

**Federico M. Mazzolani**

**University of Naples “Federico II”, Italy**



## **STEEL IN STRUCTURAL RESTORATION 2**

**PROTECTION OF RESTAURATION SITES**

**CONSERVATIVE RESTAURATION**

**RE-USE OF EXISTING BUILDINGS :  
The industrial archeology**

**DRASTIC CHANGE  
OF STRUCTURAL SCHEME**

**RESTRUCTURING  
OPERATIONS**





# **RESTRUCTURING OPERATIONS**

# ■ Typical Restructuring Operations

- Emptying
- Insertion
- Extension (vertical, horizontal)
- Lightening



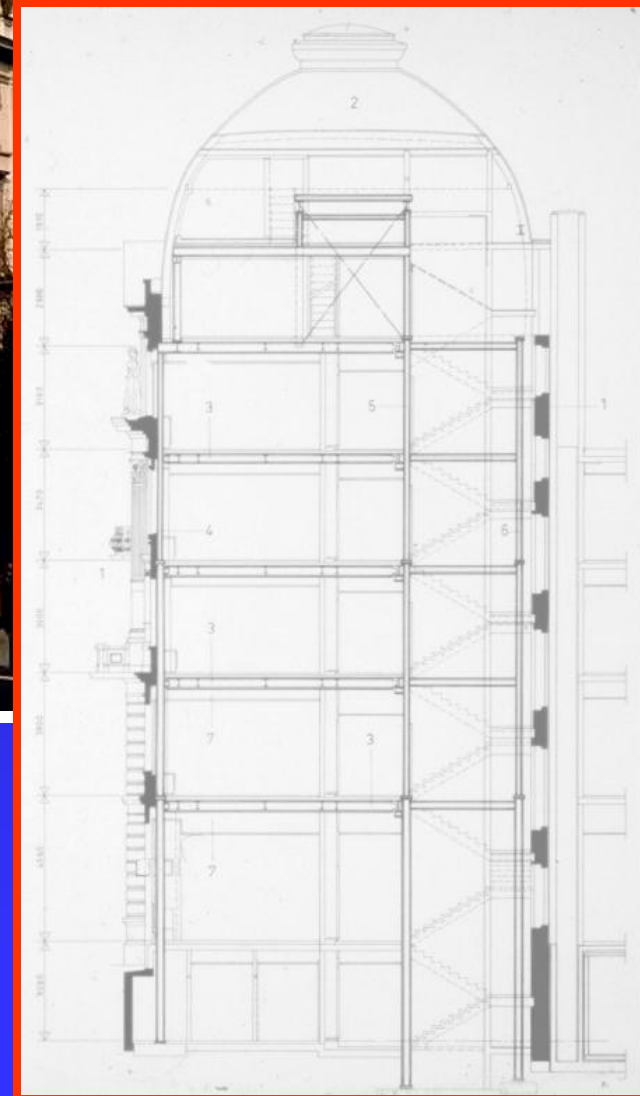
# **EMPTYING**

## **(degutting)**

■ **Emptying** = substitution of the internal part of a building with different structural systems, by keeping the old facades



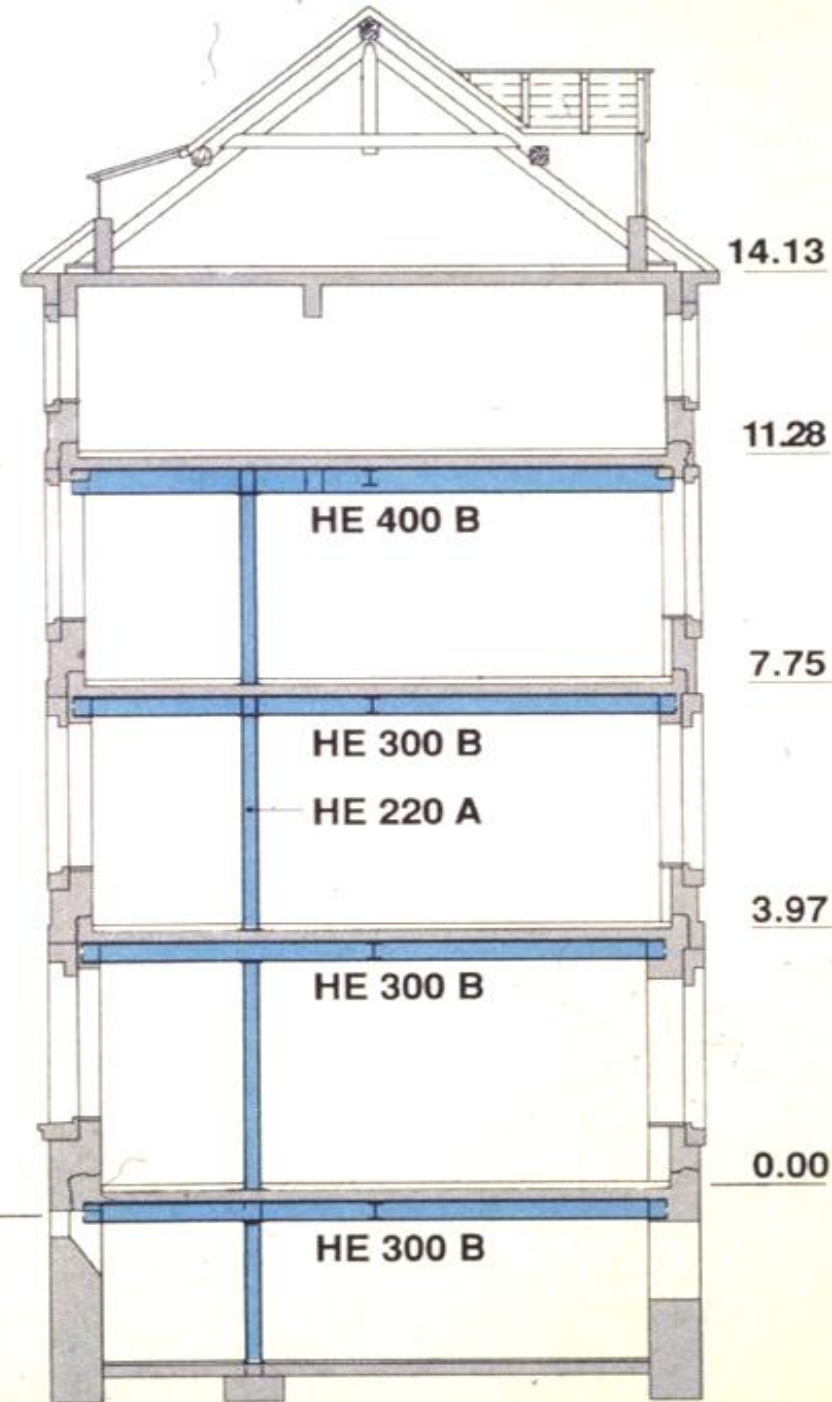
**The old “Roemerhof”  
(Zurich, Switzerland)**

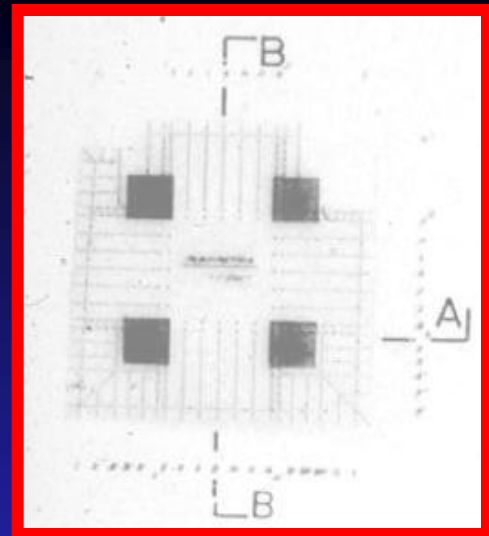




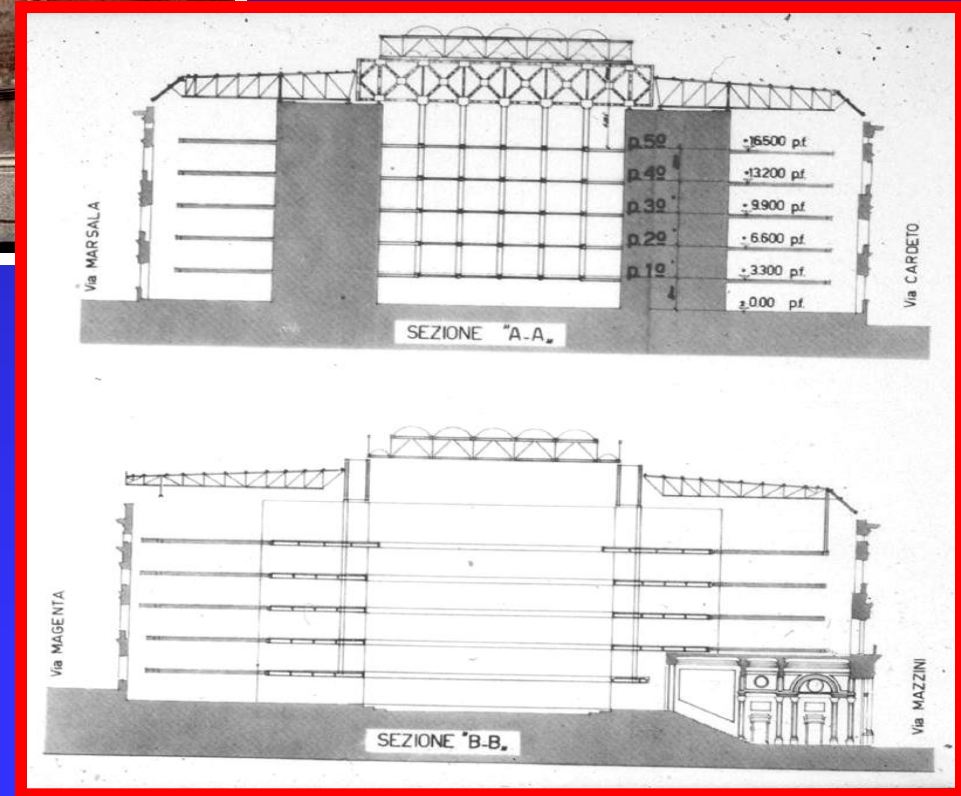


**The “Kannerland” Limpertsberg  
(Luxembourg)**

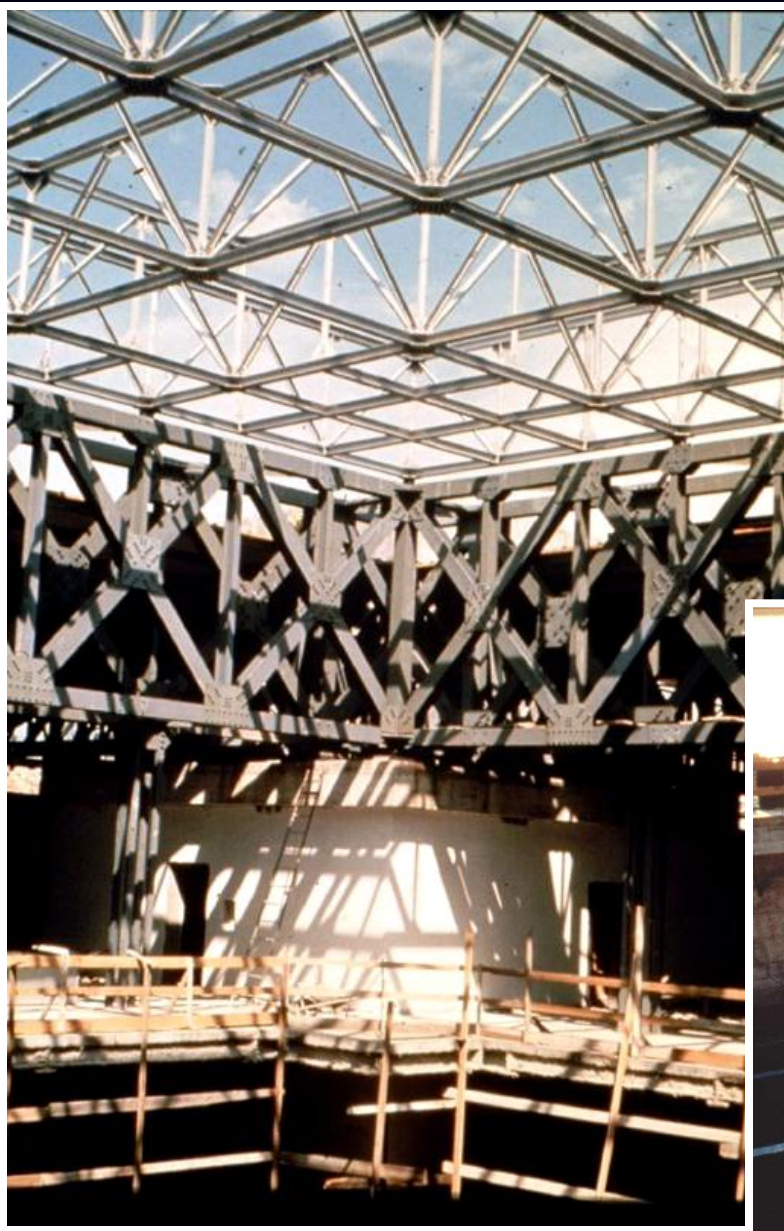




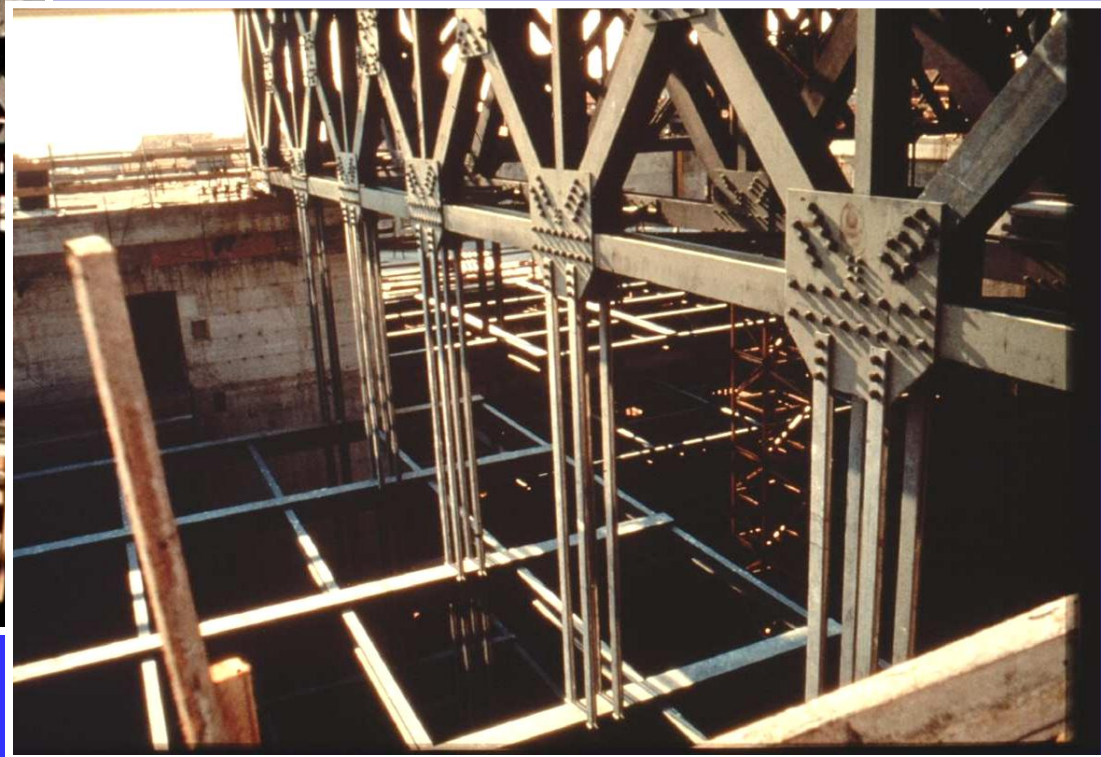
**The “Law Court” building  
(Ancona, Italy)**







**The “Law Court” building  
(Ancona, Italy)**

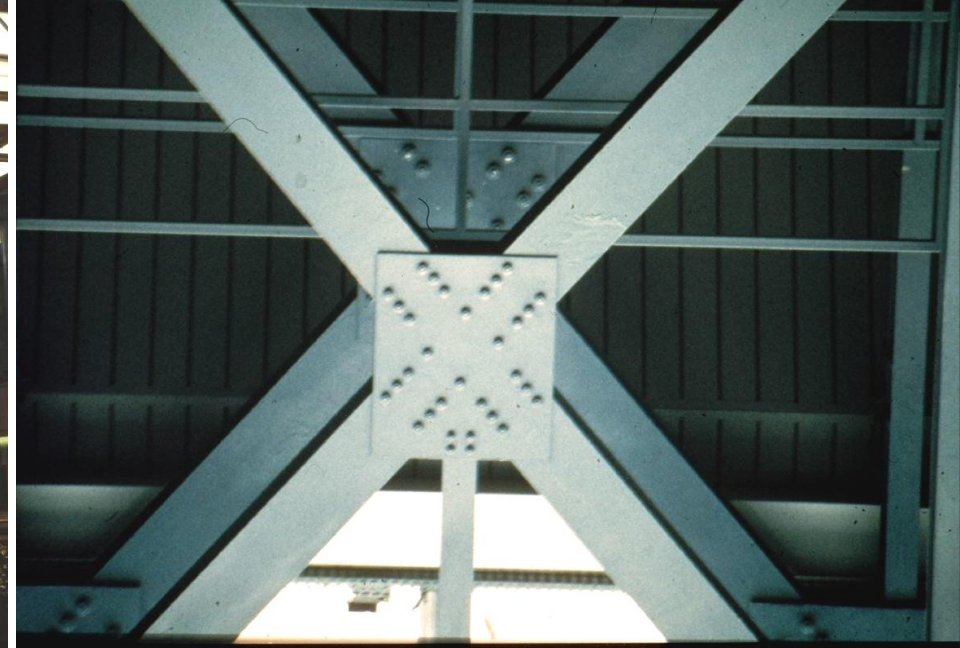




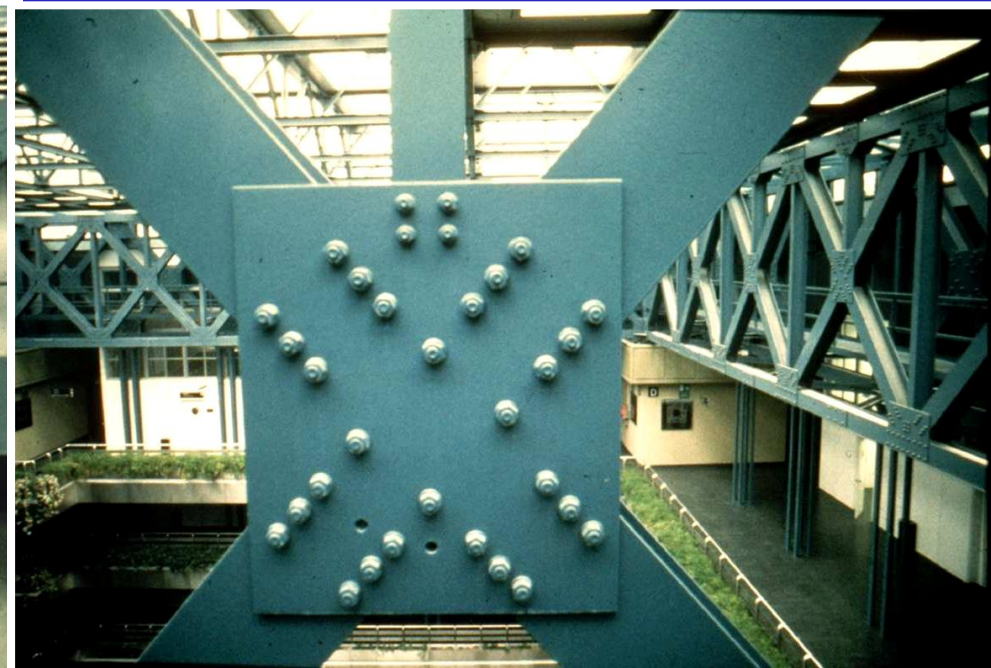
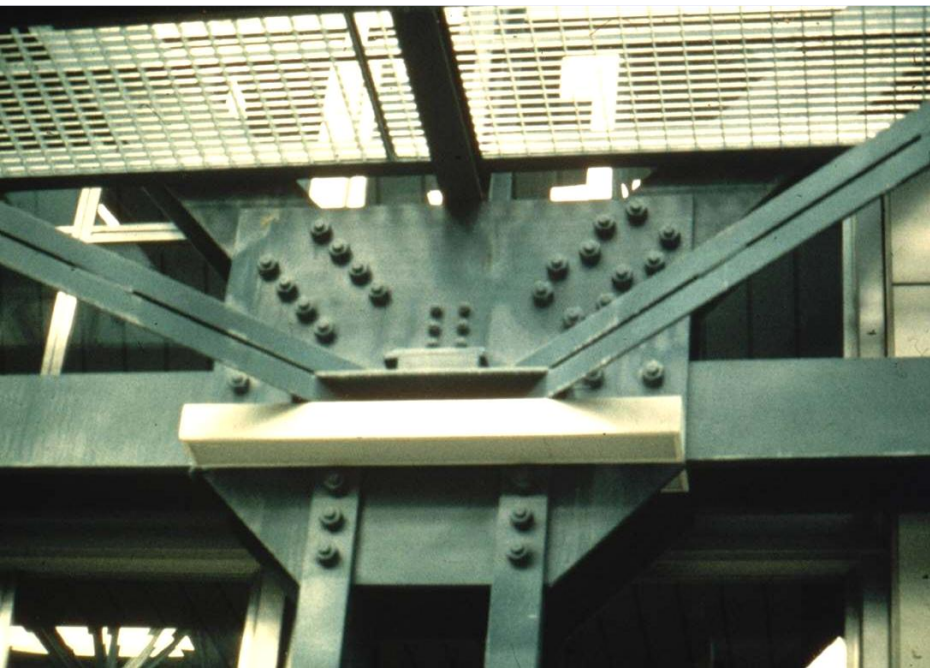


