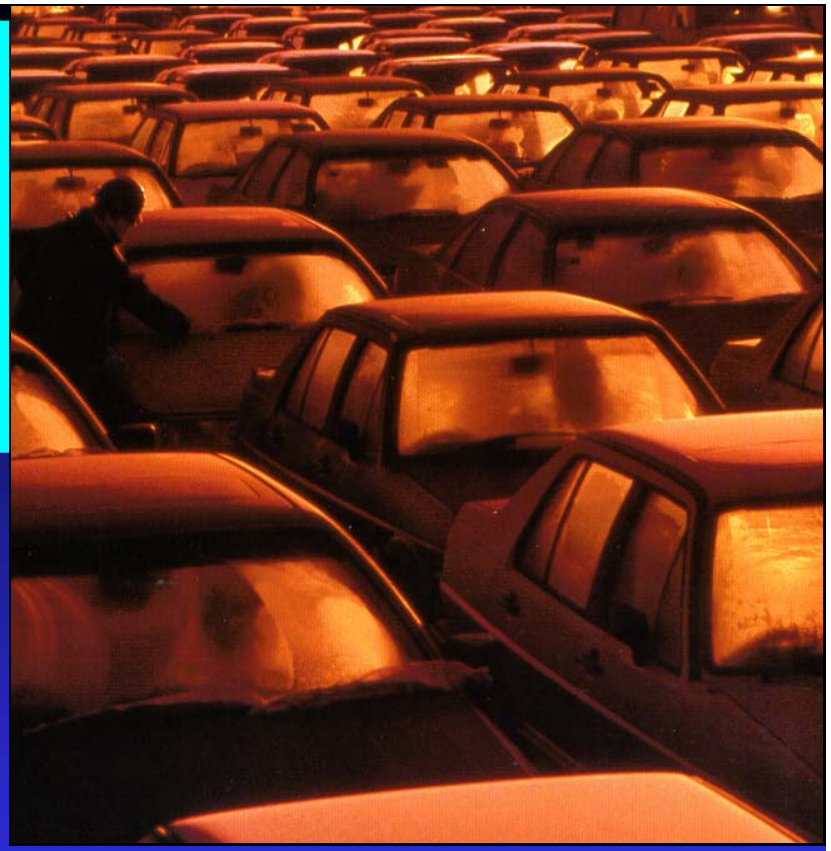




Surface Construction Costs and Neighborhood Devaluation



Social Benefits of Urban Underground Infrastructure



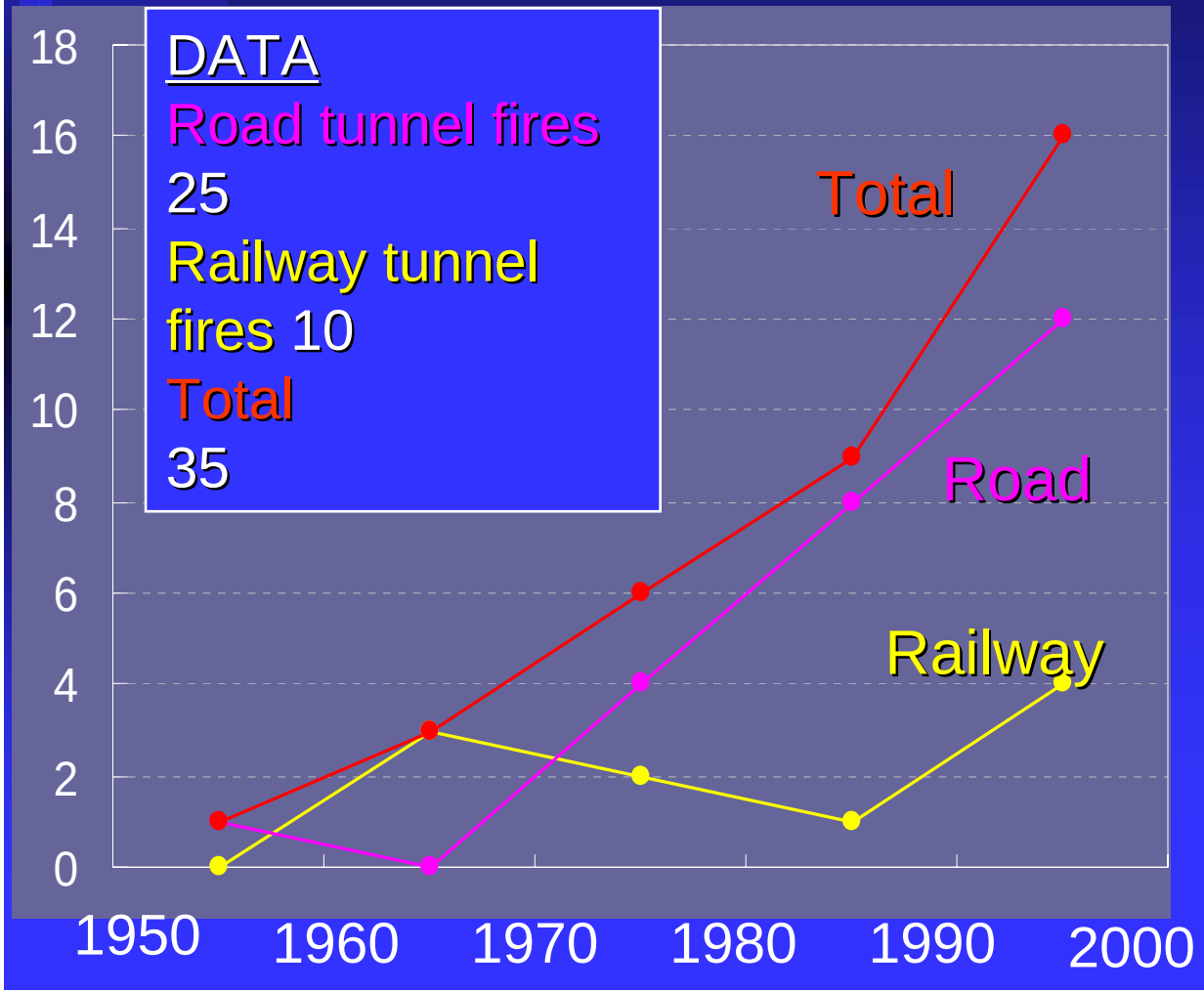
- Time Savings
  - → Time is money
- Energy Savings
  - → Less Environmental Impacts
- Lower Long-Term Maintenance Costs
- Reliability (safety, comfort and time table)
- Priority of the Surface Space Use for more Noble Purposes

