

World Tunnel Congress 2004 and 30th ITA General Assembly

Singapore, 22-27 May 2004

## ITA OPEN SESSION

# *Urban Underground Space and Benefits of Going Underground*

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France

# The Urban Problems

## (1) Growth of the Urban Population

- 3 Billions in 2003 – 5 Billions in 2030
- 50% of the World's Population in 2007
- Will double in 38 years
- Mainly in less developed regions
- Very slow in the more developed regions

# The Urban Problems

## (2) Allocating the « Urban Space » to the various urban functions





# The Urban Problems

## (2) Allocating the « Urban Space » to the various urban functions



# The Urban Problems

(3) Necessity of favouring  
economic development

# The Urban Problems

## (4) Pressures on the urban environment





# The Urban Problems

## (5) Impacts on global environment

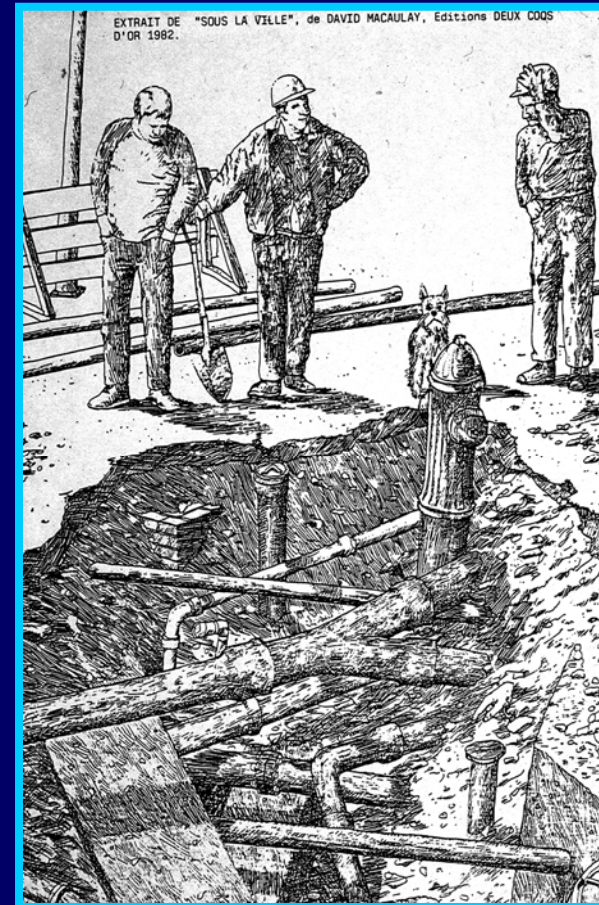
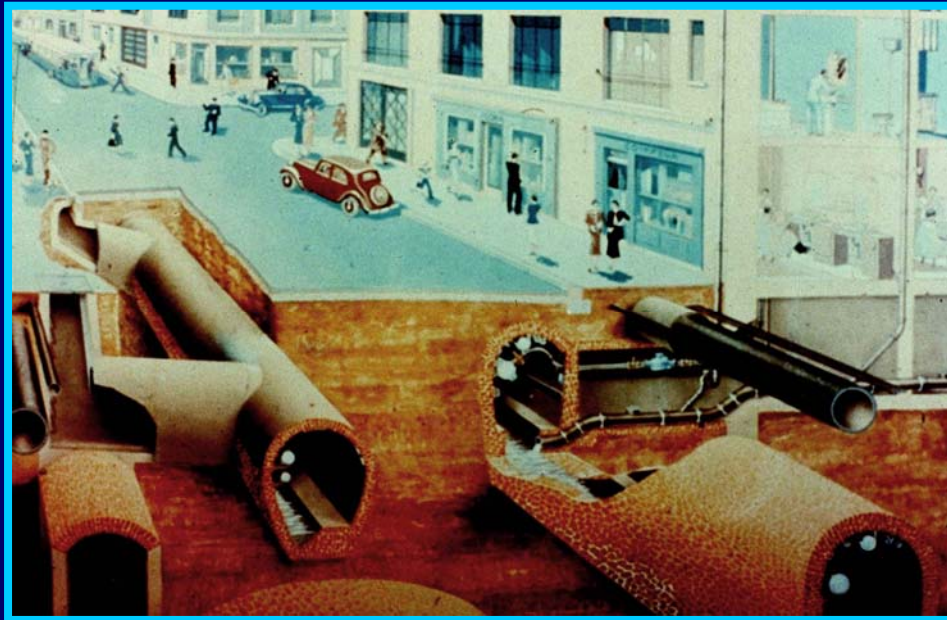


# **The RELATIONSHIP between the CITY and its UNDERGROUND SPACE**



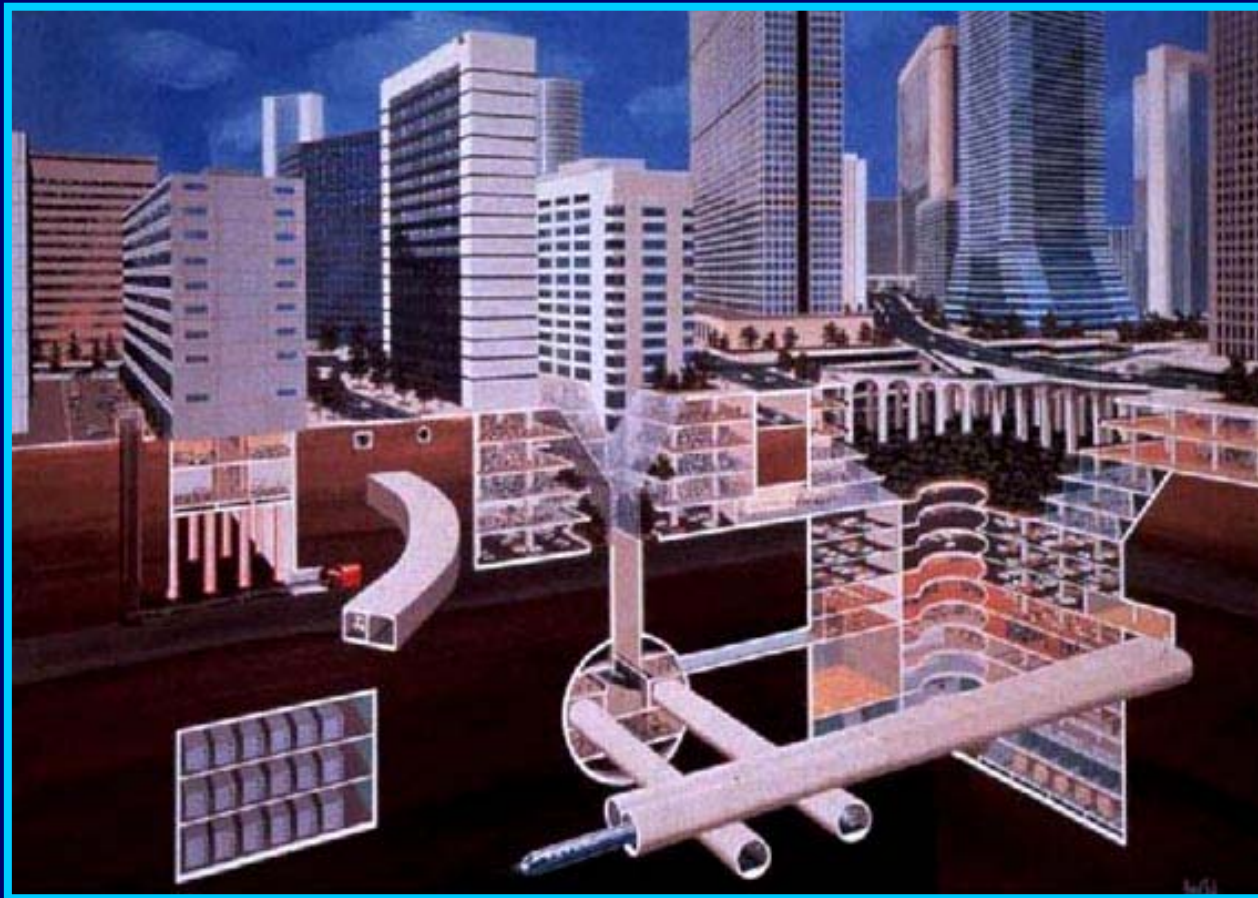
# The Relationship between the City and its Underground Space