**The “Law Court” building  
(Ancona, Italy)**

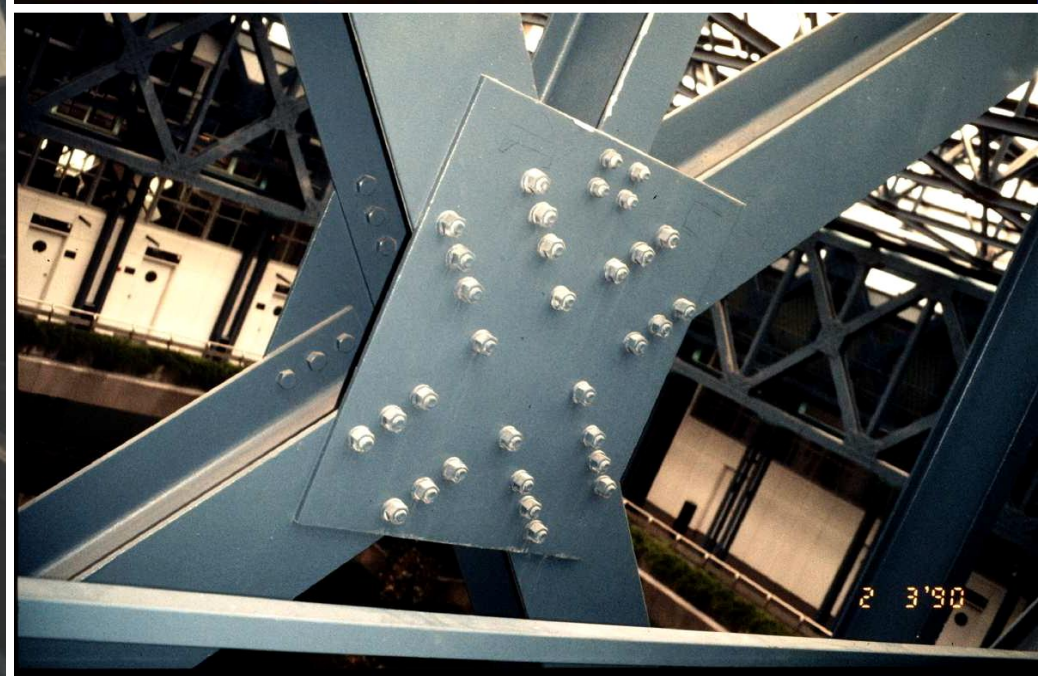




**The “Law Court” building (Ancona, Italy)**

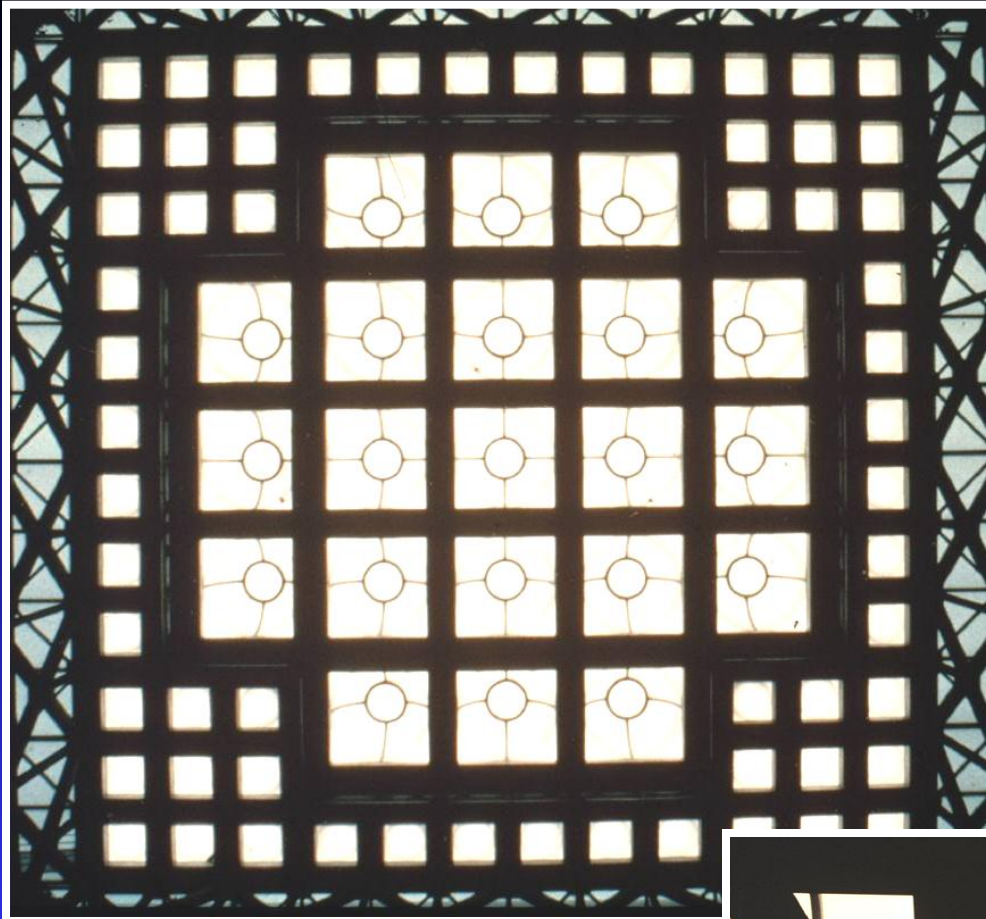






**The “Law Court” building  
(Ancona, Italy)**





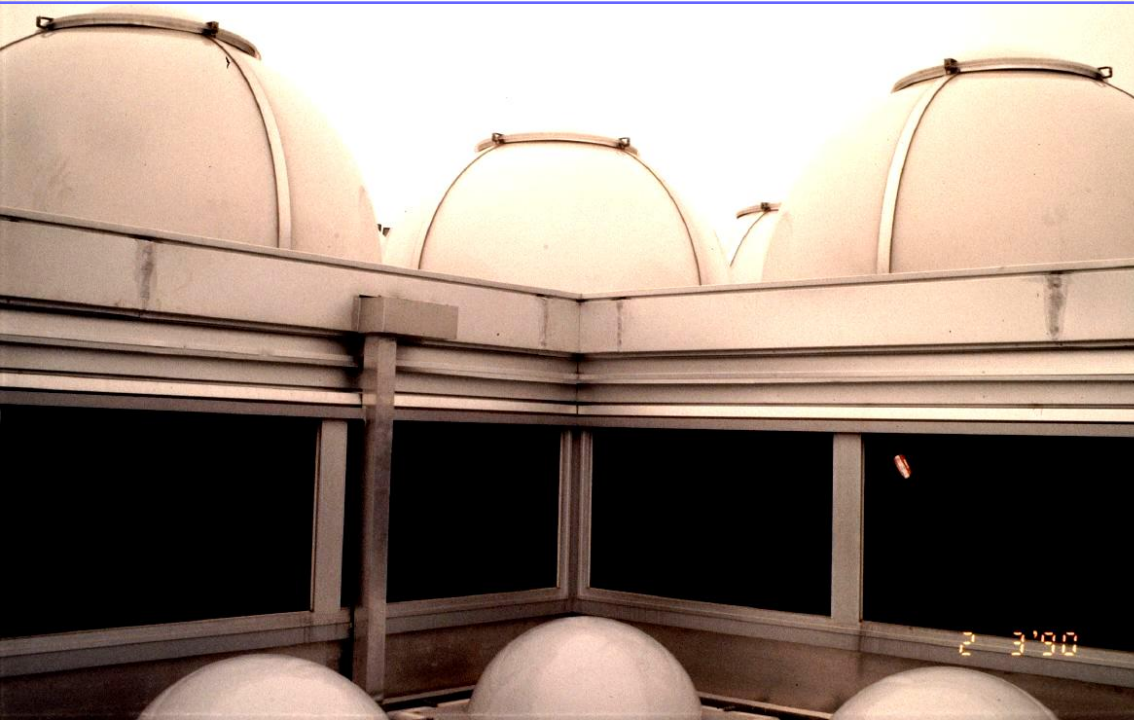
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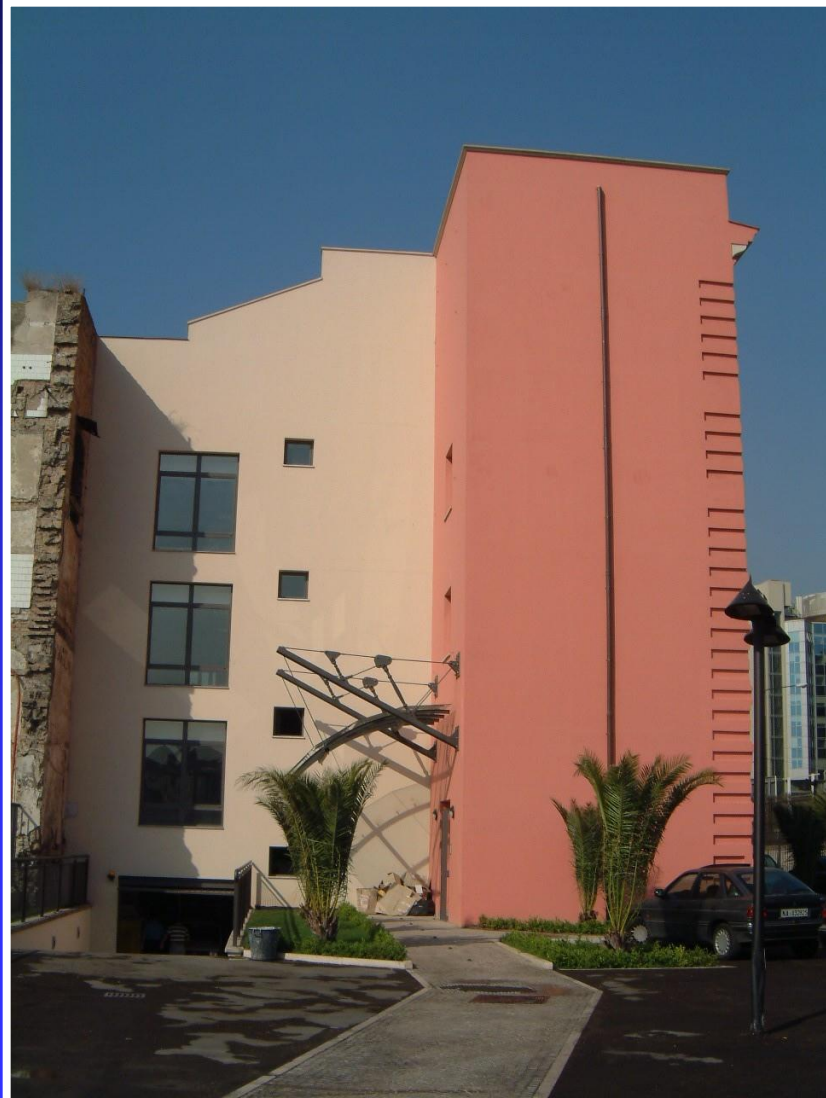


**The “Law Court” building (Ancona, Italy)**





# The CNR Institute “GEOMARE SUD”(Naples, Italy)





**The CNR Institute “GEOMARE SUD”(Naples, Italy)**



## 8, Boulevard Haussmann (Paris , France)





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## 8, Boulevard Haussmann (Paris , France)







**AGF – Ilot Lafayette (Paris , France)**



# AGF – Ilot Lafayette (Paris , France)



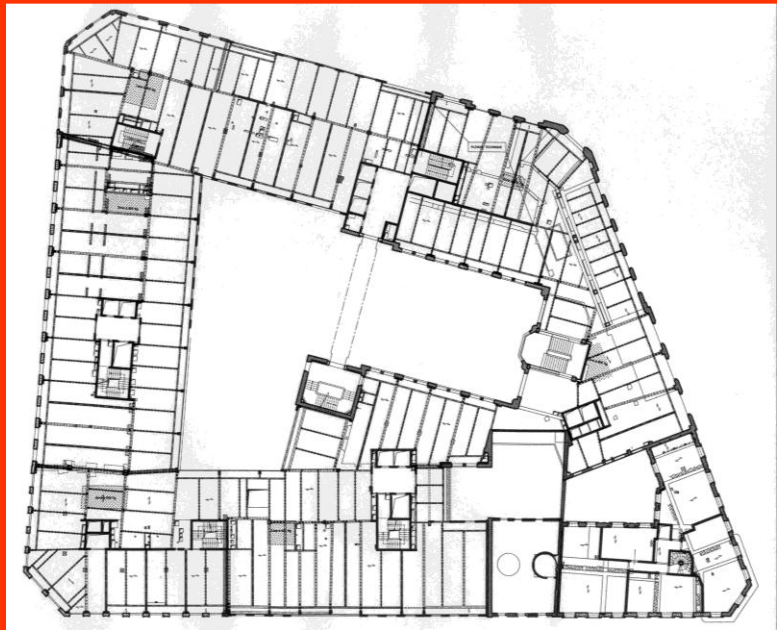


## AGF – Ilot Lafayette (Paris , France)



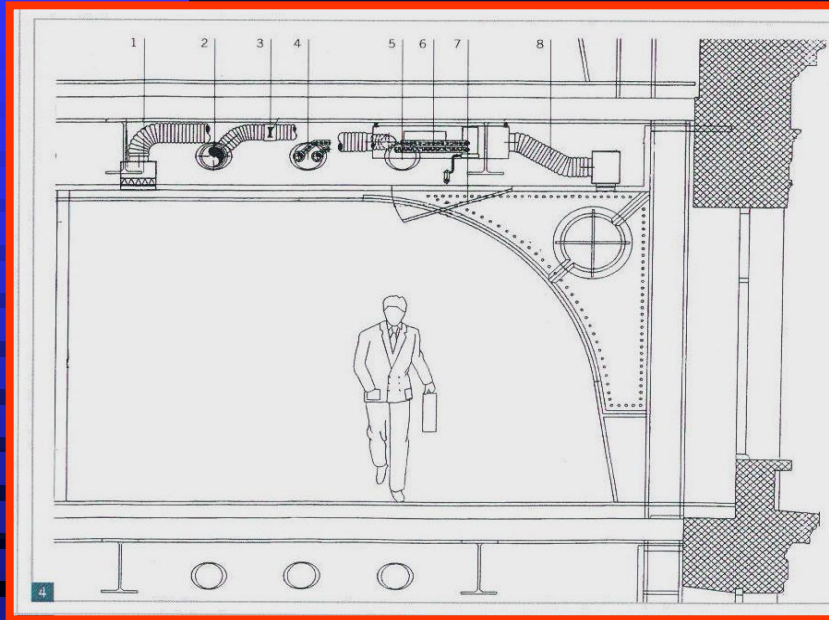


# AGF – Ilot Lafayette (Paris , France)



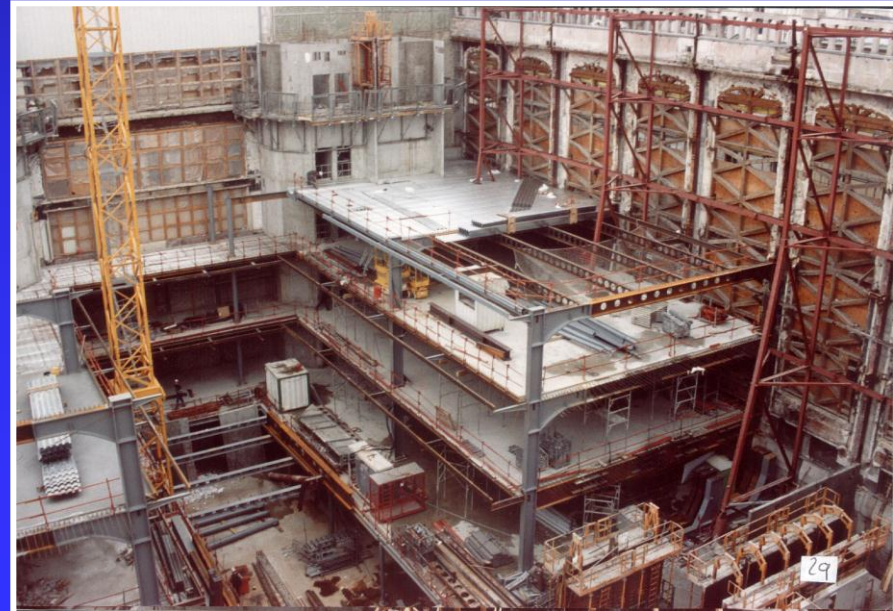
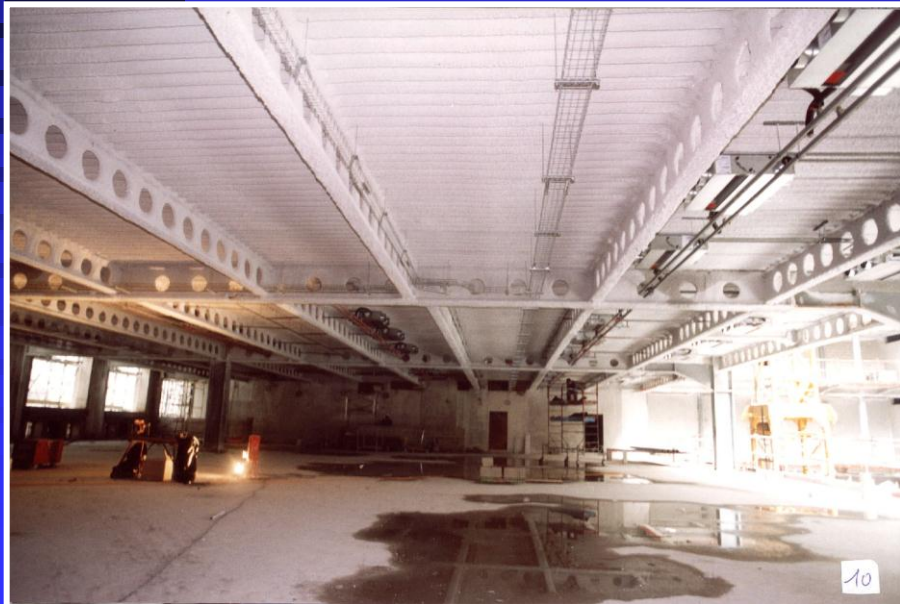


# Le Centorial (Paris , France, 2000)





# Le Centorial (Paris , France, 2000)





# Le Centorial (Paris , France, 2000)



# INSERTION



- **Insertion**= integration of the existing buildings with new structural elements inserted inside the same overall volume