Global Cost Assessment

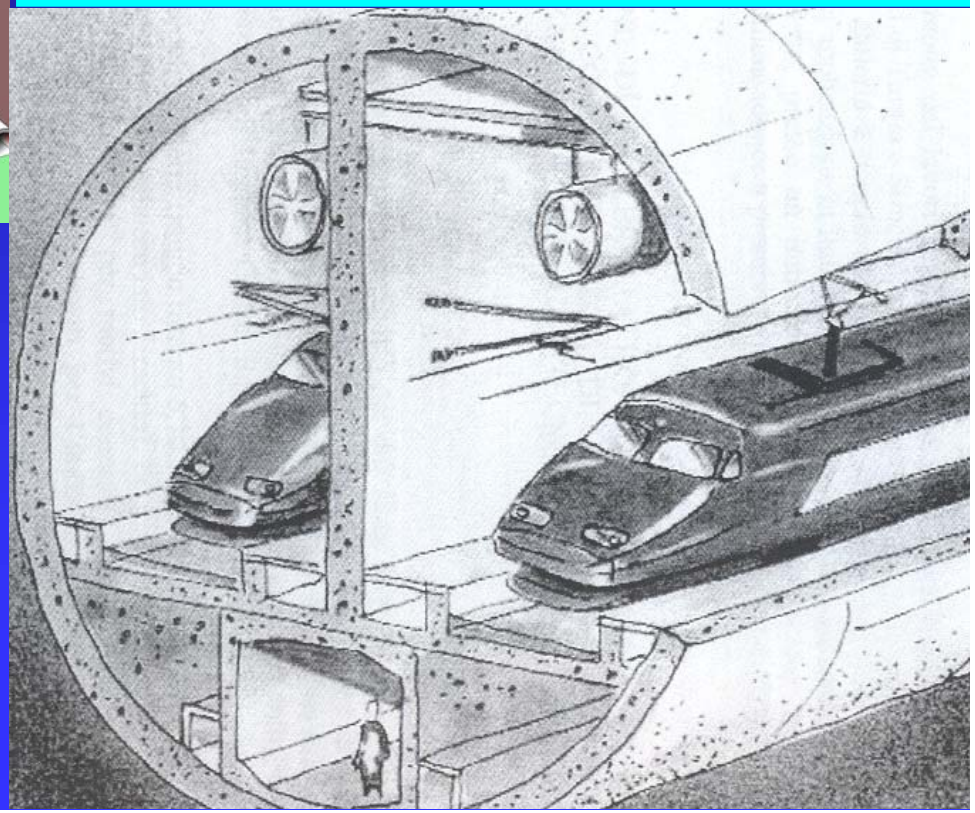
- Construction versus Global cost analyses
  - Social benefits
  - Urban reorganization, revitalization and revaluation of surroundings