## (1) Immediate underground level or « sub-surface »



# The Relationship between the City and its Underground Space

## (2) Deep level or « underground »





# The Relationship between the City and its Underground Space

## (3) The reliefs

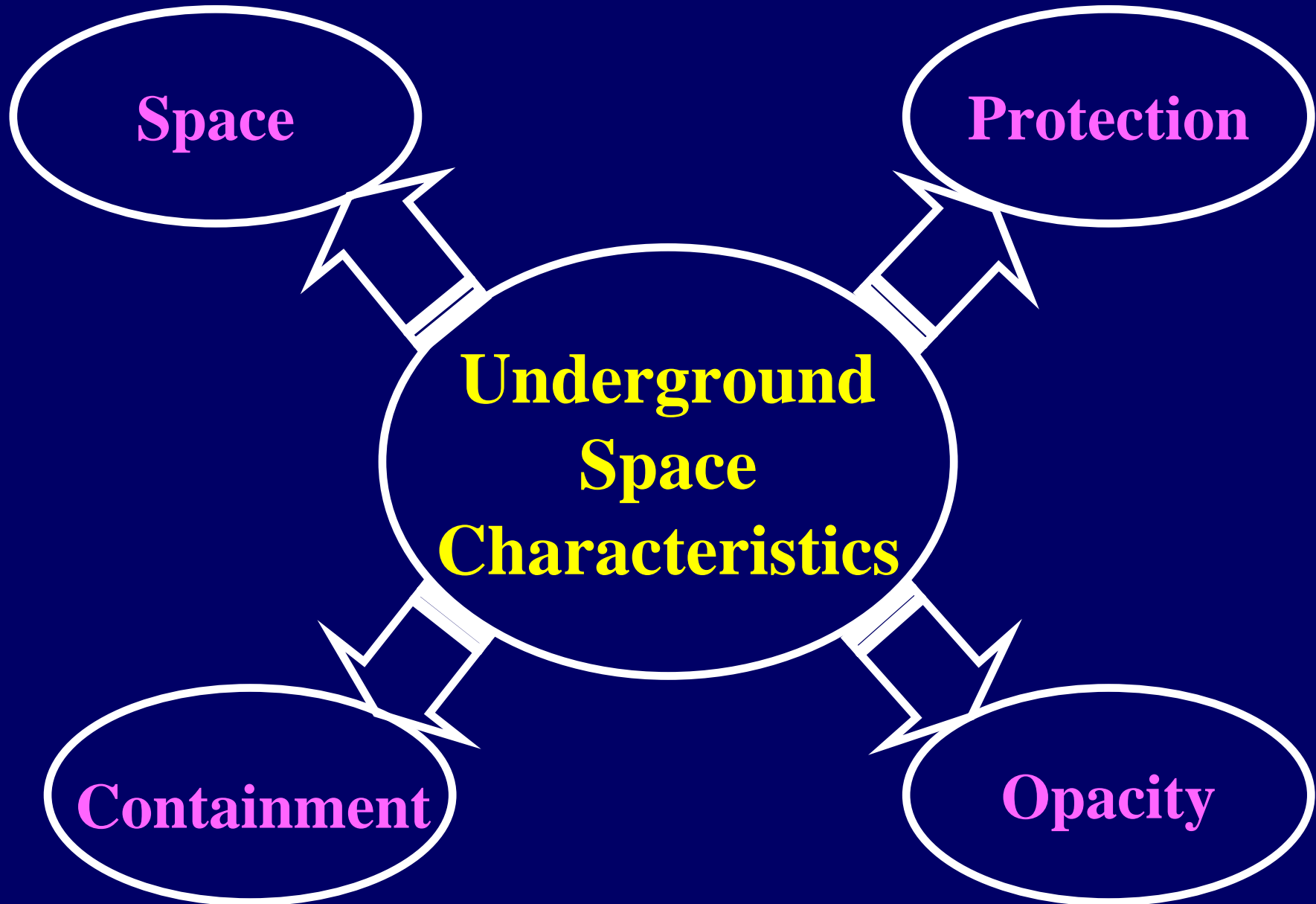


# **BENEFITS**

**resulting from the use of the**

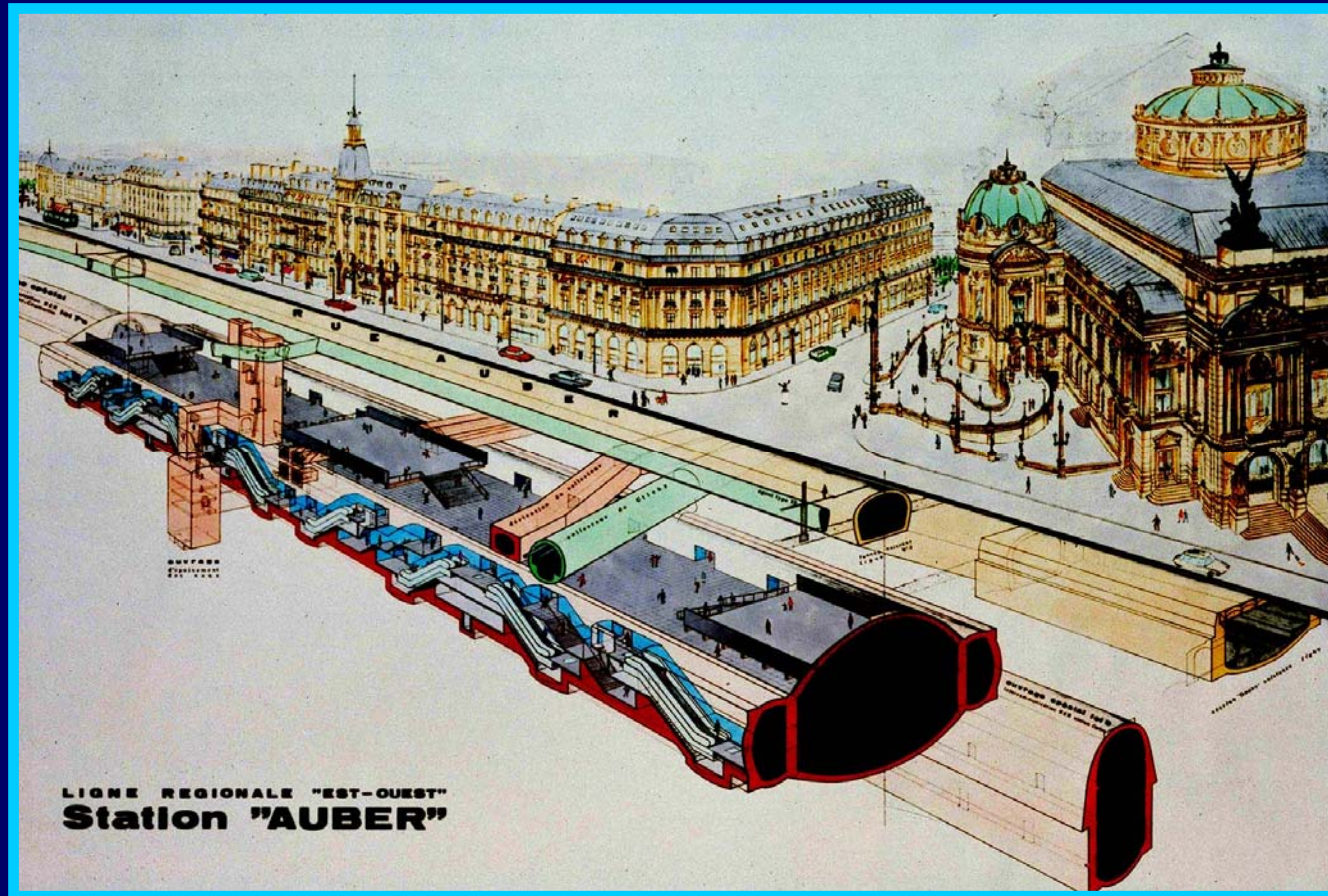