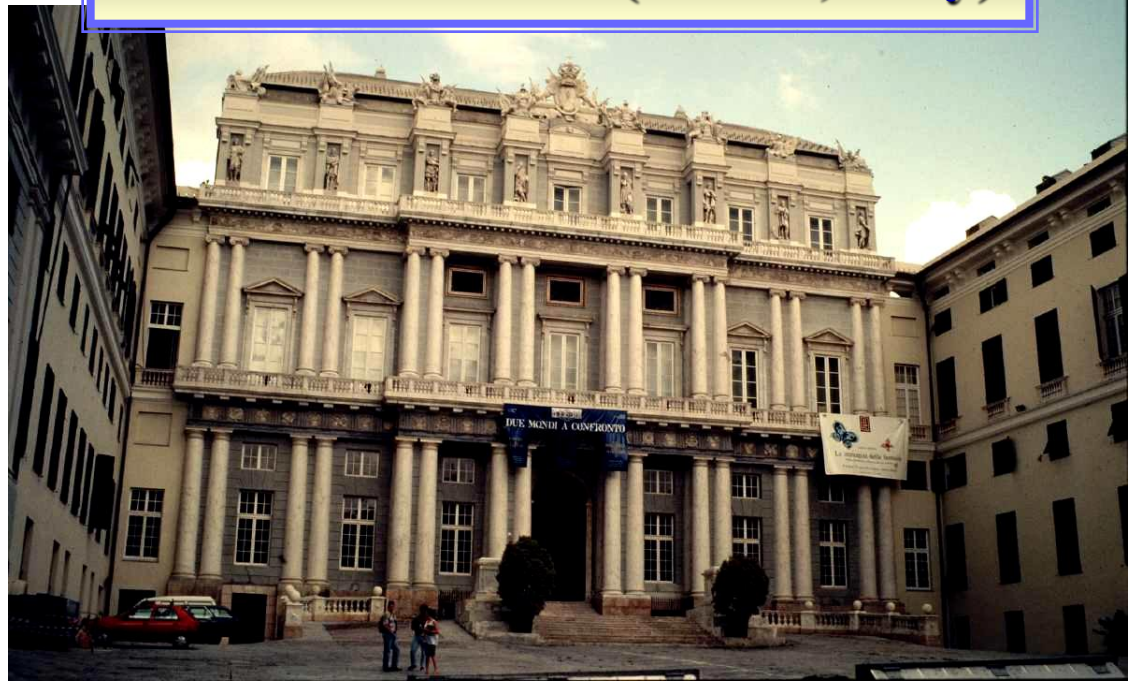
**The “Sinopie” Museum (Pisa, Italy)**



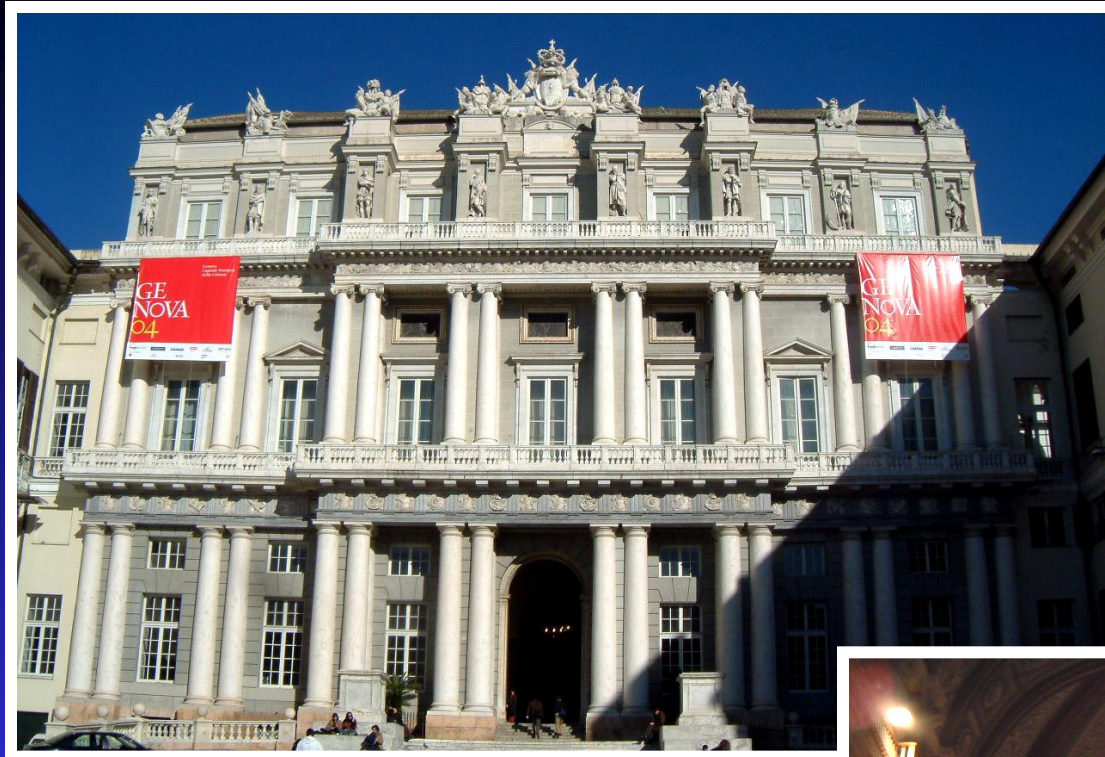




**The Ducal Palace (Genoa, Italy)**







**The Ducal Palace (Genoa, Italy)**

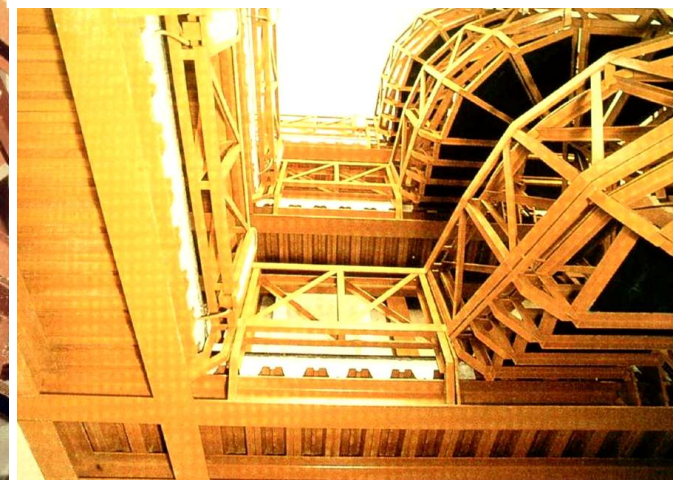


# The Ducal Palace (Genoa, Italy)

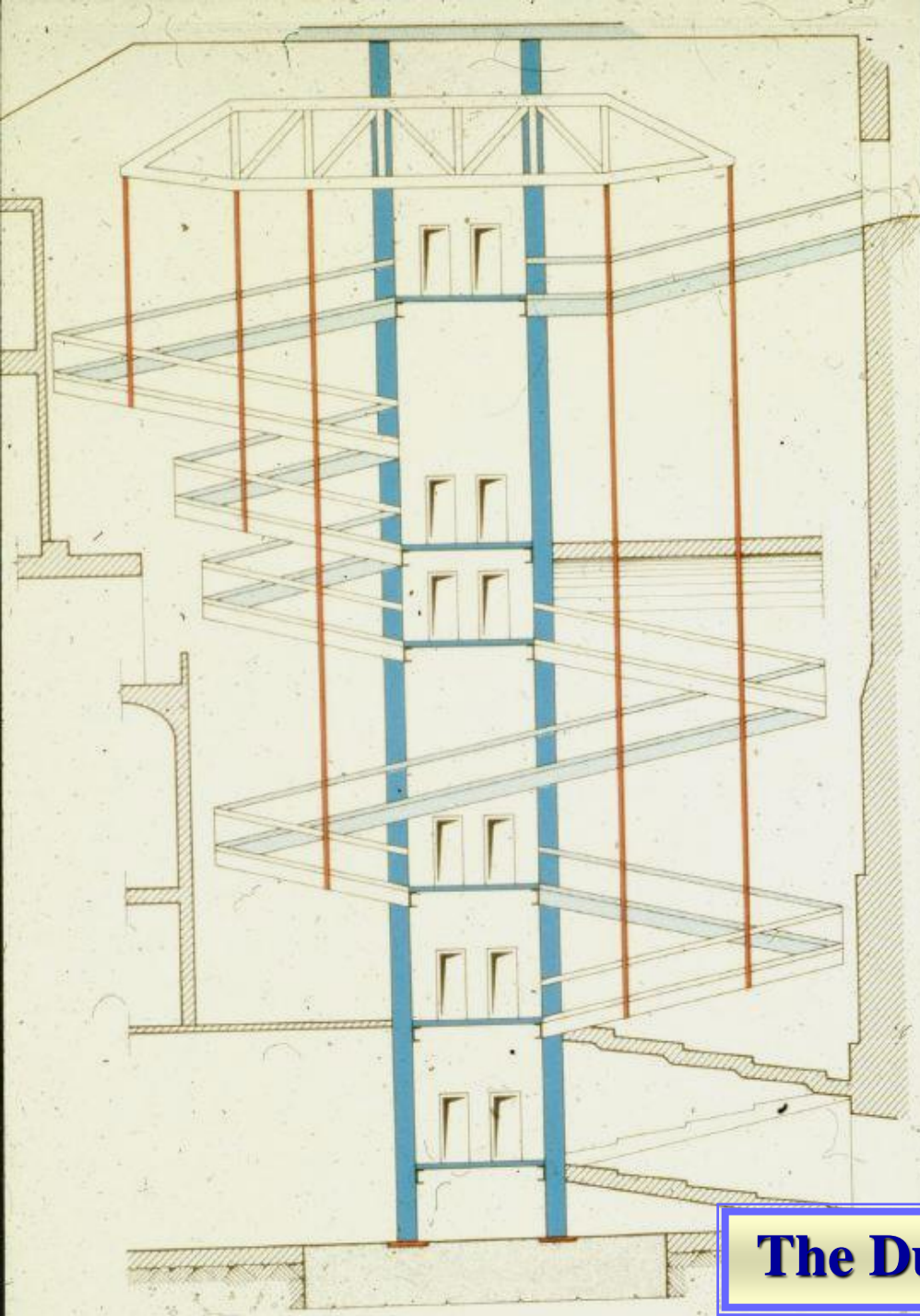




# The Ducal Palace (Genoa, Italy)







**The Ducal Palace (Genoa, Italy)**



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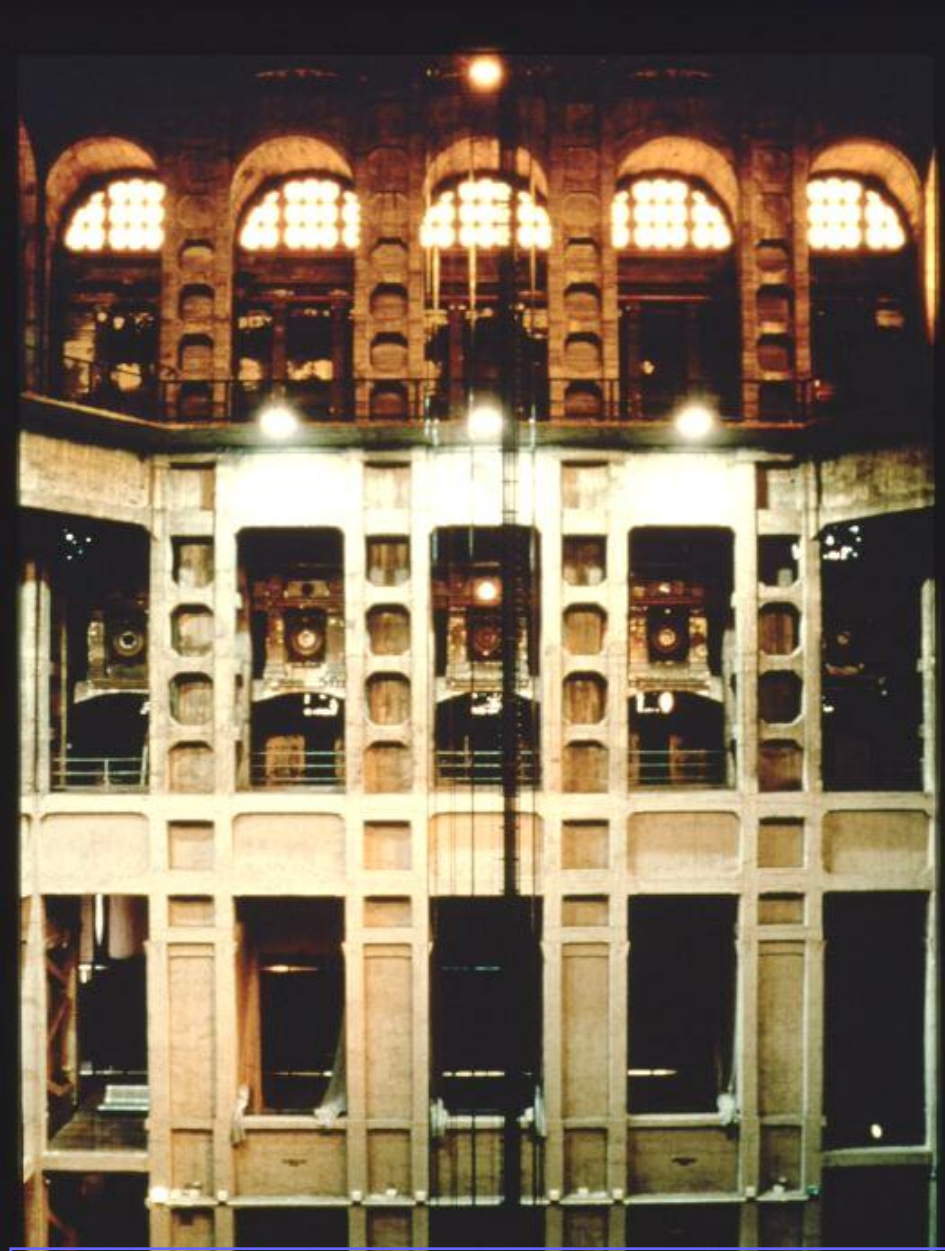
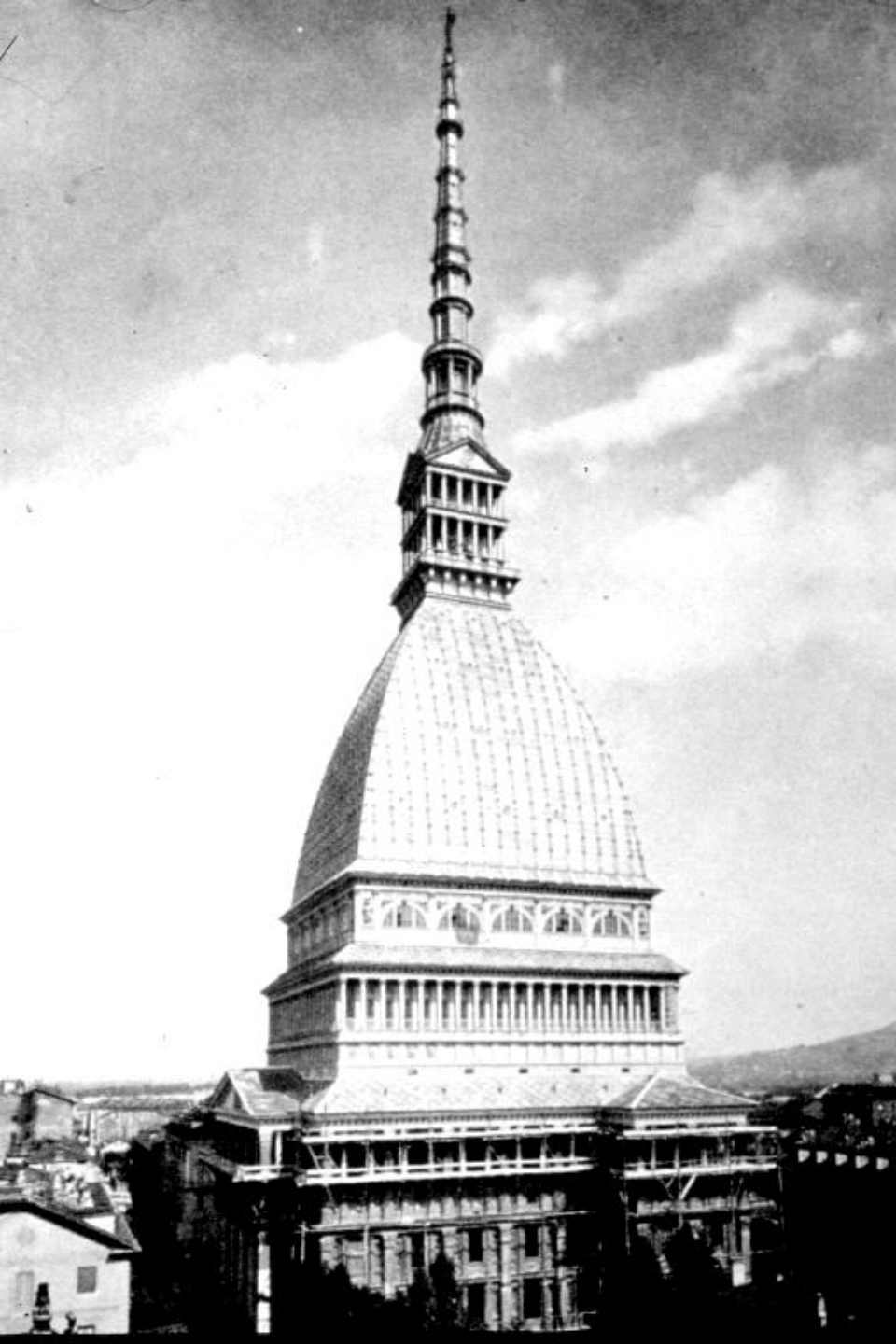