- **Need of a feasibility model → Best cost-benefit investment**

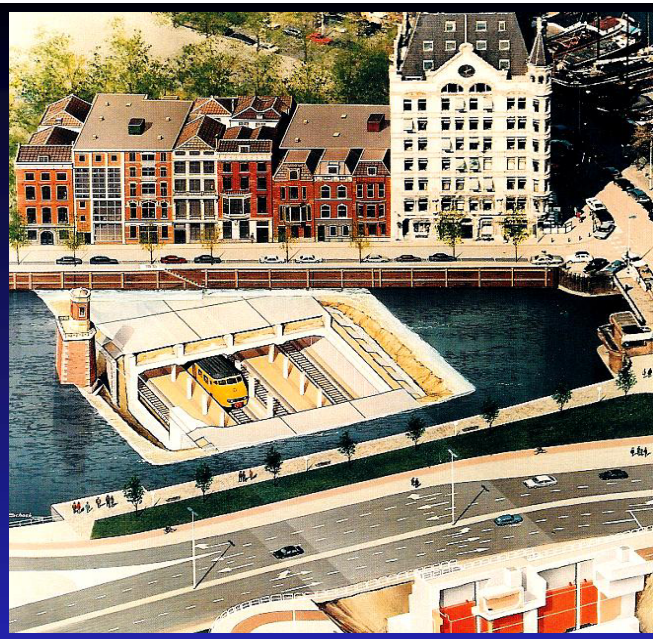
Sensibilities During Operation: Fires



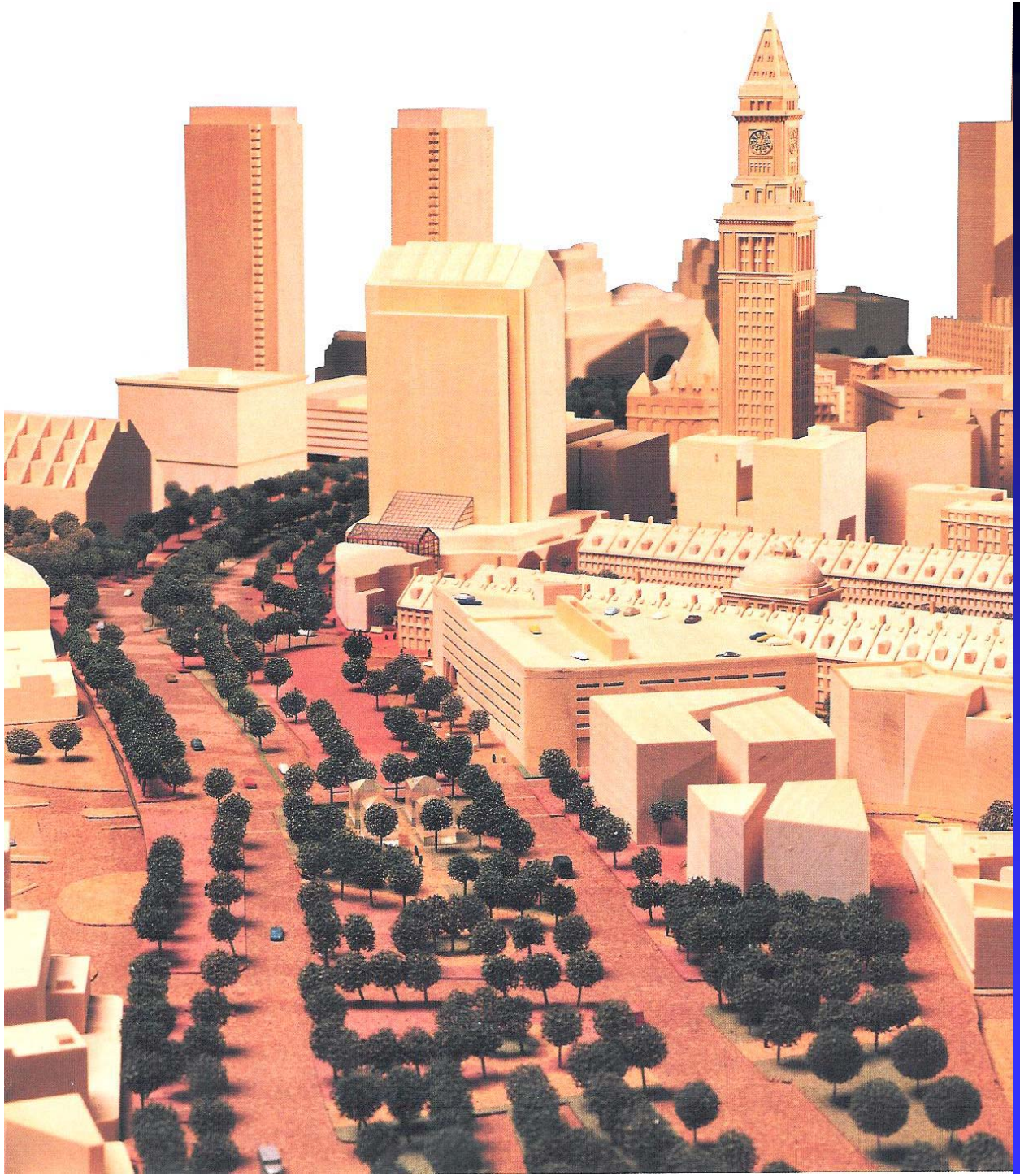
Safety and Security During Operation



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



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