# **URBAN UNDERGROUND SPACE**





**BENEFITS**  
as regards  
**LAND USE**  
**AND LOCATION PROBLEMS**

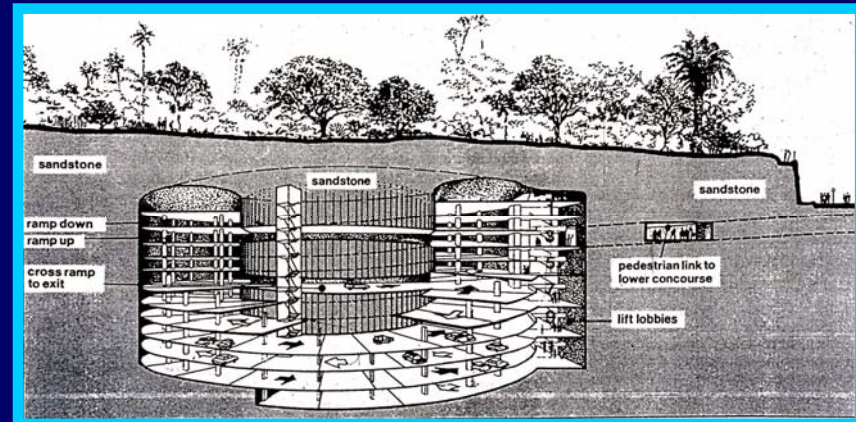
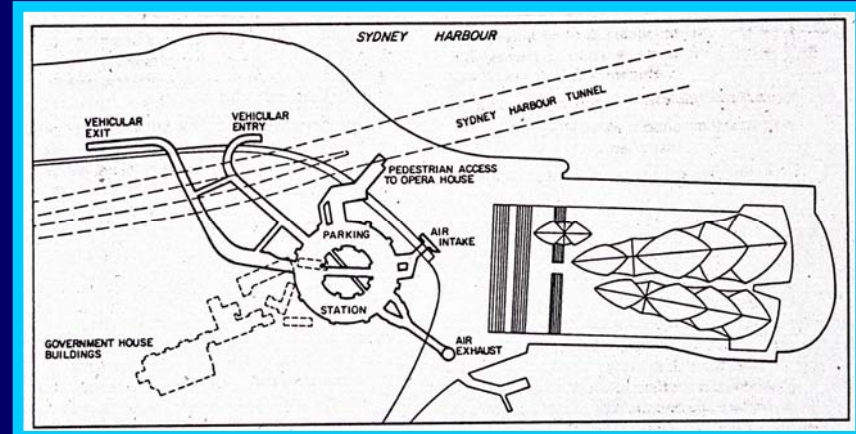
# Benefits as regards **LAND USE AND LOCATION PROBLEMS**



**PARIS – « AUBER » Station – RER Line A**



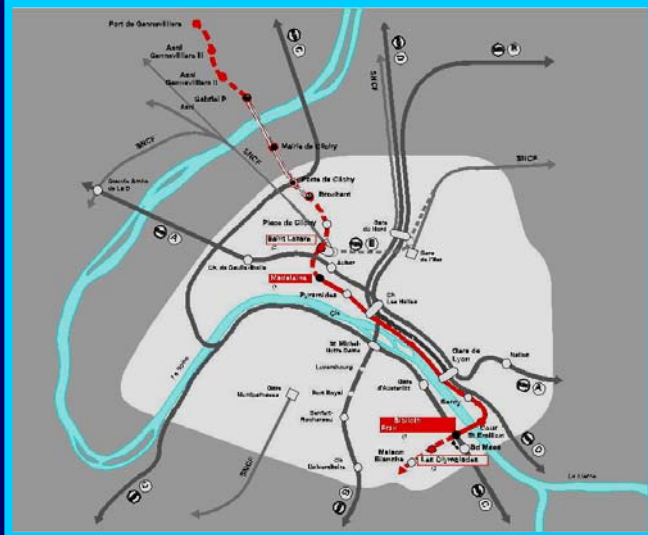
# Benefits as regards LAND USE AND LOCATION PROBLEMS