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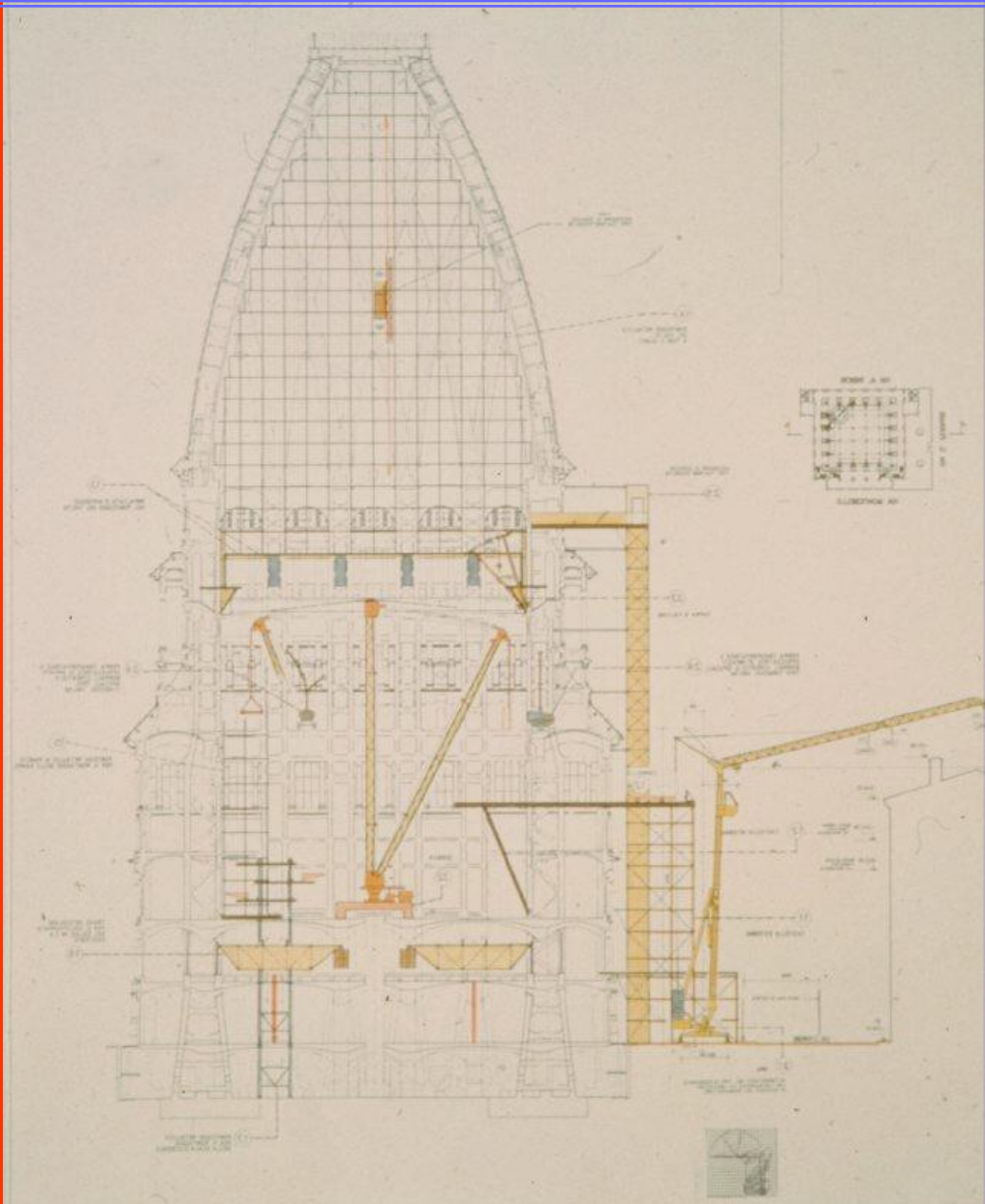
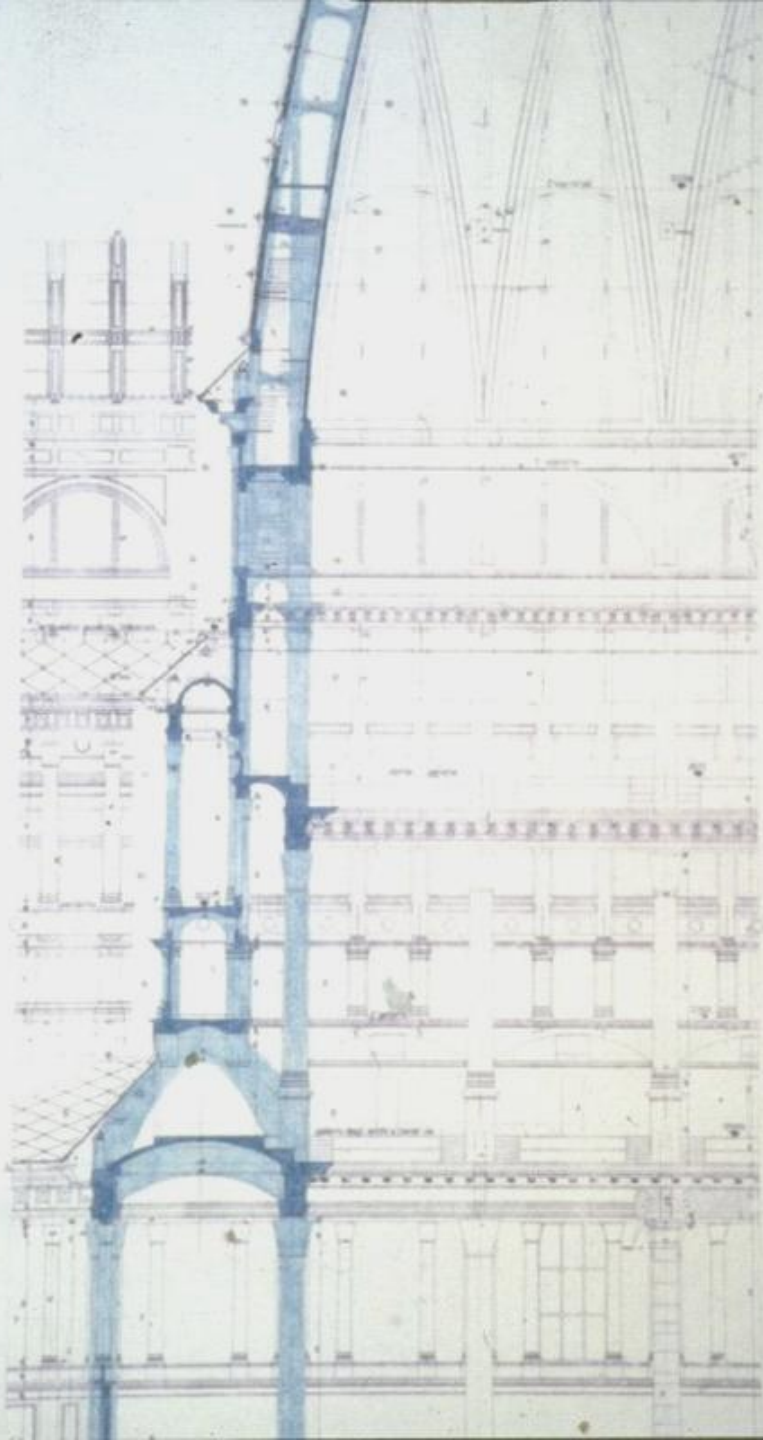




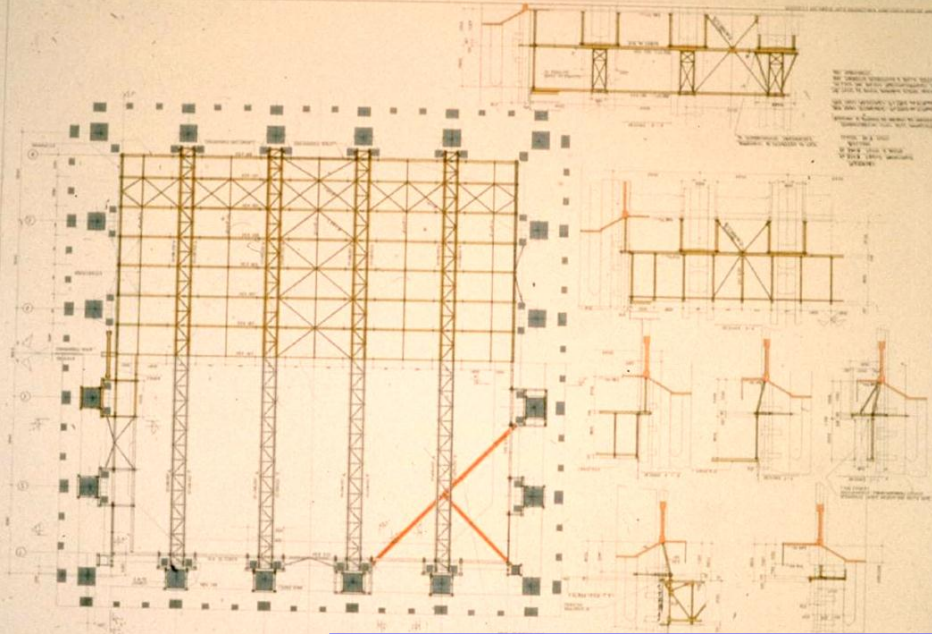
**The “Mole Antonelliana” (Turin, Italy)**



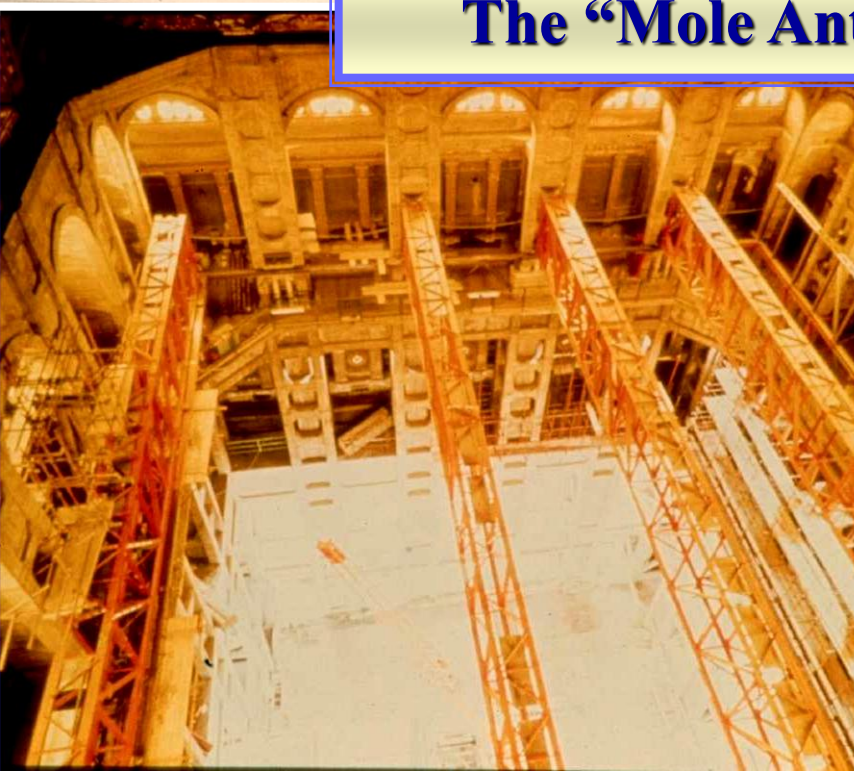
# The “Mole Antonelliana” (Turin, Italy)



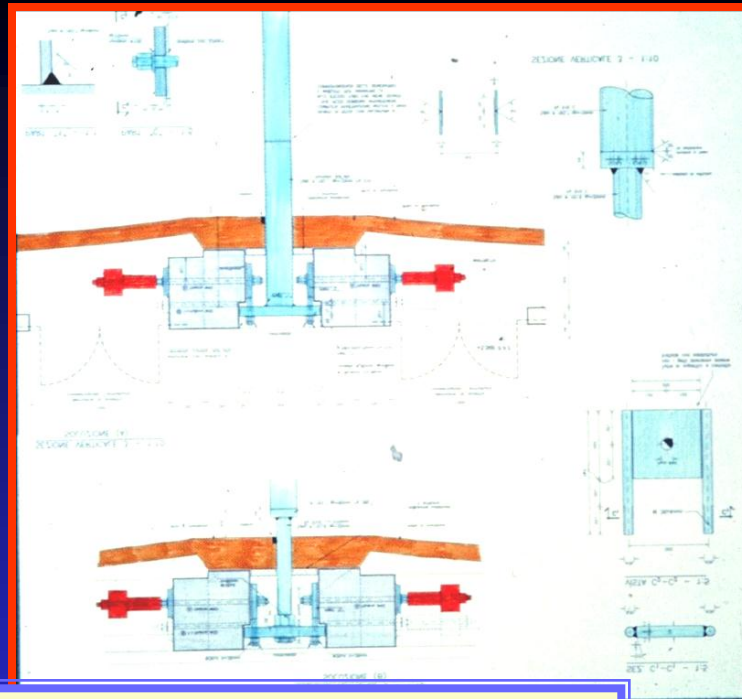
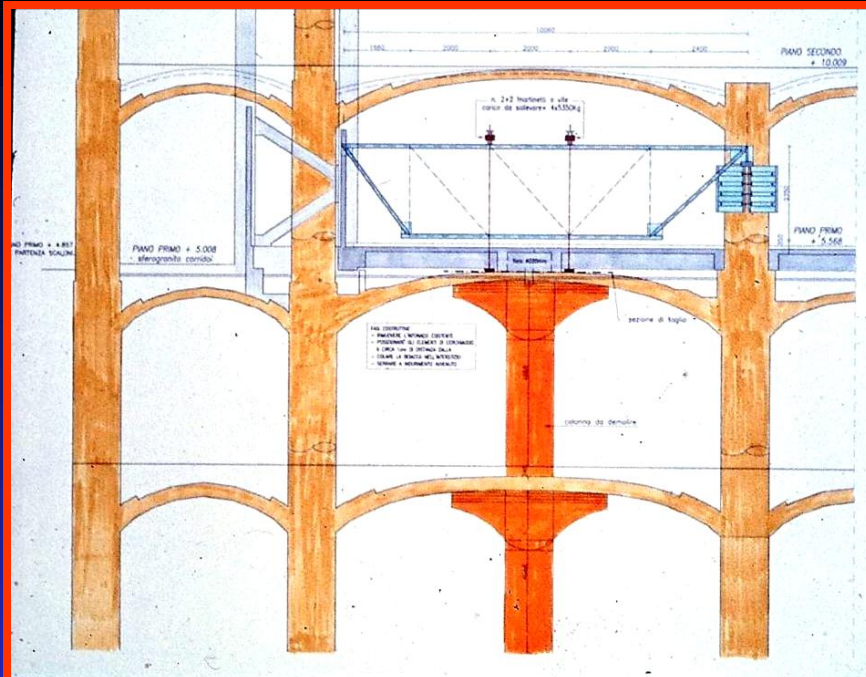




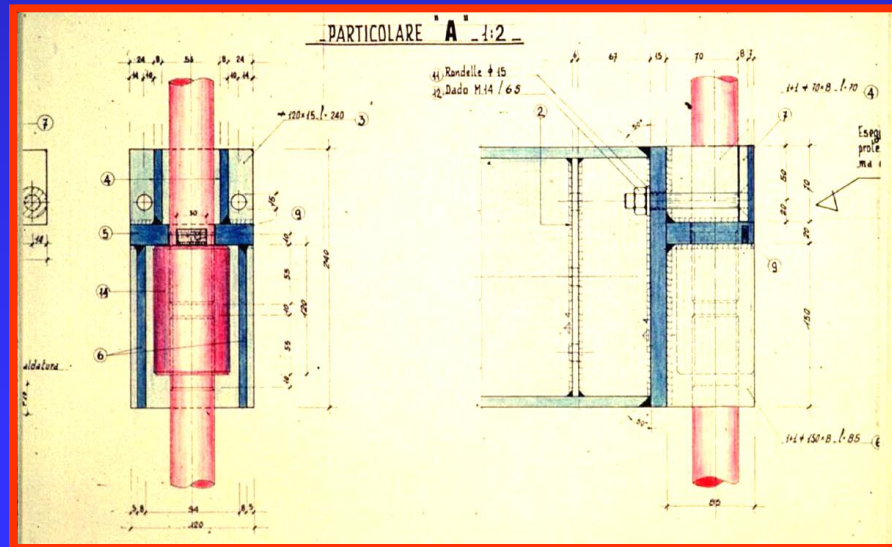
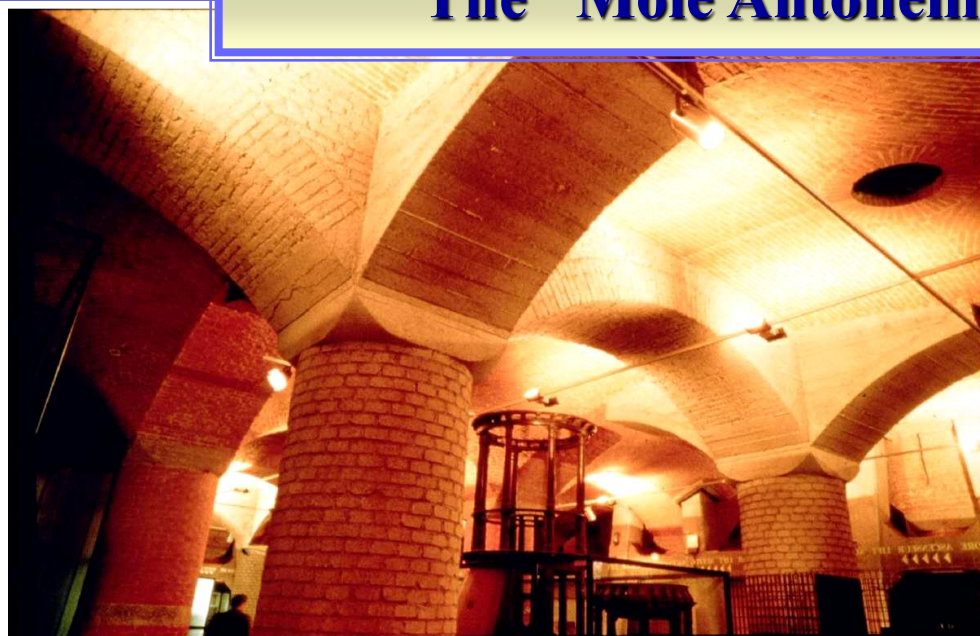
**The “Mole Antonelliana” (Turin, Italy)**





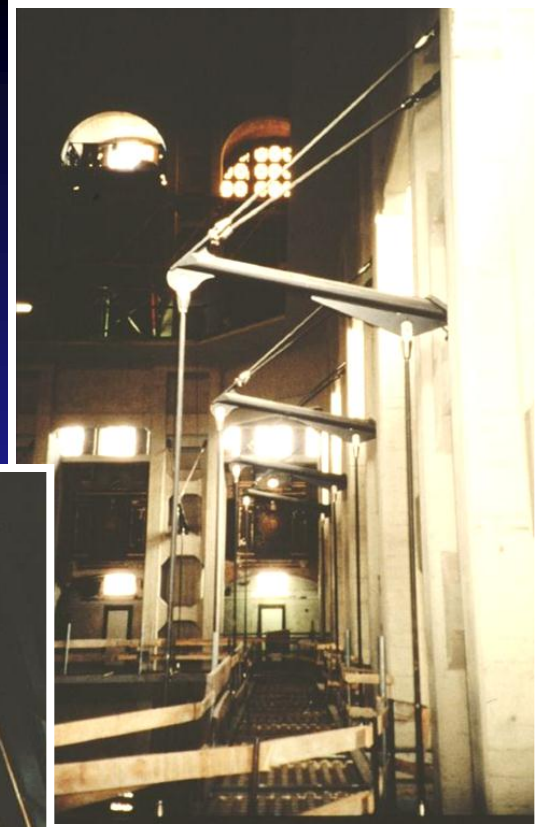
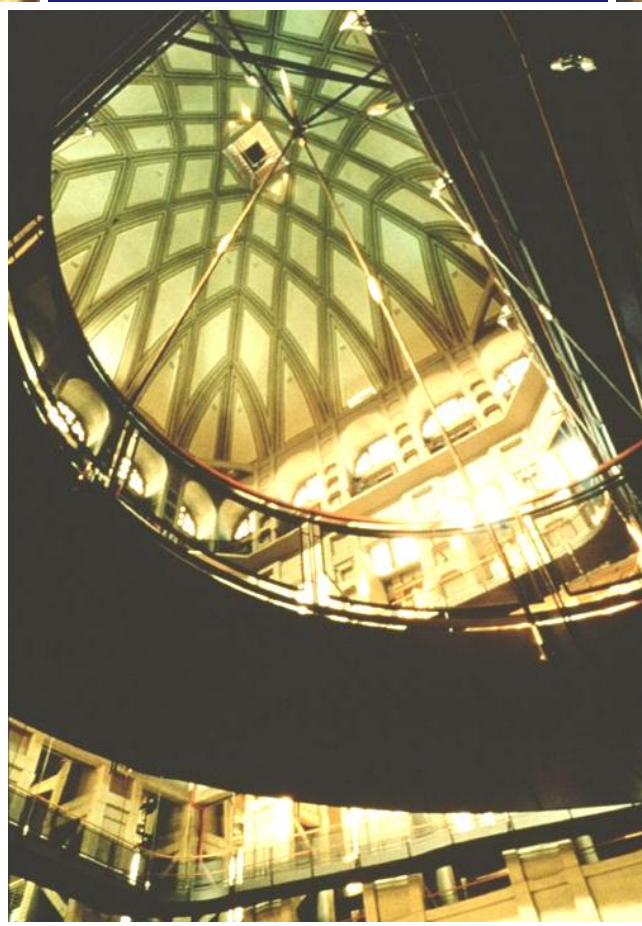


## The “Mole Antonelliana” (Turin, Italy)





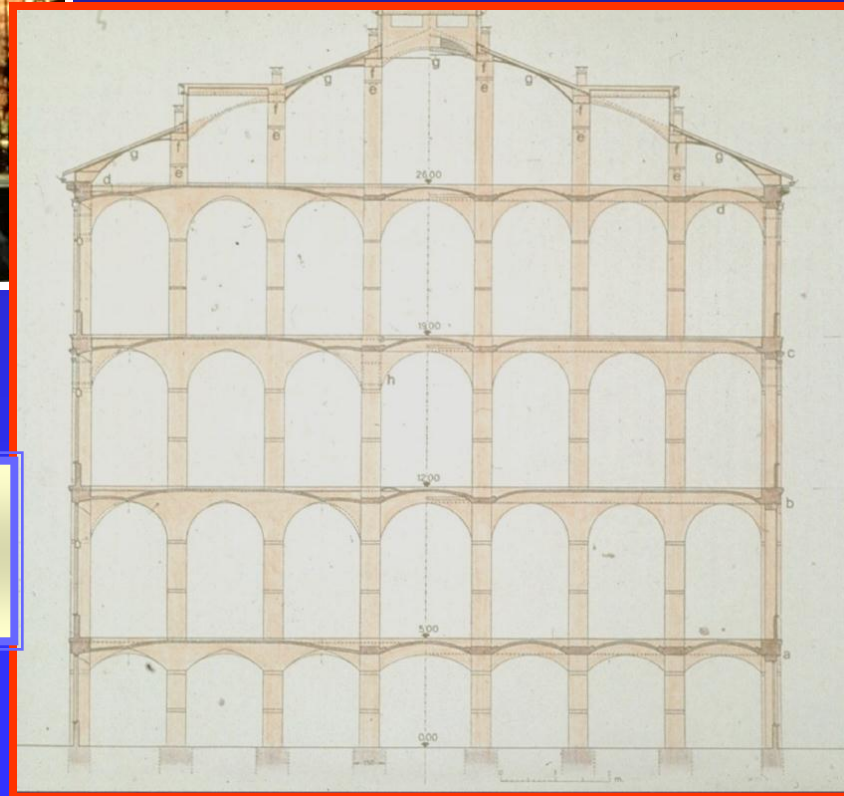
**The “Mole  
Antonelliana”  
(Turin, Italy)**



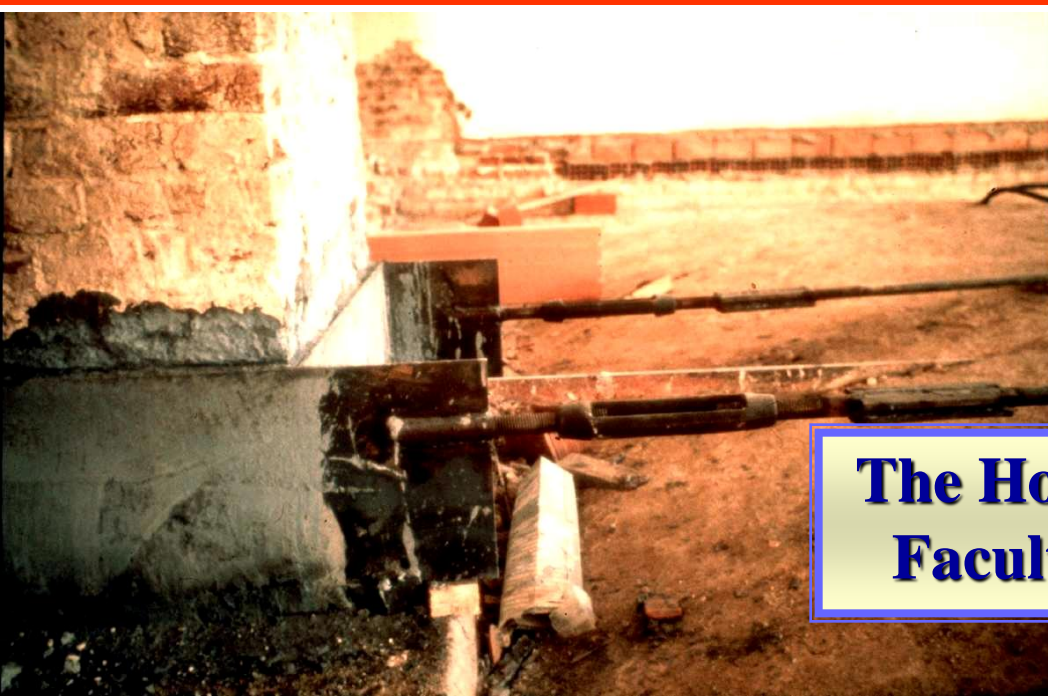
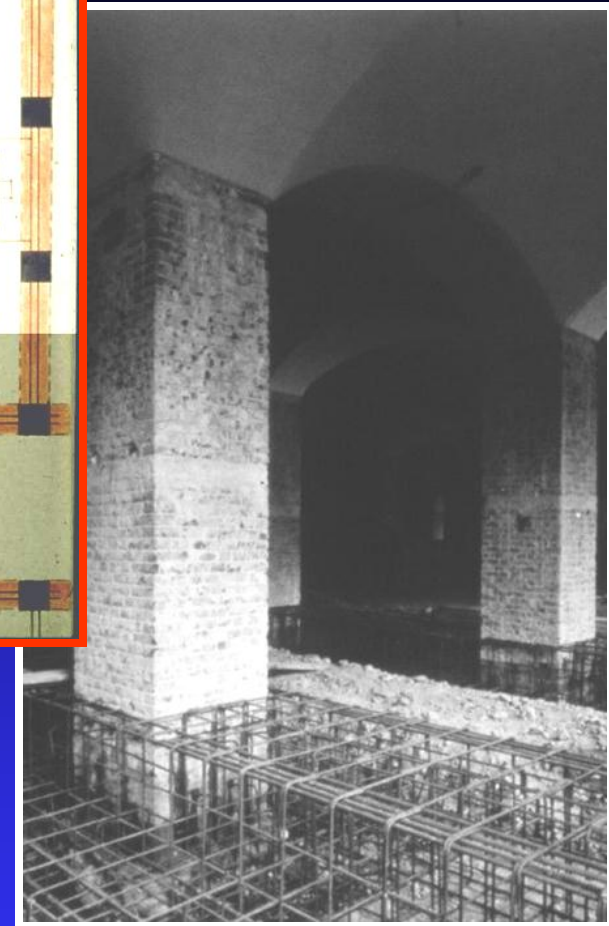
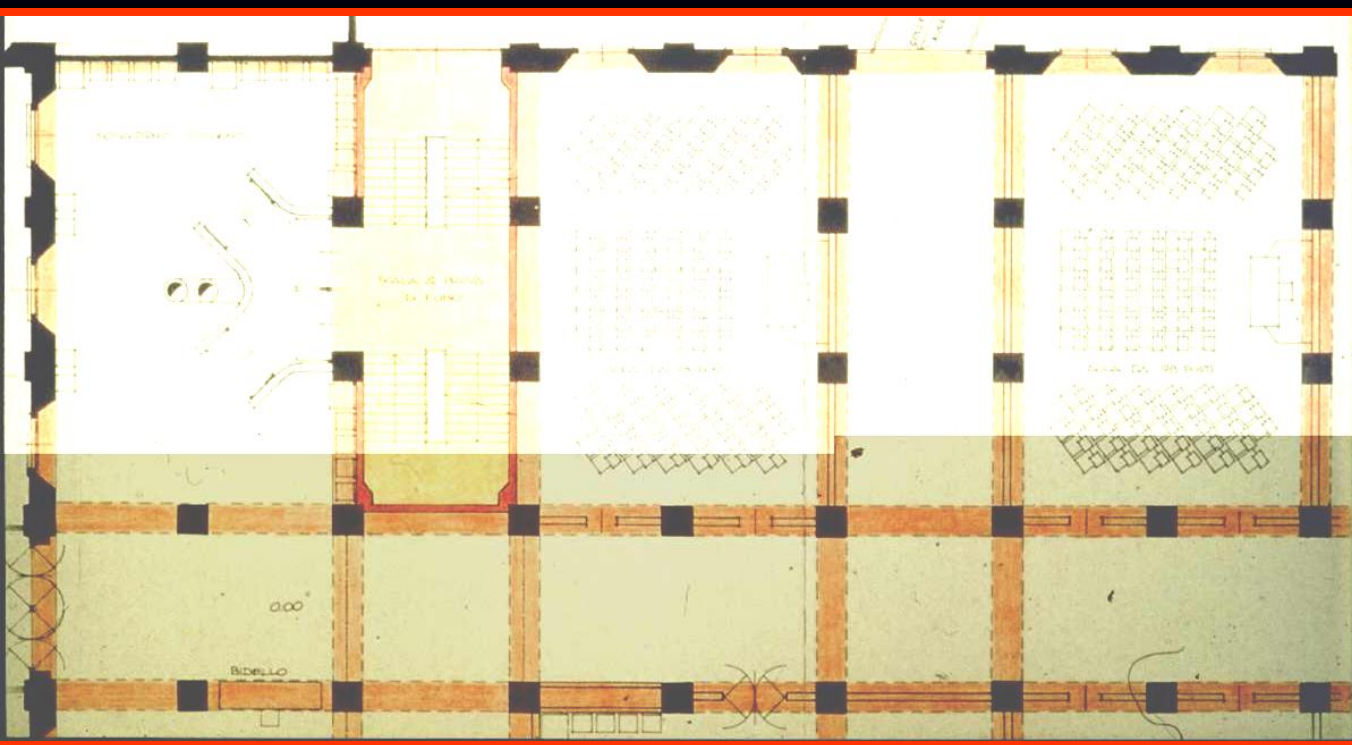




**The House for the Old, now the New  
Faculty of Economy (Turin, Italy)**







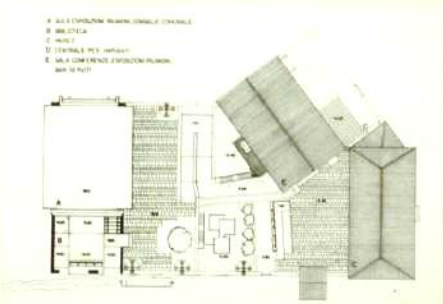
**The House for the Old, now the New  
Faculty of Economy (Turin, Italy)**



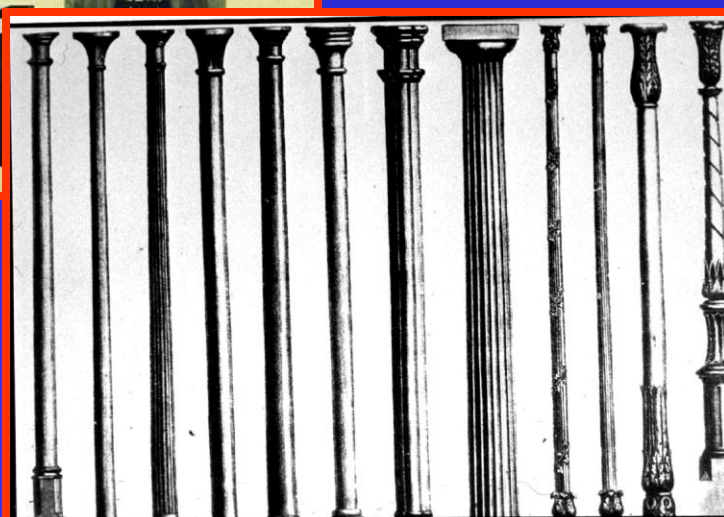


**The House for the Old,  
now the New Faculty of  
Economy (Turin, Italy)**

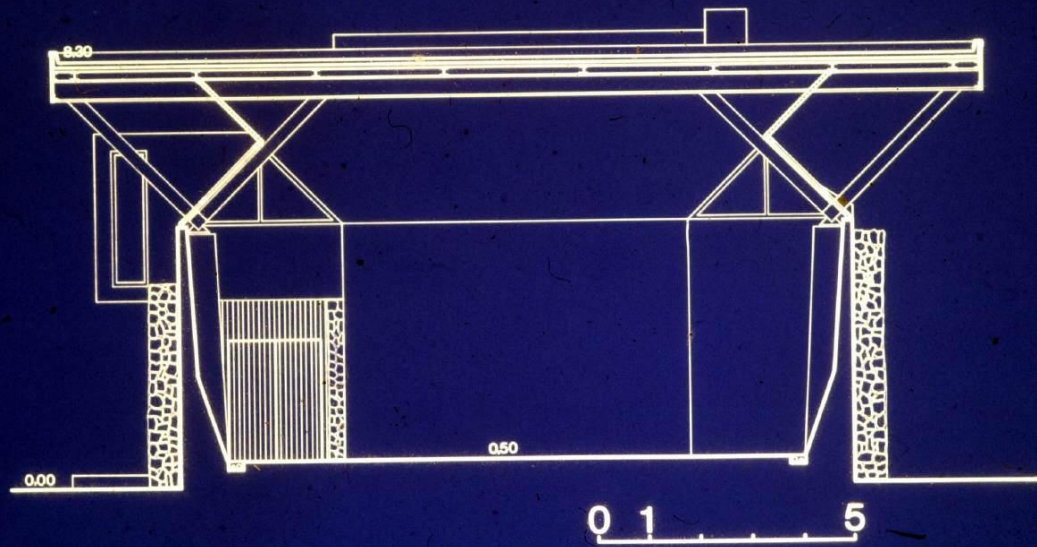




## The old royal iron mills in Mongiana (Calabria, Italy)



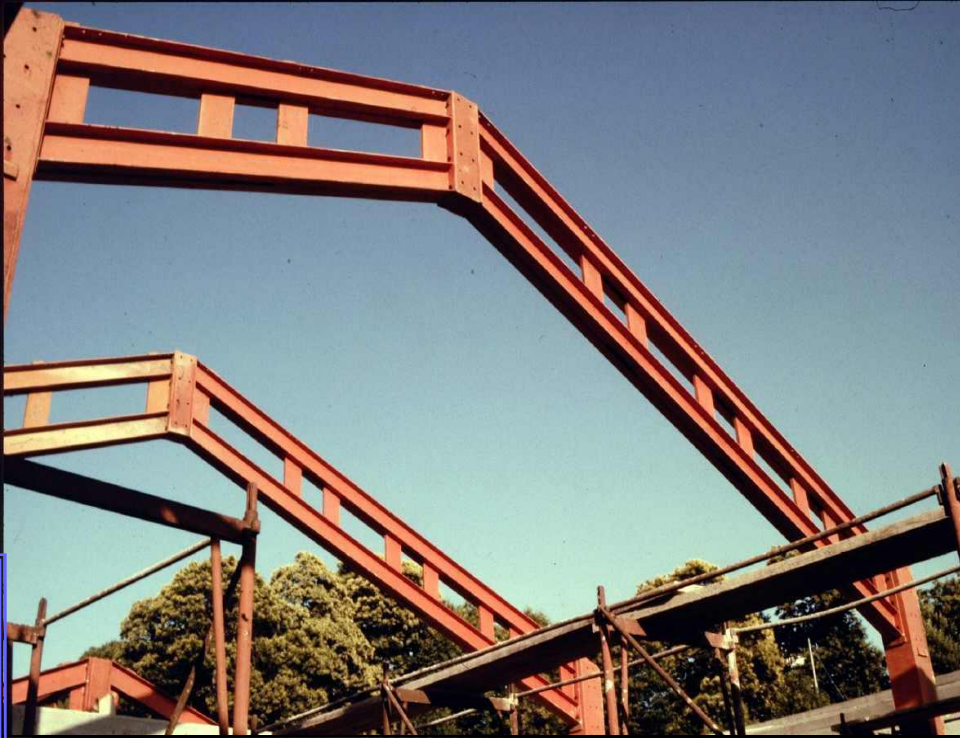
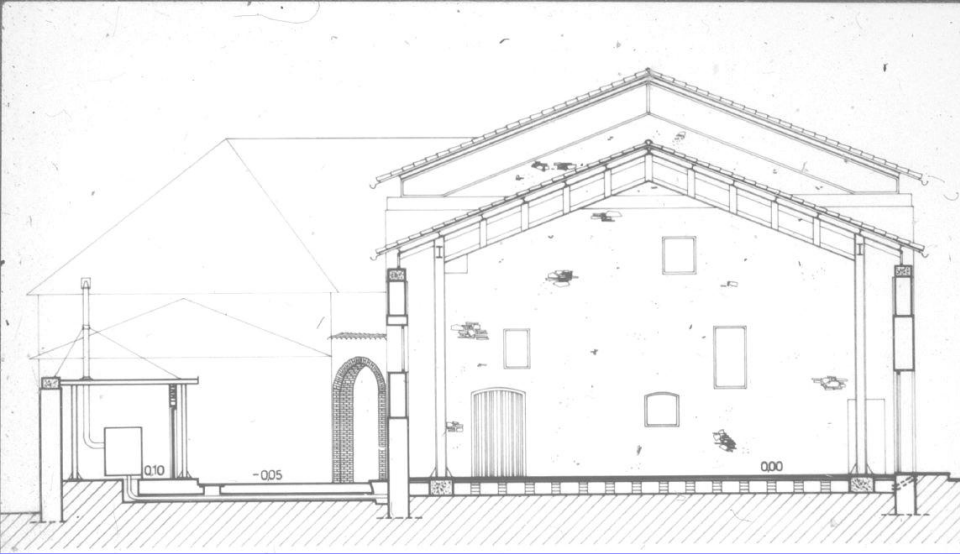




**The old royal iron mills in  
Mongiana (Calabria,  
Italy)**



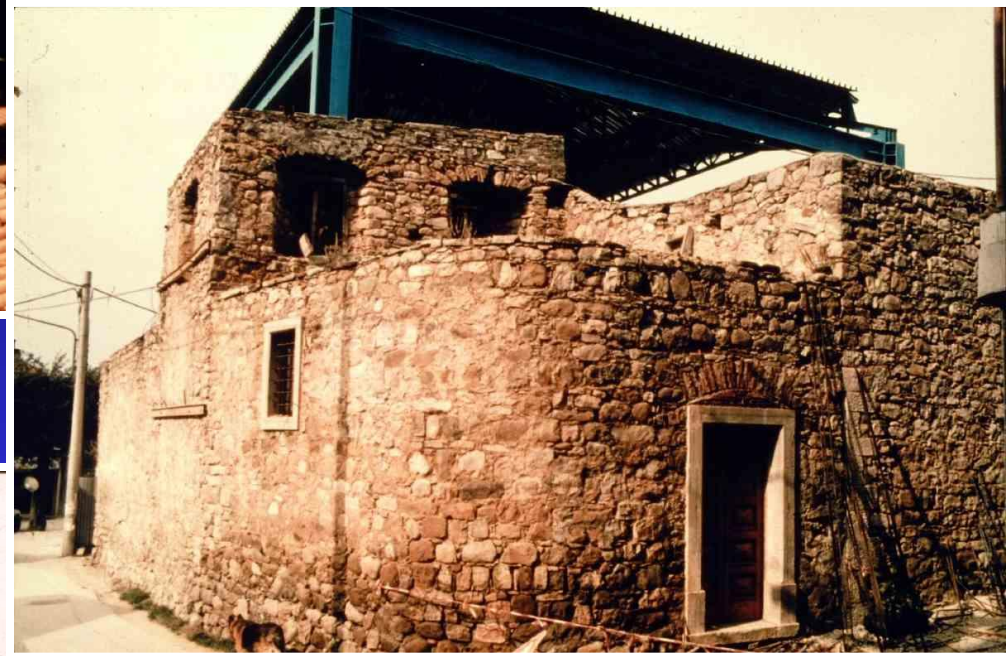




**The old royal iron mills  
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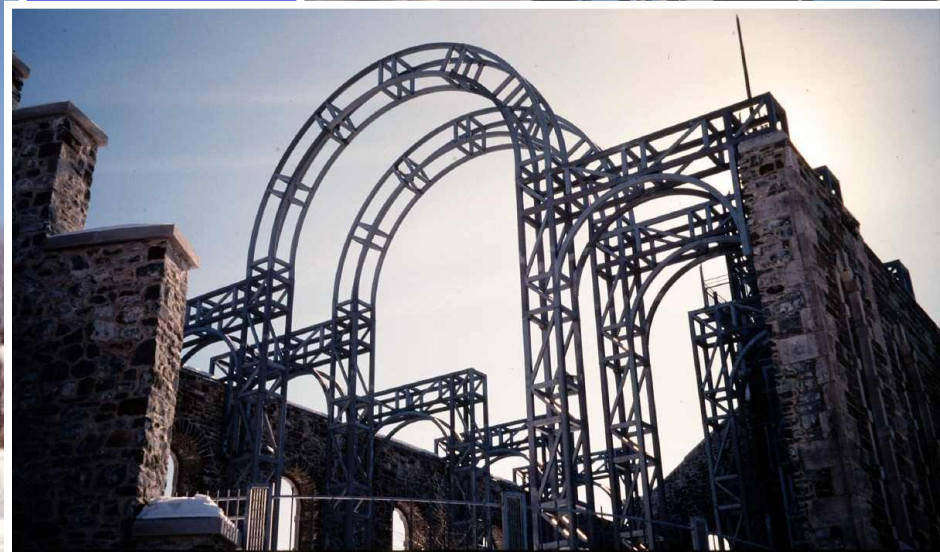
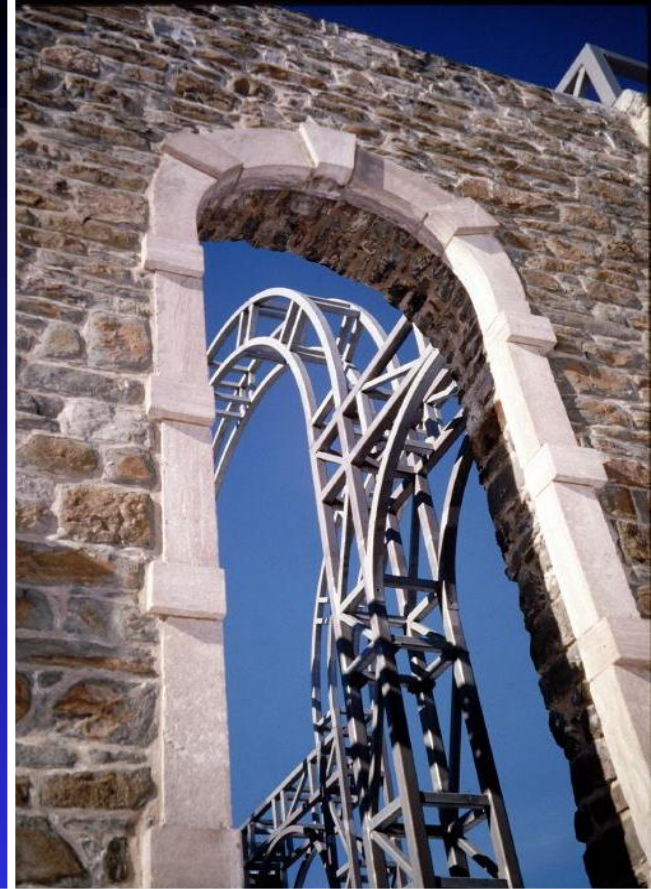