## SYDNEY – Underground Opera House car park

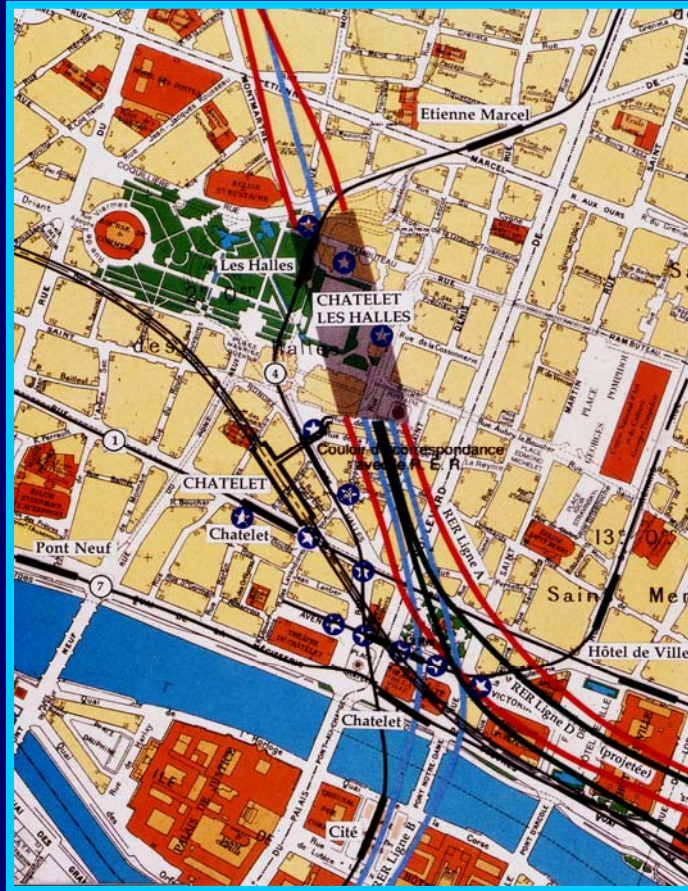


# Benefits as regards LAND USE AND LOCATION PROBLEMS



PARIS Metro – « Meteor » Line 14

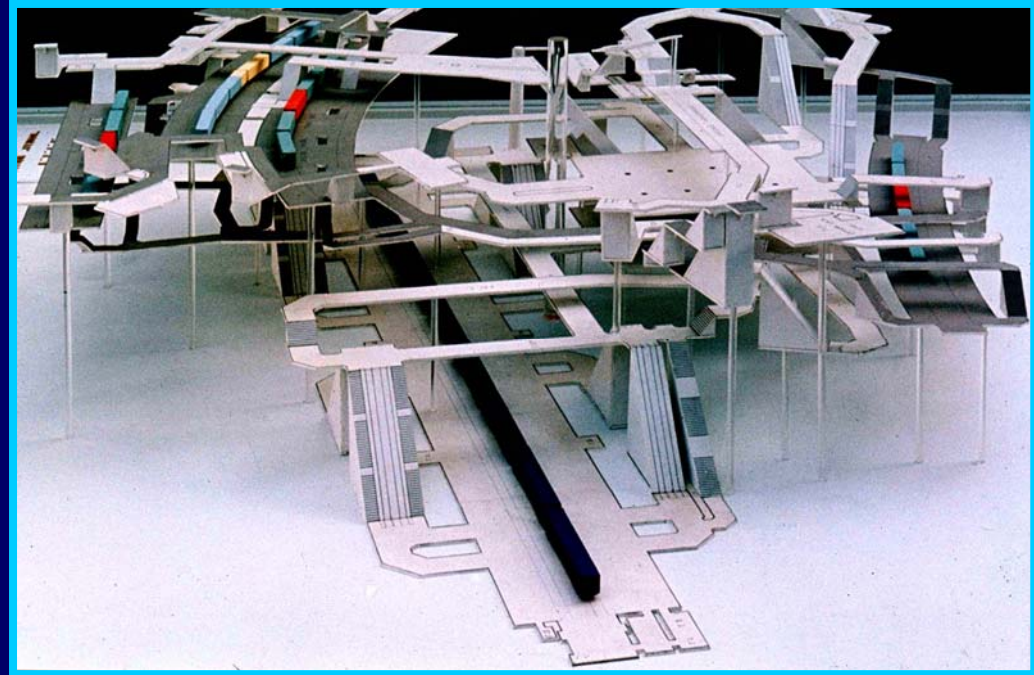
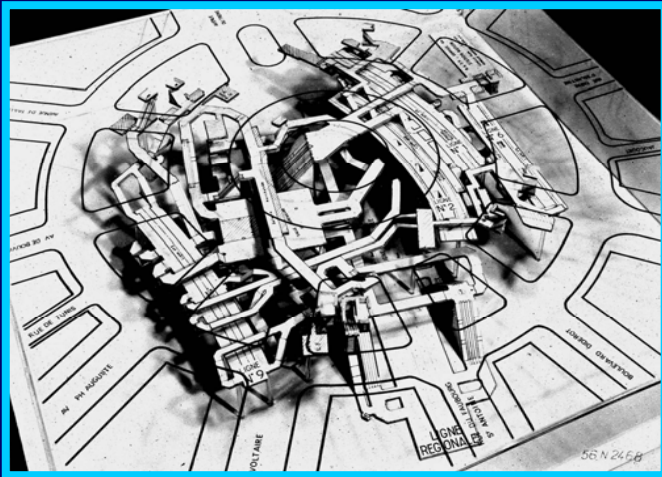
# Benefits as regards LAND USE AND LOCATION PROBLEMS



« Separate conflicting transport activities »



# Benefits as regards **LAND USE AND LOCATION PROBLEMS**



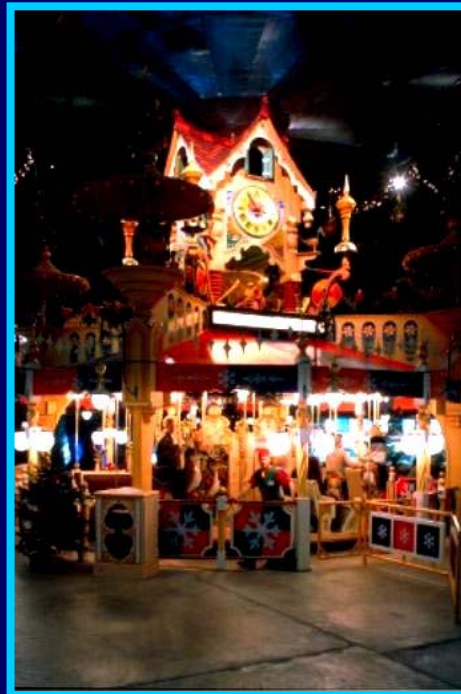
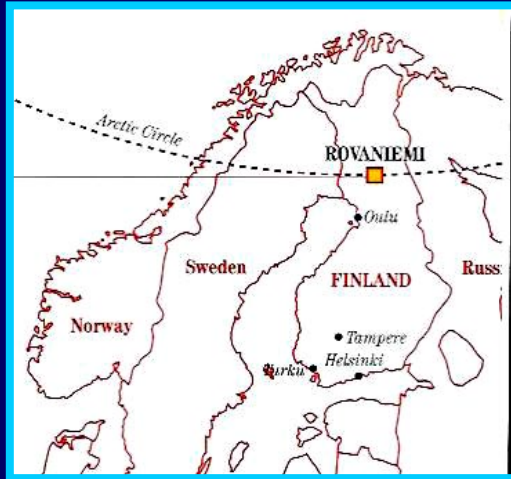
**PARIS – Several levels  
of transport facilities  
below the « Nation » Square**