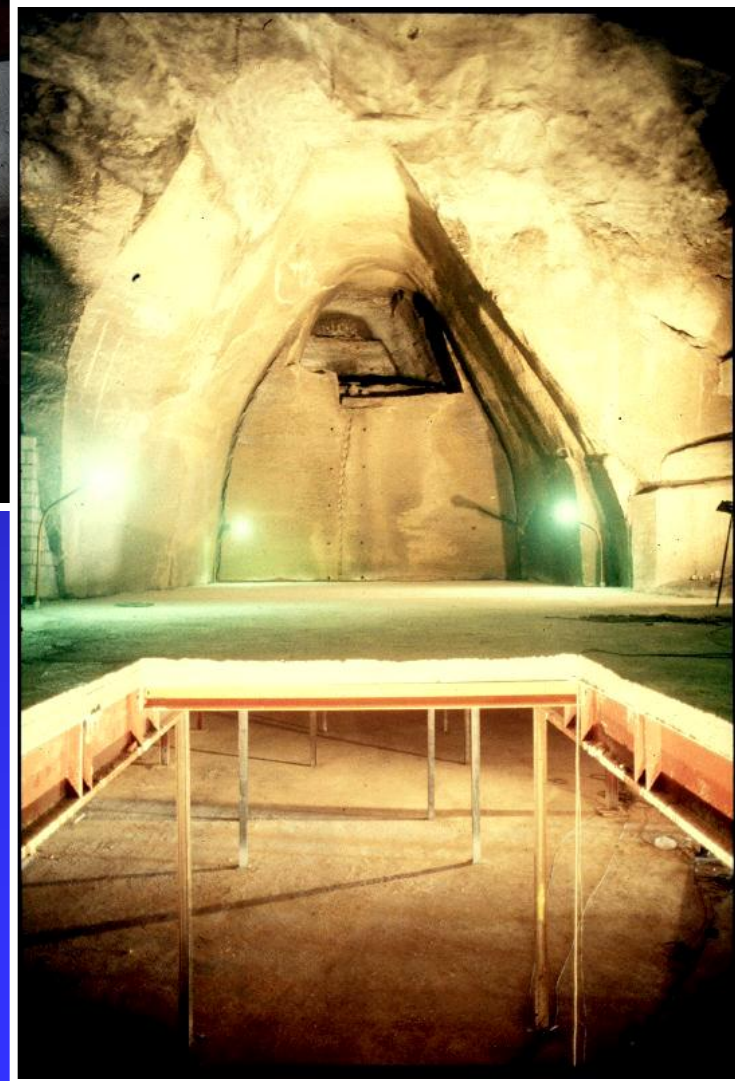
**The St. Rocco church,  
now” Sacrarium”  
(Morra de Sanctis - Avellino,  
Italy)**



**A masonry church destroyed by fire  
(Quebec City, Canada)**

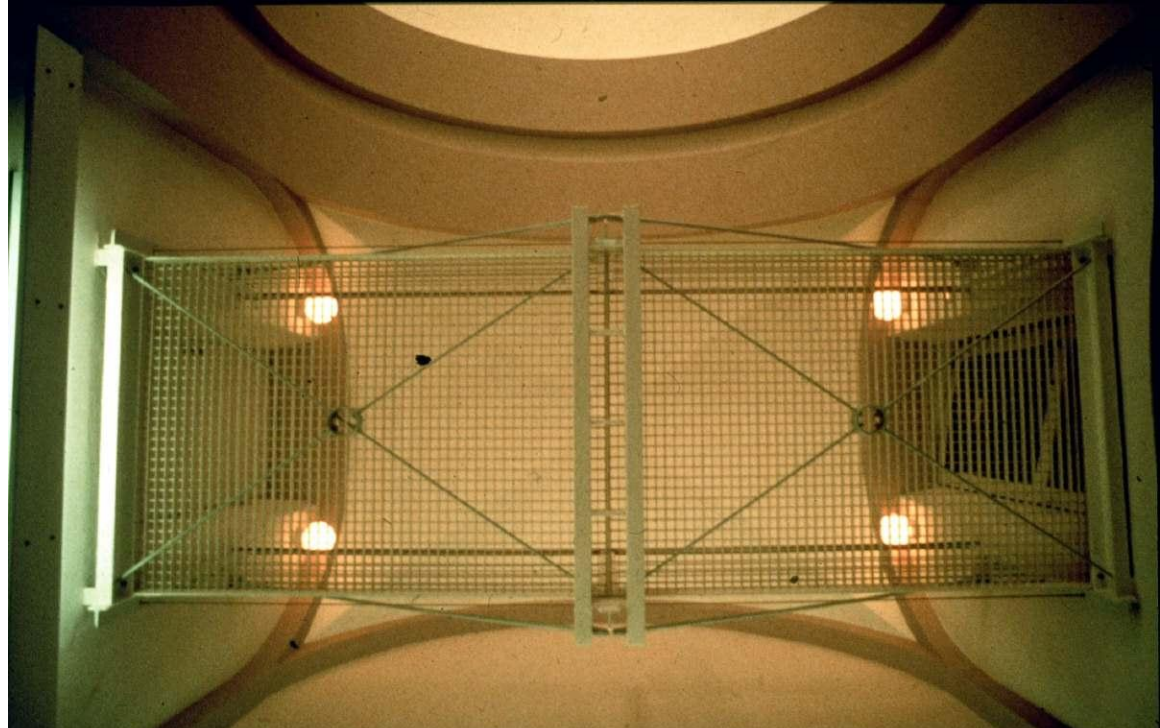






**Parking area in a tuff cave  
(Naples, Italy)**

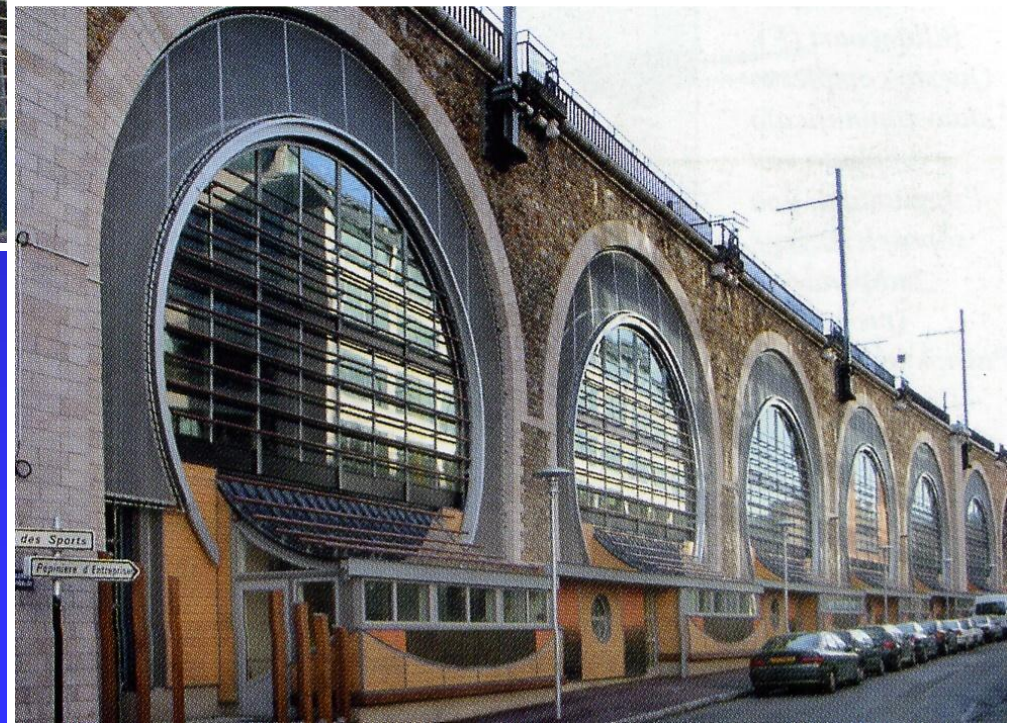




**Chemistry Institute of  
TU (Berlin, Germany)**

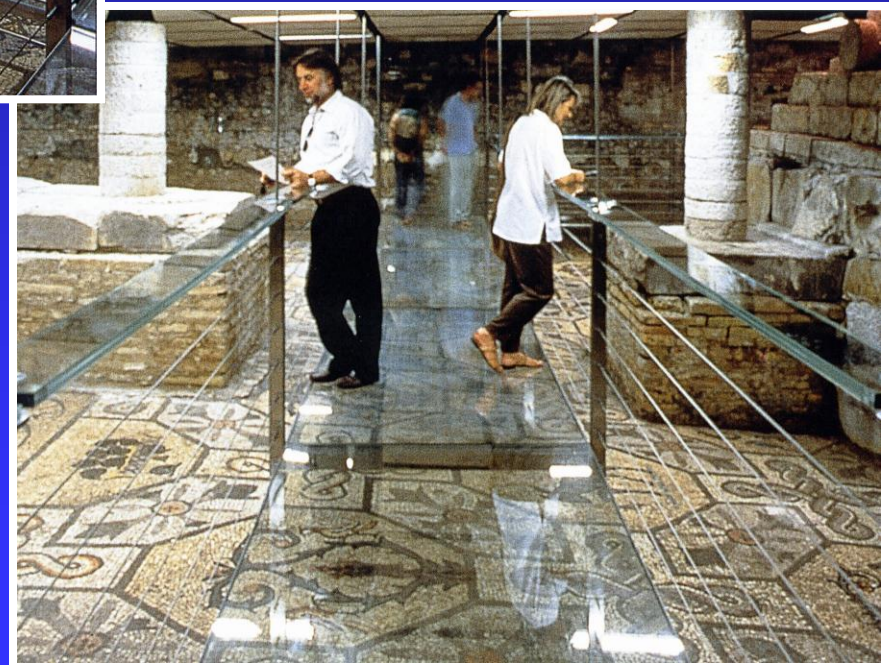


# Issy Les Moulineaux (France): Les Arches (Dudosc & Landowski)

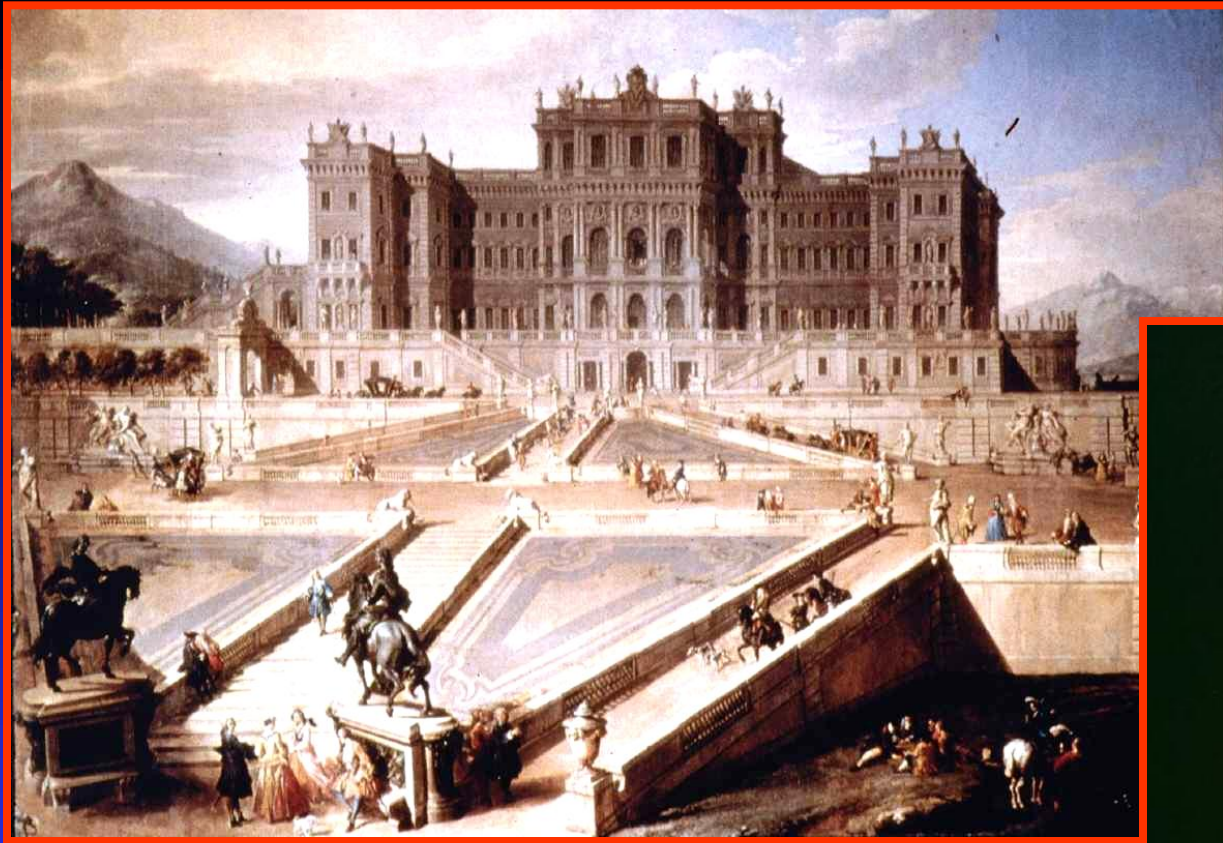




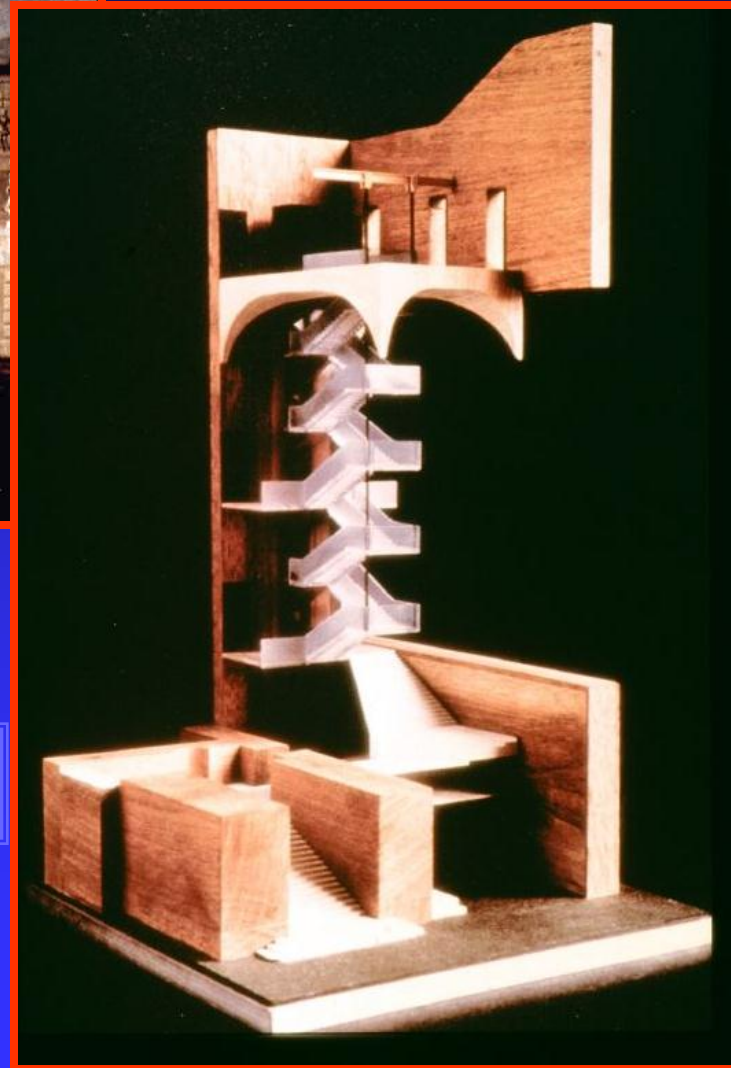
## Floating path on a roman mosaic in Aquileia ( Italy )







**The Rivoli's Castle near Turin (Italy)**





# The Rivoli's Castle near Turin (Italy)





# **EXTENSIONS**

**Horizontal extension**

**Vertical extension**



- **Horizontal extension** = addition of new volumes beside the existing building



# Horizontal extension





**Horizontal extension**



**The University of Tessaly (Volos-Greece)**



# Horizontal extension



**Bow-windows in a building  
(Vienna, Austria)**





# Horizontal extension



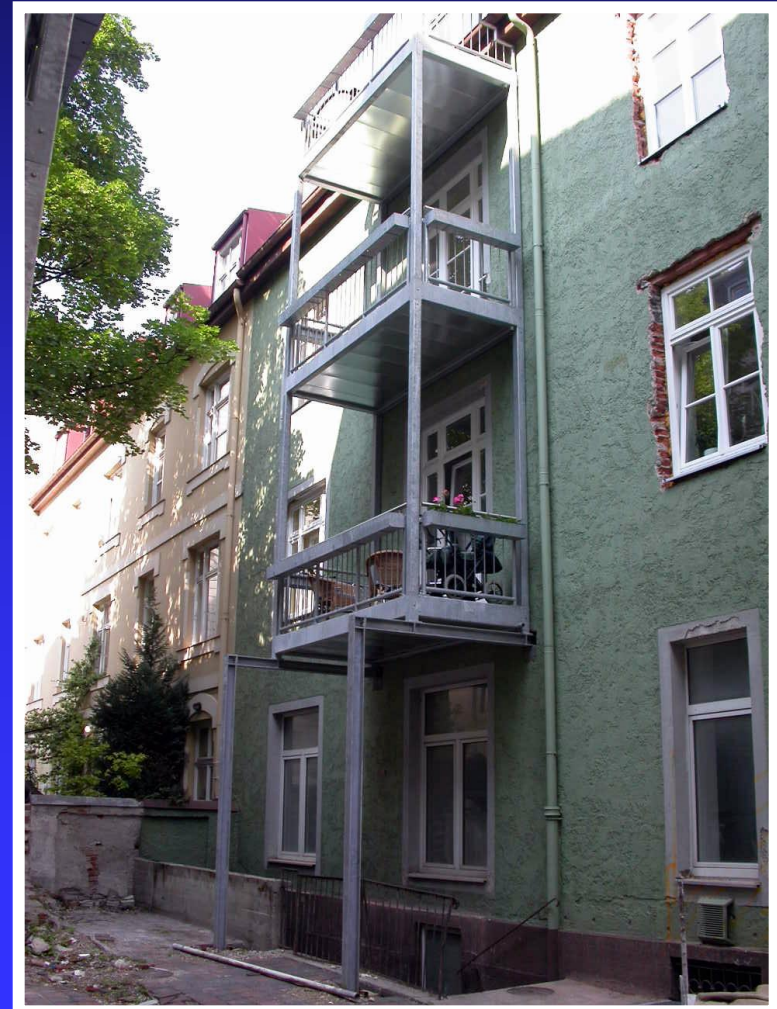
**Bow-windows in a building  
(Munich, Germany)**



# Horizontal extension

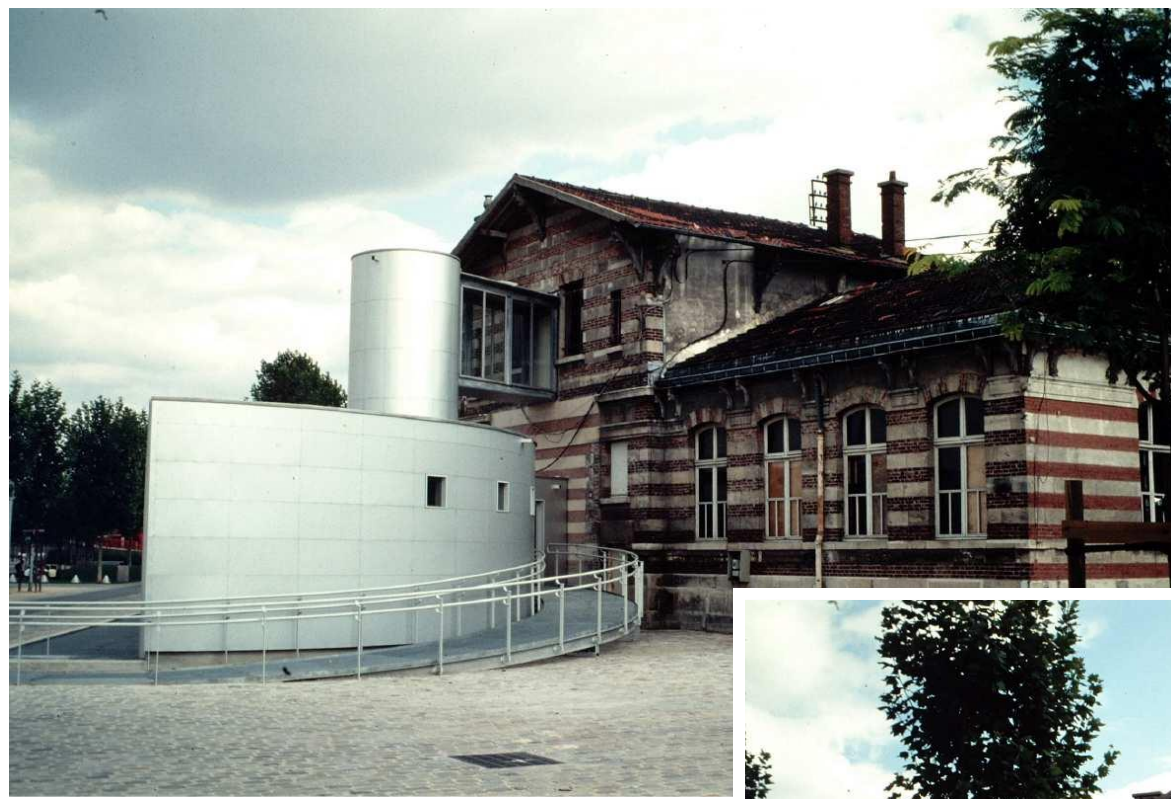


**Bow-windows in a building  
(Munich, Germany)**

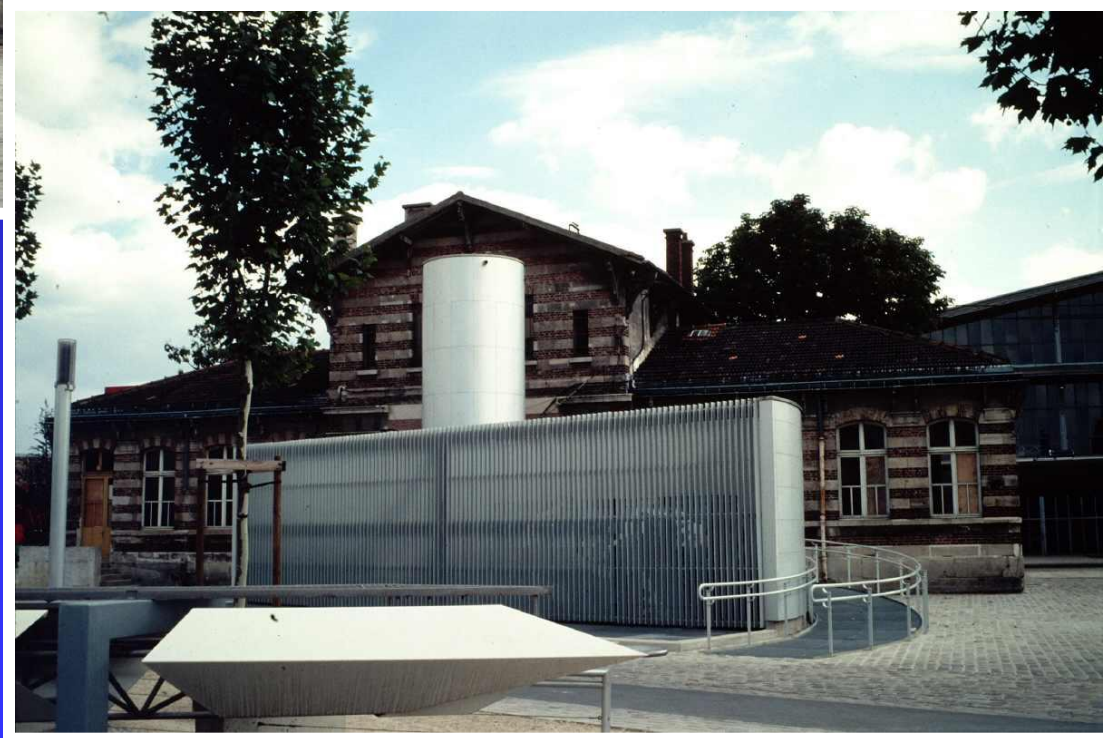




# Horizontal extension



**La Villette Park  
(Paris, France)**





# Horizontal extension

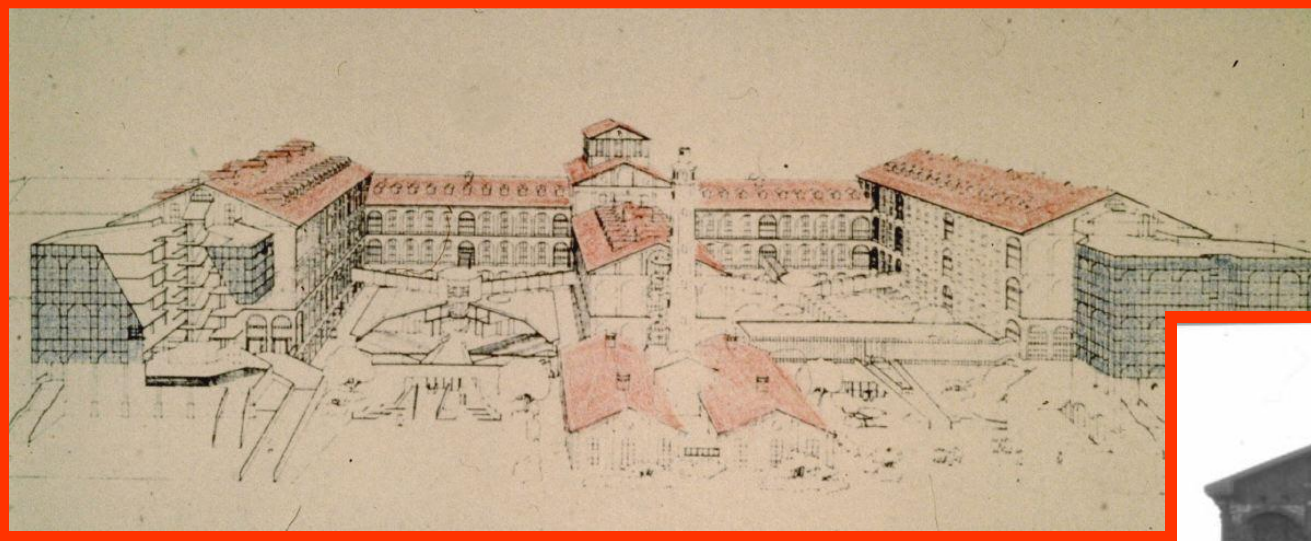


**Episcopal Palace in  
St. Andrea di Conza  
(Avellino, Italy)**





**Horizontal  
extension**



**The new Faculty of Economy (Turin,  
Italy)**

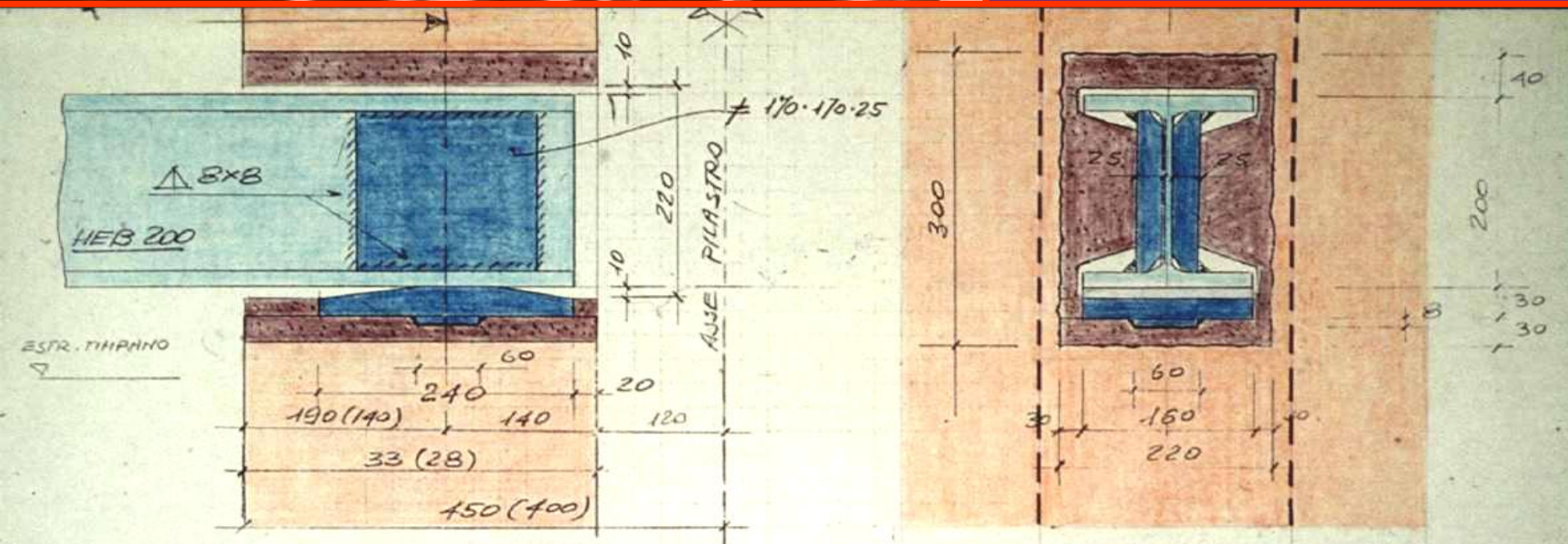




# The new Faculty of Economy (Turin, Italy)

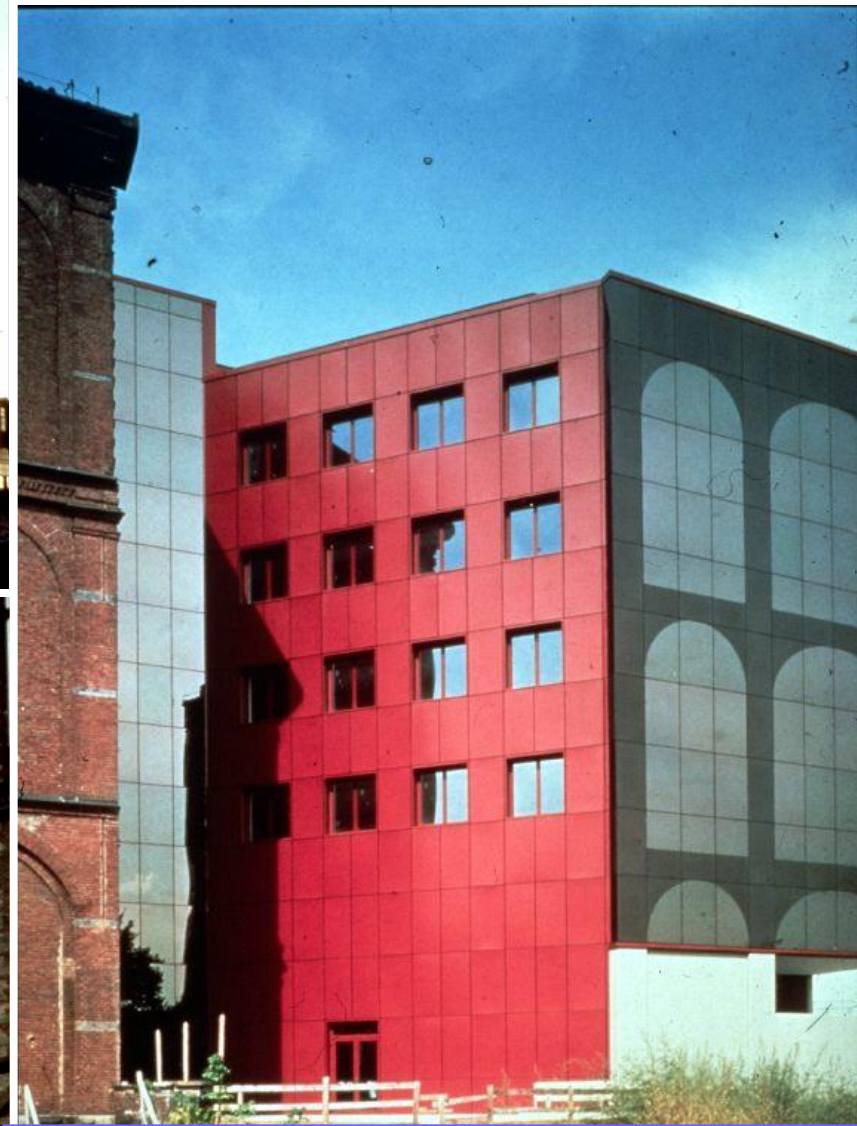
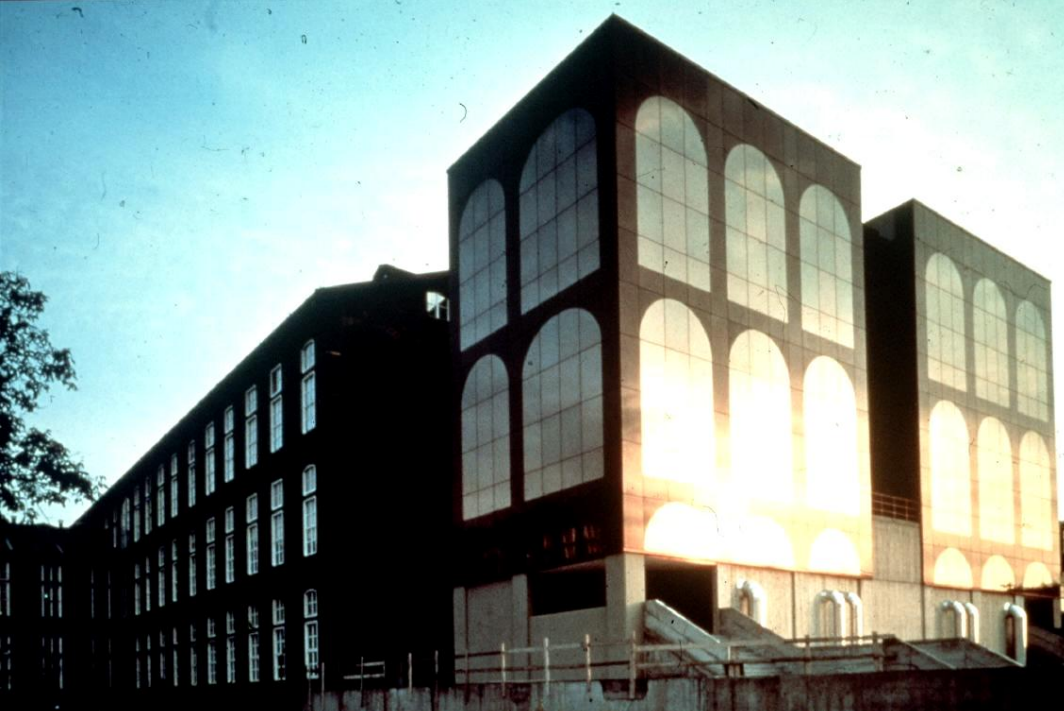