# **BENEFITS** as regards **ISOLATION**



# Benefits as regards ISOLATION

## (1) Climate



**The « Santa Claus Village » on the Arctic Circle - Finland**

# Benefits as regards ISOLATION

## (1) Climate



## Underground storage facilities- Kansas City - USA

# Benefits as regards ISOLATION

## (2) Earthquakes

### Kobe earthquake – Japan - 1995



**Severe damage to the City Hall**



**Almost no damage to the underground shopping mall**



# Benefits as regards ISOLATION

## (3) Noise and vibration

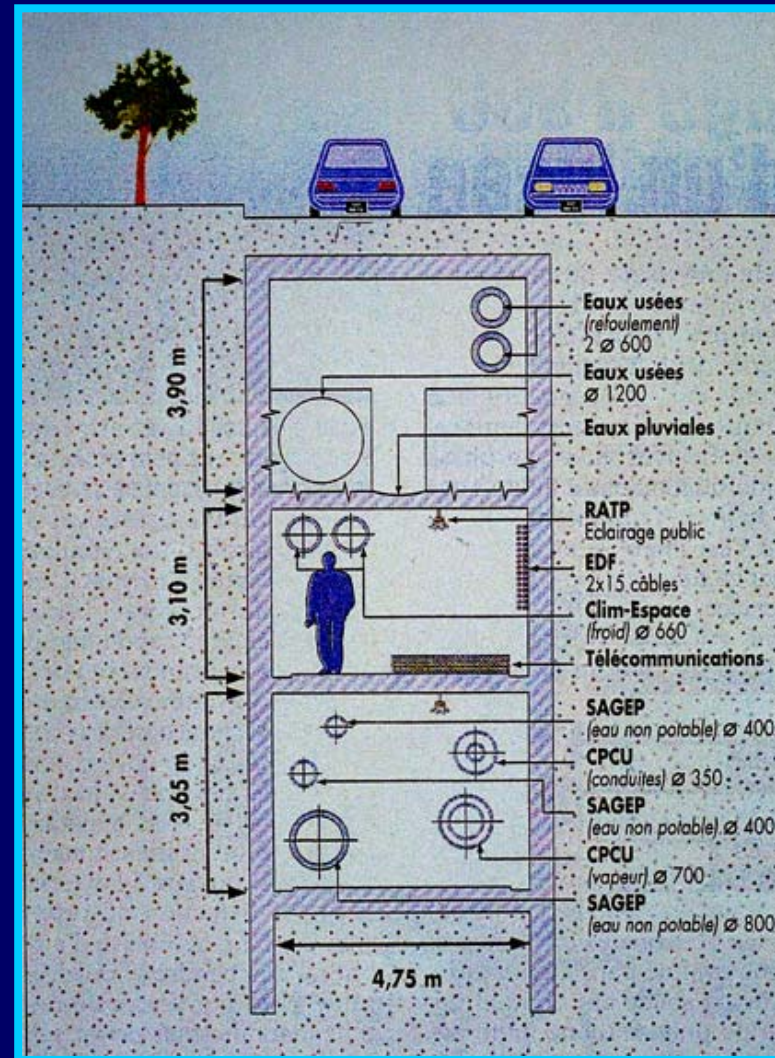


Church in the rock – Helsinki - Finland



# Benefits as regards ISOLATION

## (4) Multi-purpose service tunnels



# **BENEFITS** as regards **ENVIRONMENTAL PROTECTION**

# Benefits as regards **ENVIRONMENTAL PROTECTION**

## (1) Aesthetics



**BEFORE**



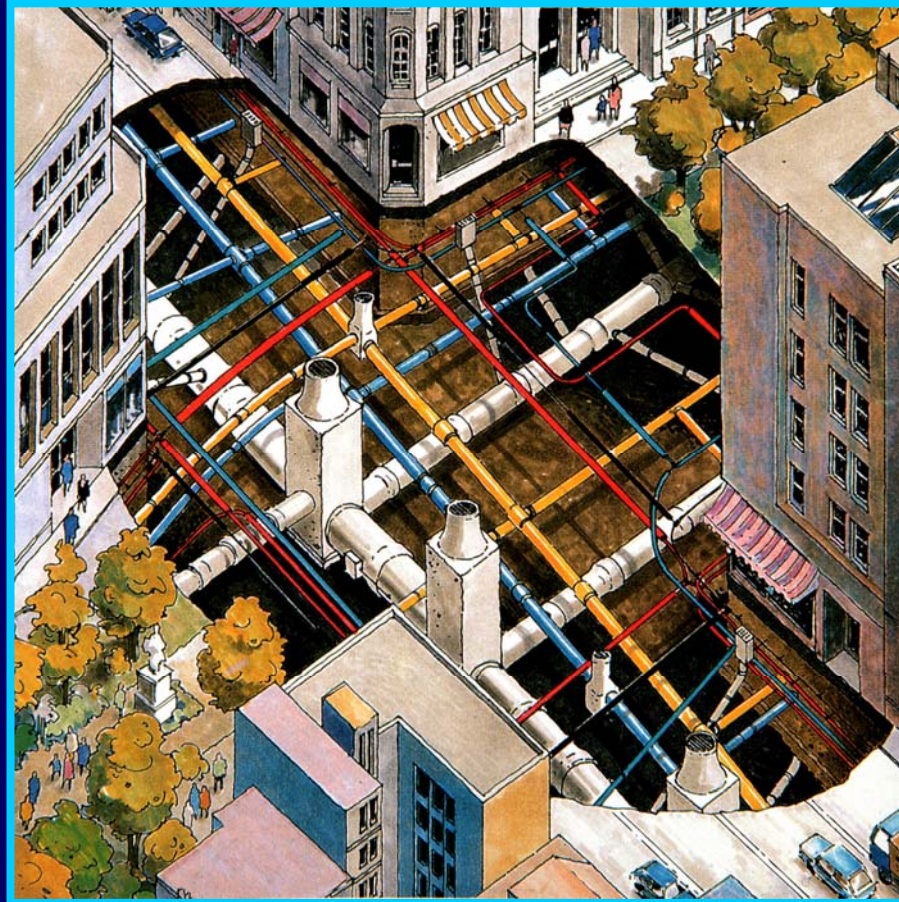
**AFTER**

**Car park in Marseilles - France**



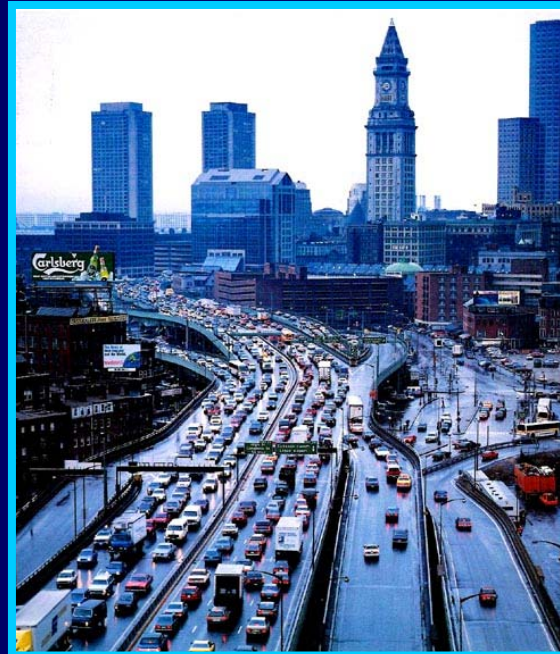
# Benefits as regards **ENVIRONMENTAL PROTECTION**

## (2) Public utilities

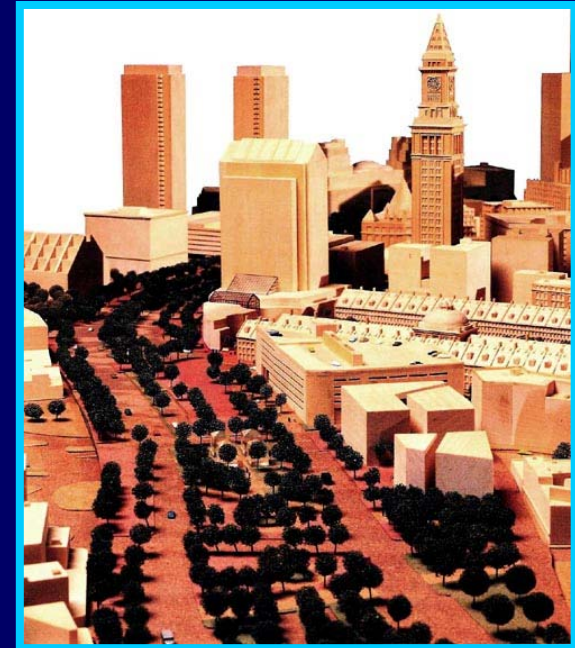


# Benefits as regards **ENVIRONMENTAL PROTECTION**

## (3) Traffic tunnels



**BEFORE**



**AFTER**

**The « Central Artery » - Boston - USA**



# Benefits as regards **ENVIRONMENTAL PROTECTION**

## (4) Underground car parks

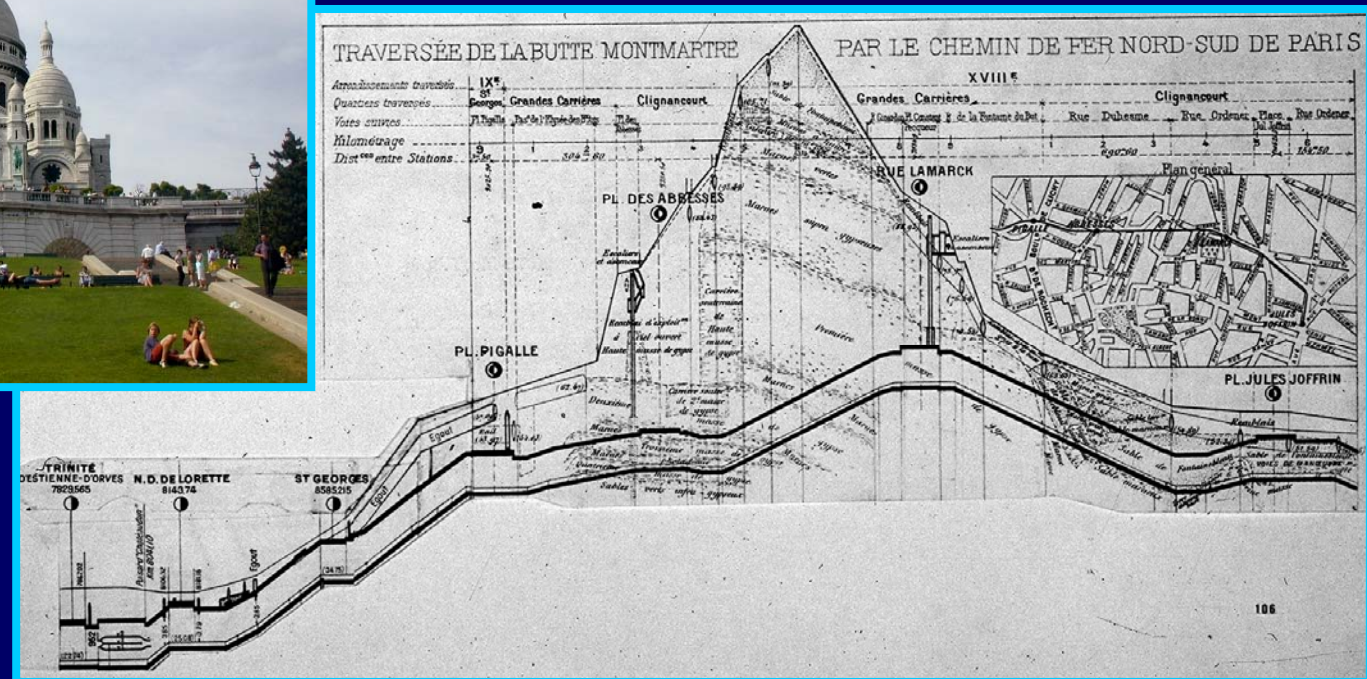


**Underground car park below a schoolyard – Stockholm - Sweden**



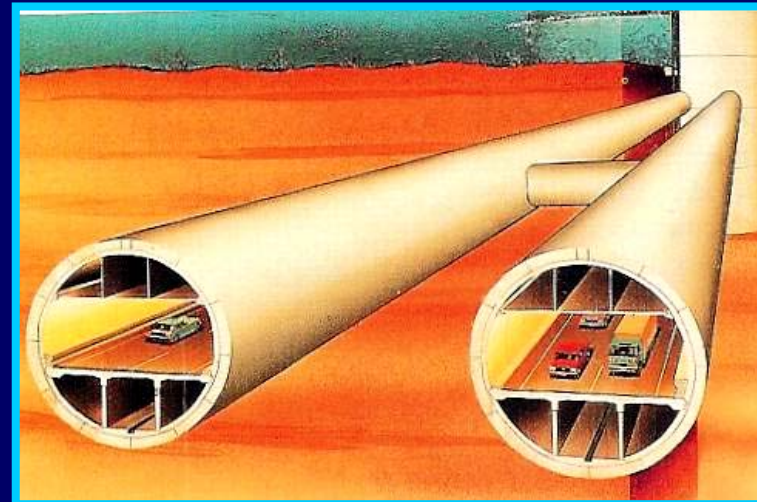
# **BENEFITS** as regards **TOPOGRAPHY**

# Benefits as regards TOPOGRAPHY CONSTRAINTS



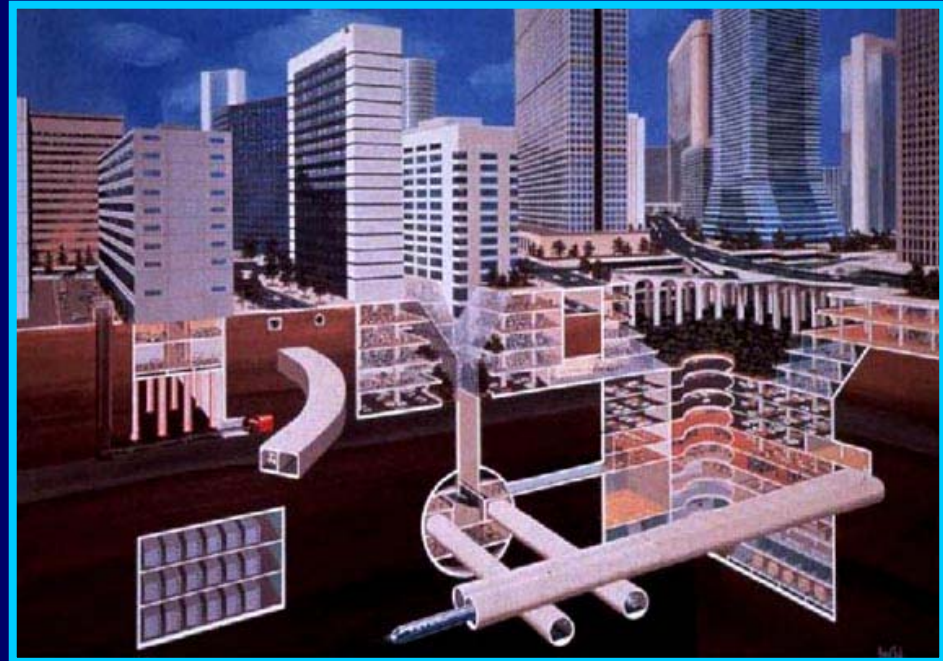
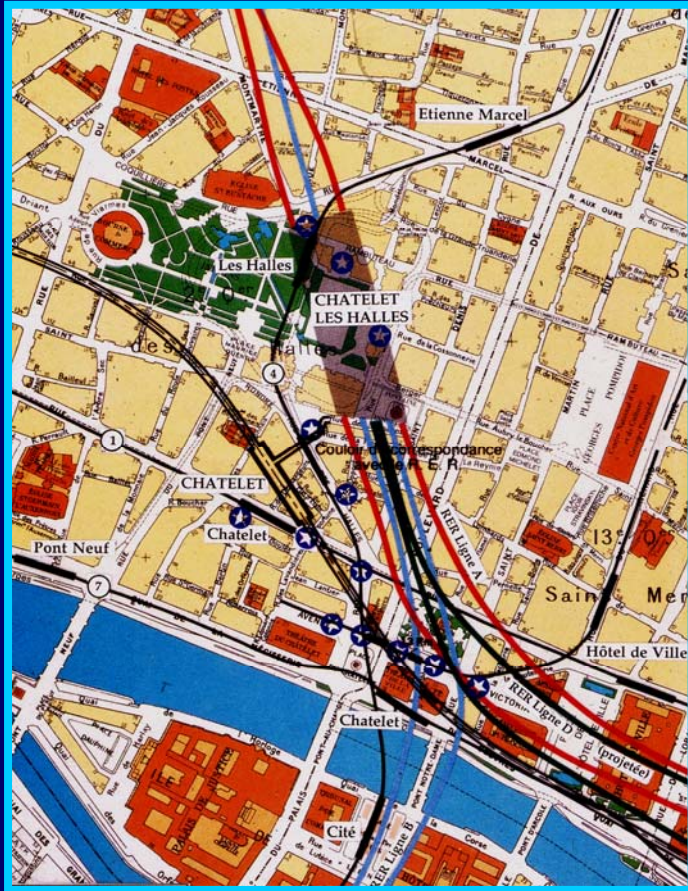
**Metro Line crossing the « Butte Montmartre » - Paris**

# The Trans-Tokyo Bay Highway





# Benefits as regards TOPOGRAPHY CONSTRAINTS



« 3D Planning »

**How to get  
MORE BENEFITS  
from the use of the  
URBAN UNDERGROUND SPACE ?**

# How to get more benefits from the use of the urban underground space ?

## (1) Safety, psychological and health aspects





# How to get more benefits from the use of the urban underground space ?

## (2) Protection of the underground environment



**Paris - Catacombs**



**Paris – « Grand Louvre »**

# How to get more benefits from the use of the urban underground space ?

## (3) Relations between underground structures and the ground surface



Paris – Metro Line 1 in Neuilly



Lyon – Portal of the Fourviere Tunnel



# How to get more benefits from the use of the urban underground space ?

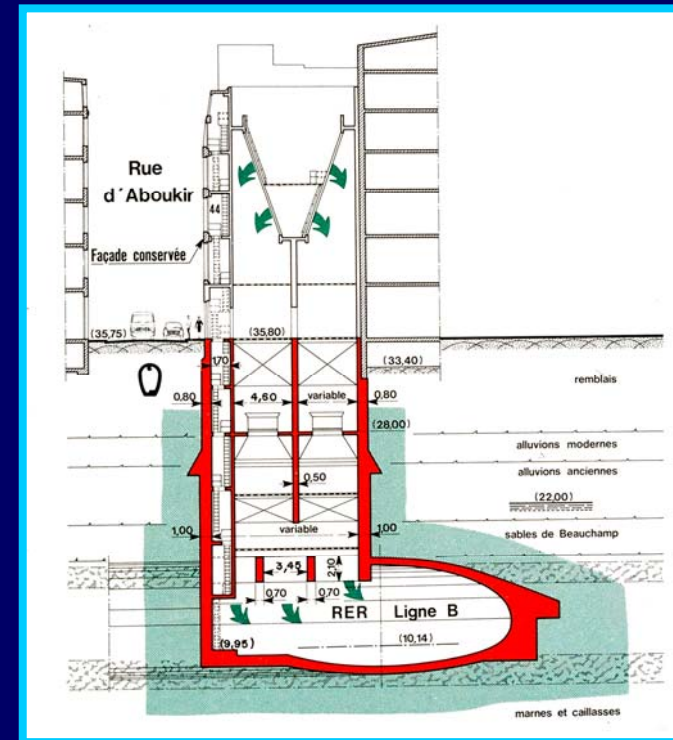
## (3) Relations between underground structures and the ground surface





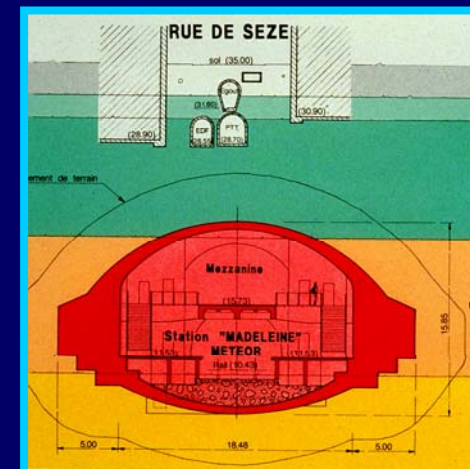
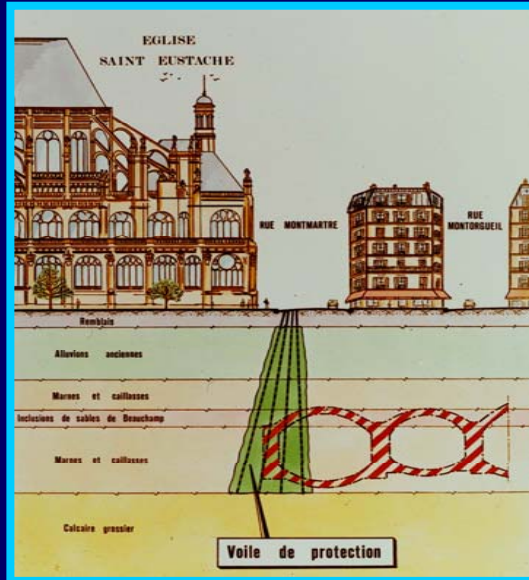
# How to get more benefits from the use of the urban underground space ?

## (3) Relations between underground structures and the ground surface



# How to get more benefits from the use of the urban underground space ?

## (4) Construction techniques



ITA Open Session - Singapore - 25 May 2004



# How to get more benefits from the use of the urban underground space ?



## (4) Construction techniques

### Paris - Champs Elysées Avenue

Maintaining trees  
during the construction  
of an underground car park



# How to get more benefits from the use of the urban underground space ?

## (4) Construction techniques



## Construction disruption with Cut & Cover methods

# How to get more benefits from the use of the urban underground space ?

- Site investigation
- Location and features of existing underground structures, facilities and public utilities
- Economical considerations
- Assessment of the projects
- Risk analysis

# Risk analysis

- Financial risks
- Public acceptance for the facility
- Changed ground conditions
- Construction risks
- Contractual risks
- Environmental risks
- Risks in operation



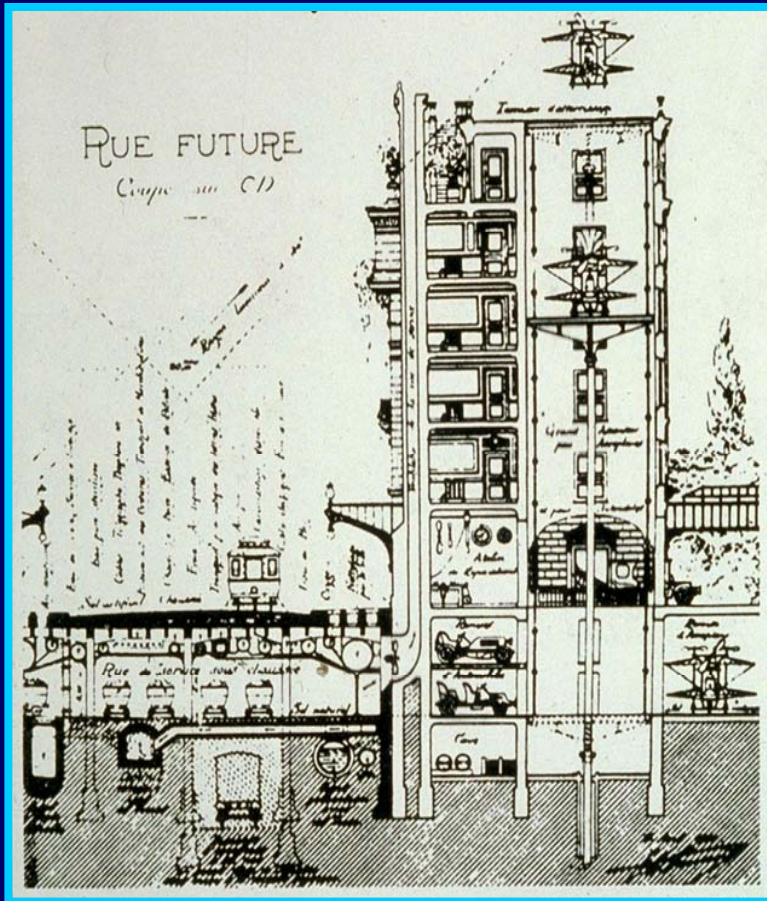
# Criteria for an optimum use of Urban Underground Space

Source : R.Sterling & J-P.Godard

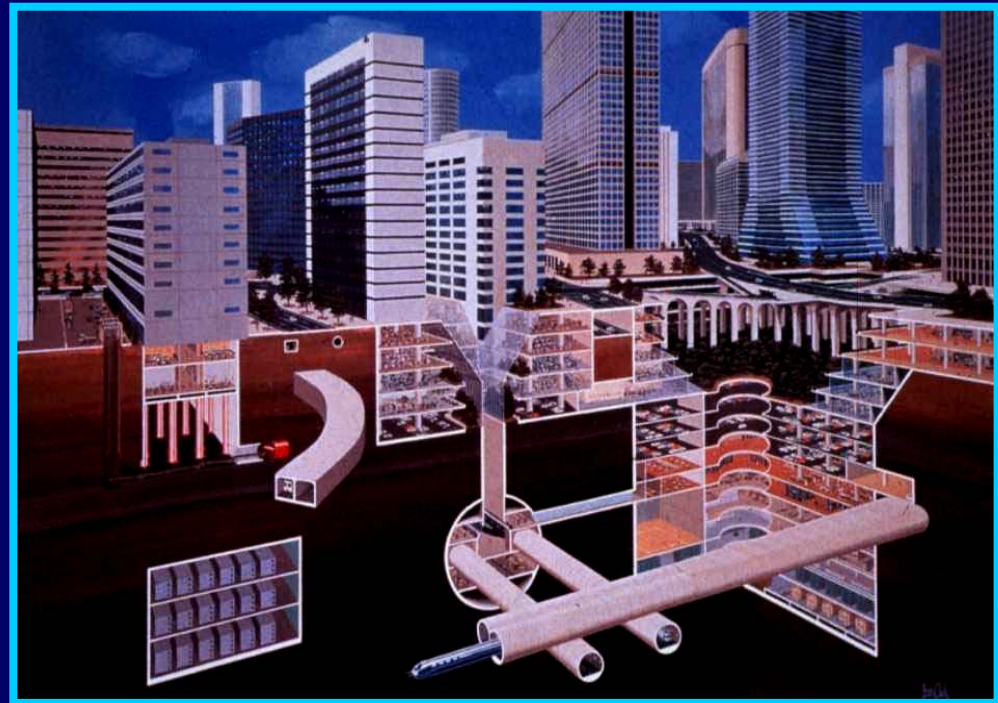
- Take into account the needs of the Community
- Maximize the benefits from the use of the underground as developable space
- Reinforce the positive features of the surface urban environment
- Make the most effective use of the features and properties of the geologic setting
- Design for « sustainability » in the use of the subsurface space

**From**  
**Urban Underground Space**  
**Use**  
**towards**  
**Urban Underground Space**  
**Development**

# Urban Underground Space Development



**Henard's Project - France (1903)**



**Expanded Use of Underground Space**