## Horizontal extension





# Horizontal extension



**The new Faculty of Economy  
(Turin, Italy)**



# Horizontal extension

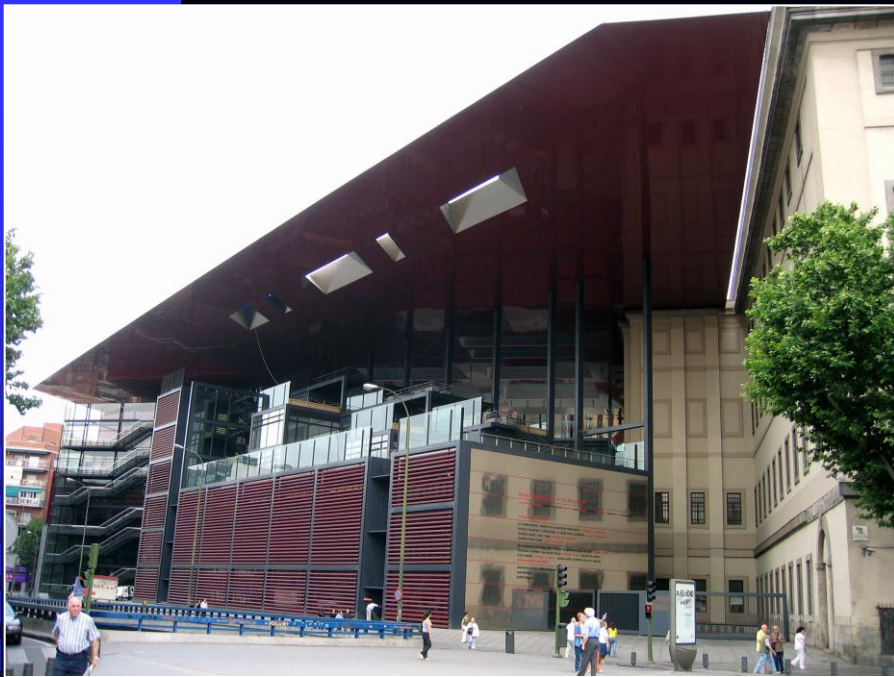


## The “Reina Sophia” Museum in Madrid





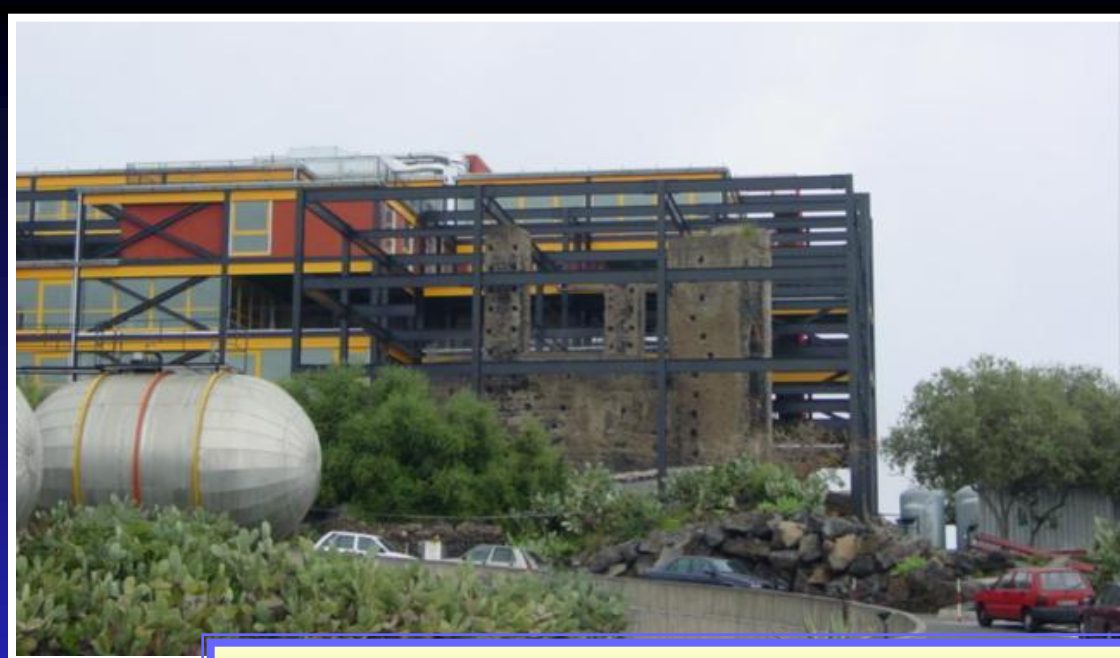
# Horizontal extension



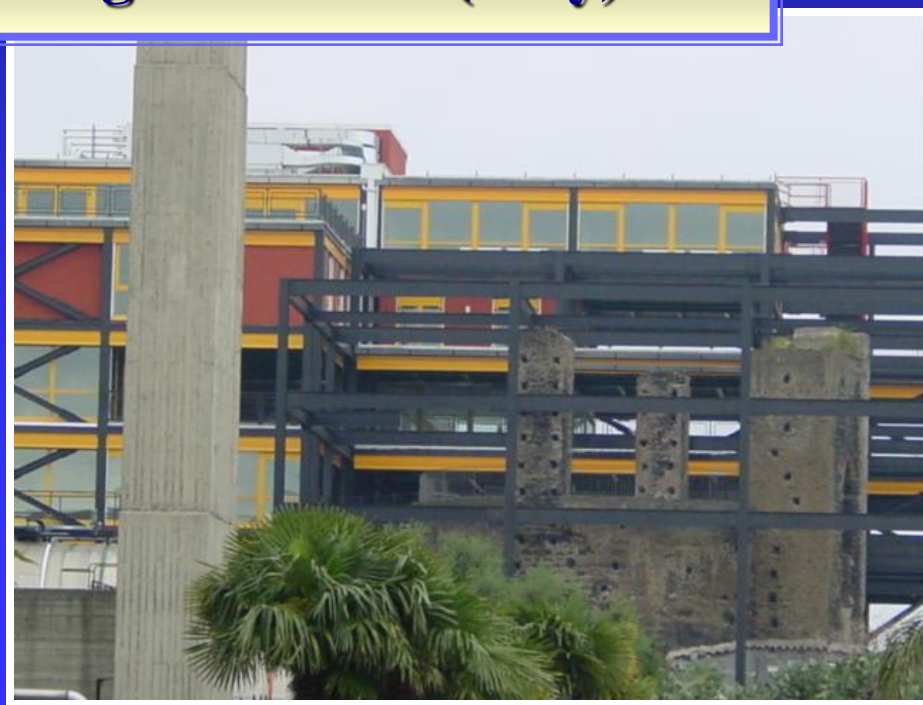
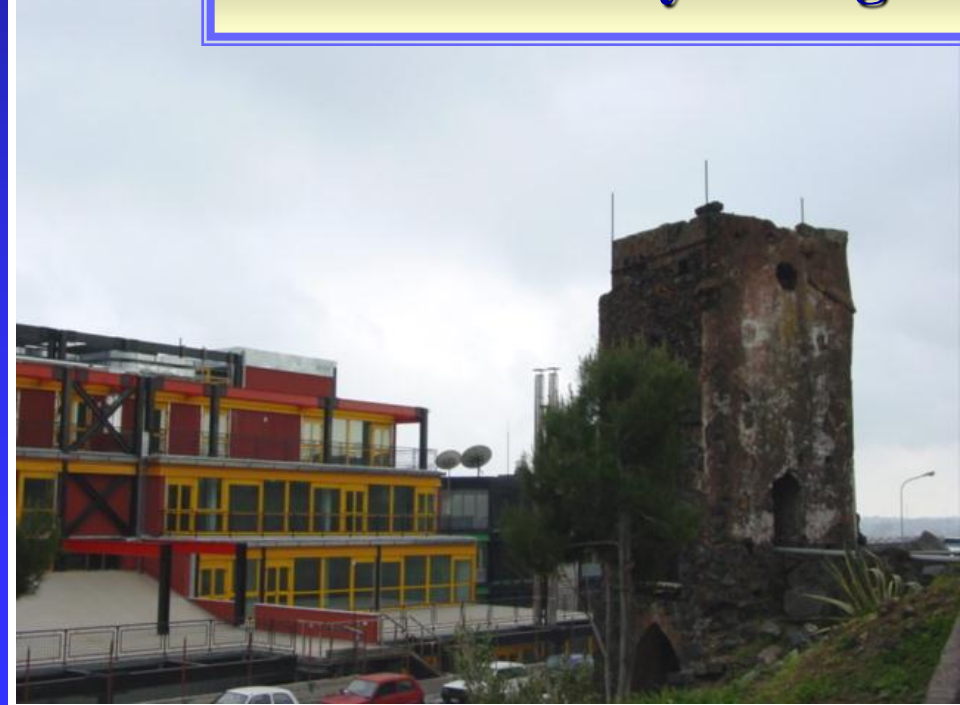
**The “Reina Sophia” Museum in Madrid**



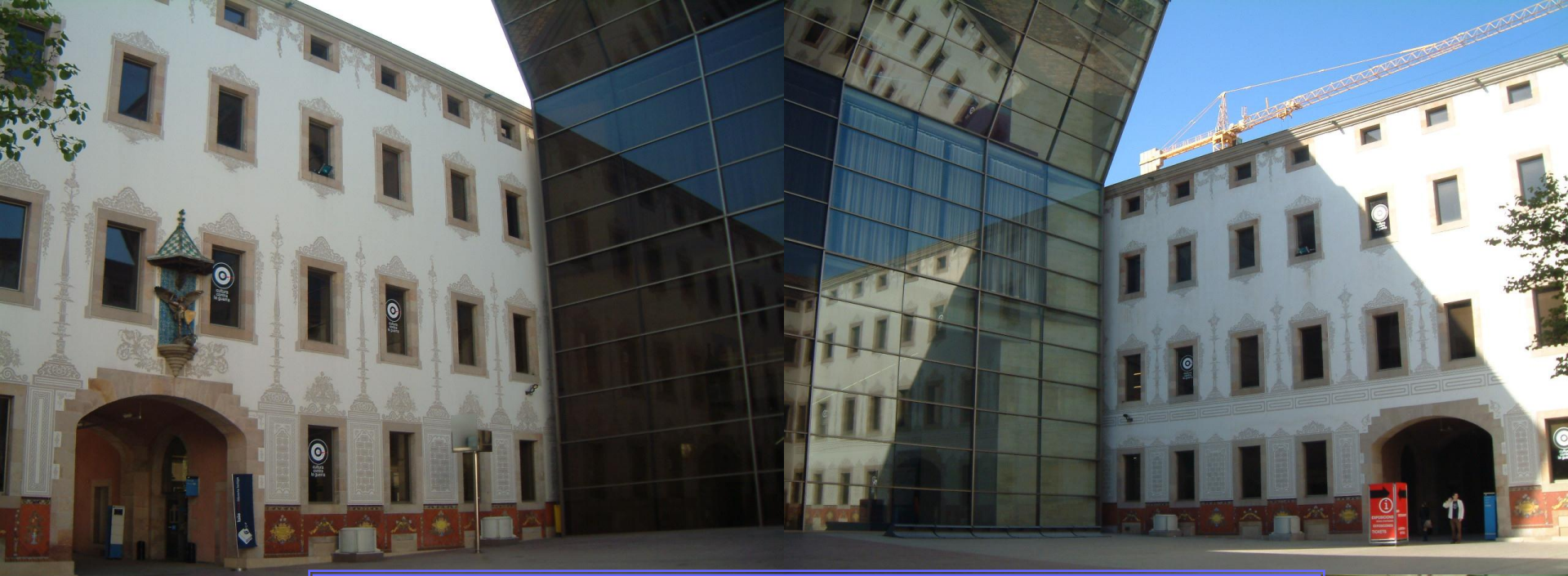
# Horizontal extension



**The Faculty of Engineering of Catania (Italy)**







## **The Civic Centre of Barcelona**



**Horizontal extension**





## **The National Museum of Dublin**



**Horizontal extension**





**Horizontal extension**

**The Architectural Faculty  
of Genova**



**A glass Pavillion for exhibition  
(Bologna,historical center)**



**Horizontal extension**





**Office building**

**Horizontal extension in Berlin ( Germany )**



## Horizontal extension in Delft ( The Netherland )



**Office building**





■ **Vertical extension** = addition of one or more stories above the existing building



# Vertical extension



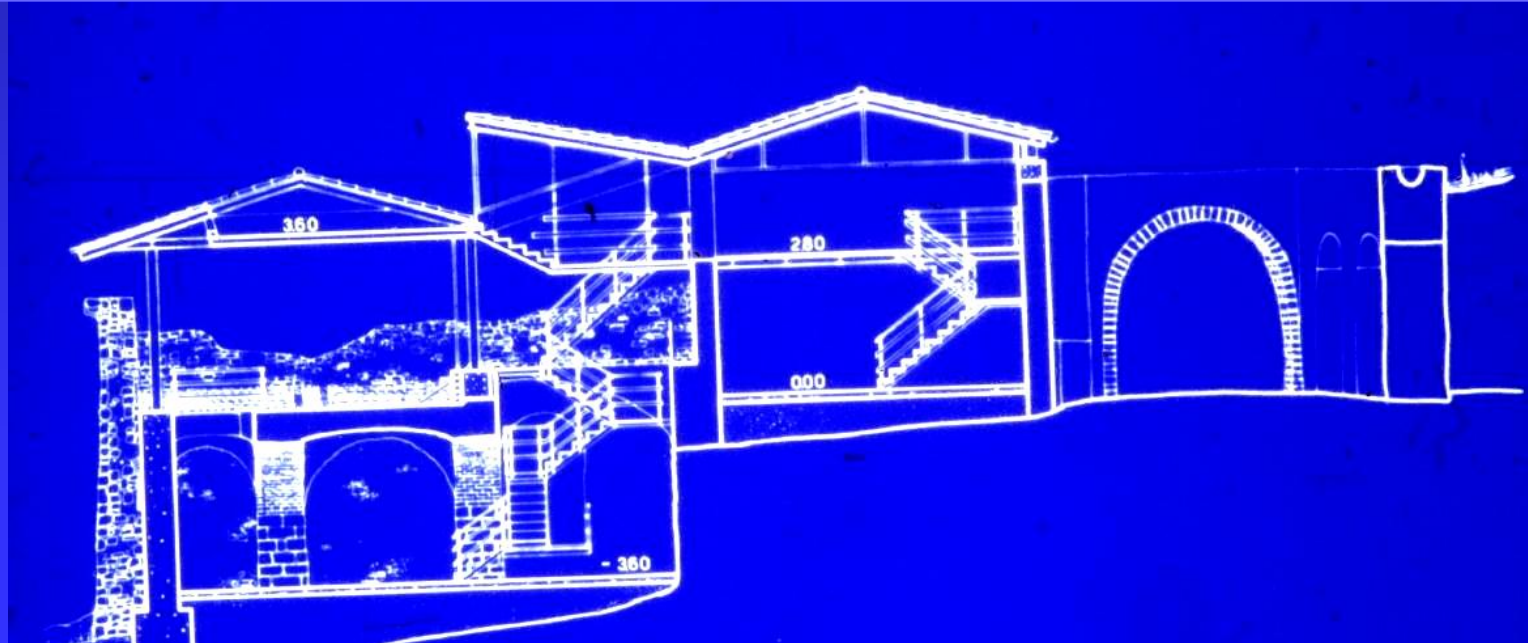
**Madrid ( Spain )**



# Vertical extension



**Conversion of an old industrial building into a Sport Club  
(Briatico-Calabria, Italy)**





# Vertical extension



**Conversion of an old  
industrial building into a  
Sport Club  
(Briatico-Calabria, Italy)**





**Conversion of an old  
industrial building into a  
Sport Club  
(Briatico-Calabria,  
Italy)**

**Vertical extension**





# Vertical extension



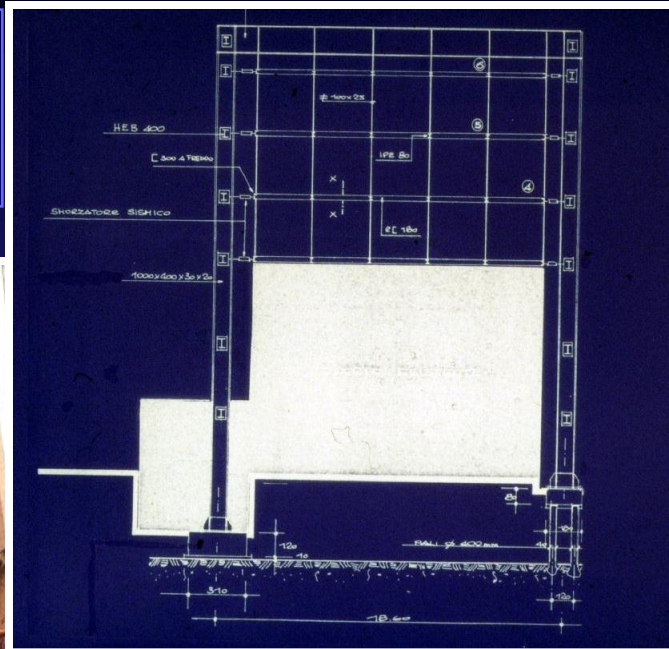
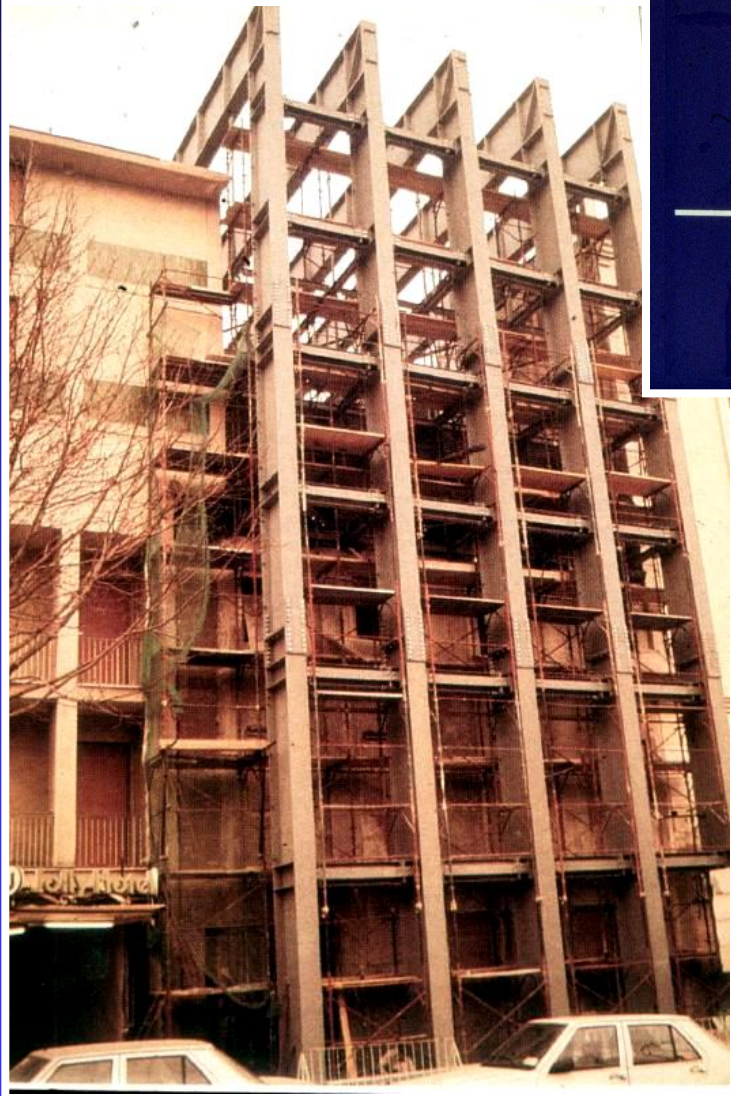
**A penthouse  
in Vienna Centre (Austria)**





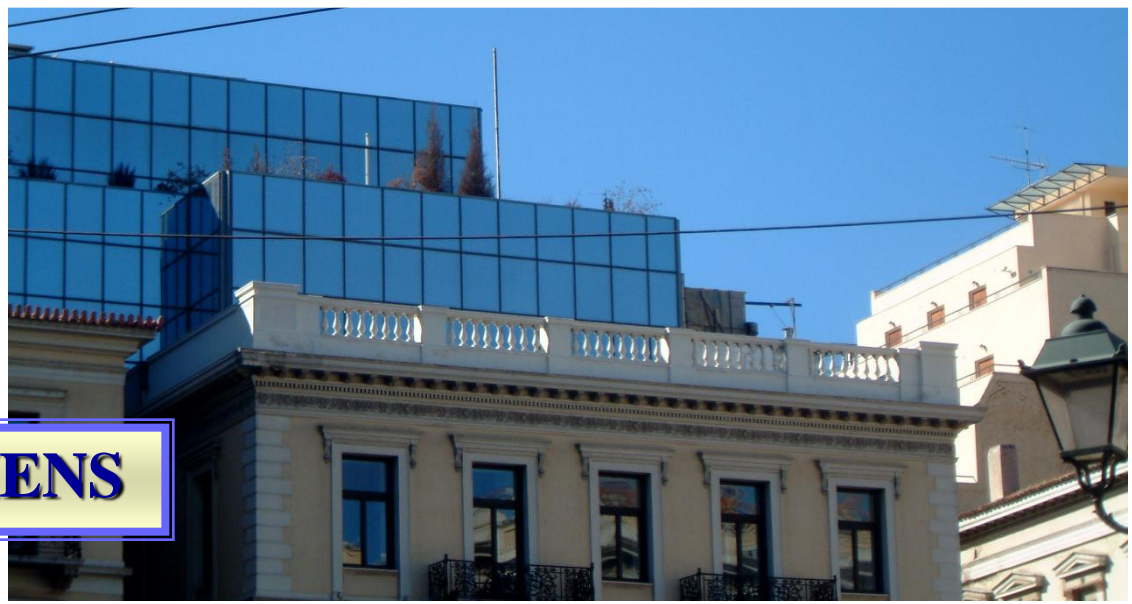
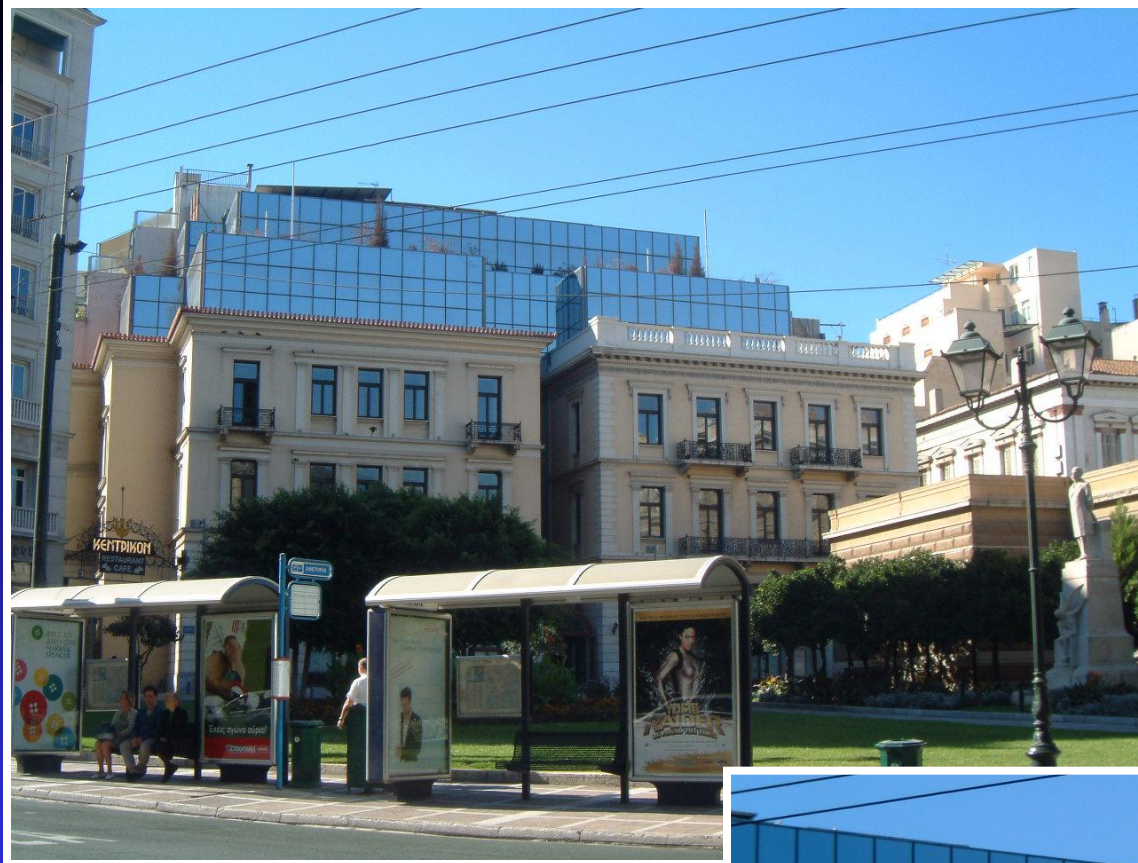
# The “Jolly Hotel” (Caserta, Italy)

## Vertical extension





# Vertical extension



**PENTHOUSE IN ATHENS**



# Vertical extension



**Superelevation in Toronto (Canada)**





# Superelevation in Toronto (Canada)





# LIGHTENING



- **Lightening**= substitution of floors, roofs or other structural elements with lighter materials





## **The new roof of the Ducal Palace (Genoa, Italy)**

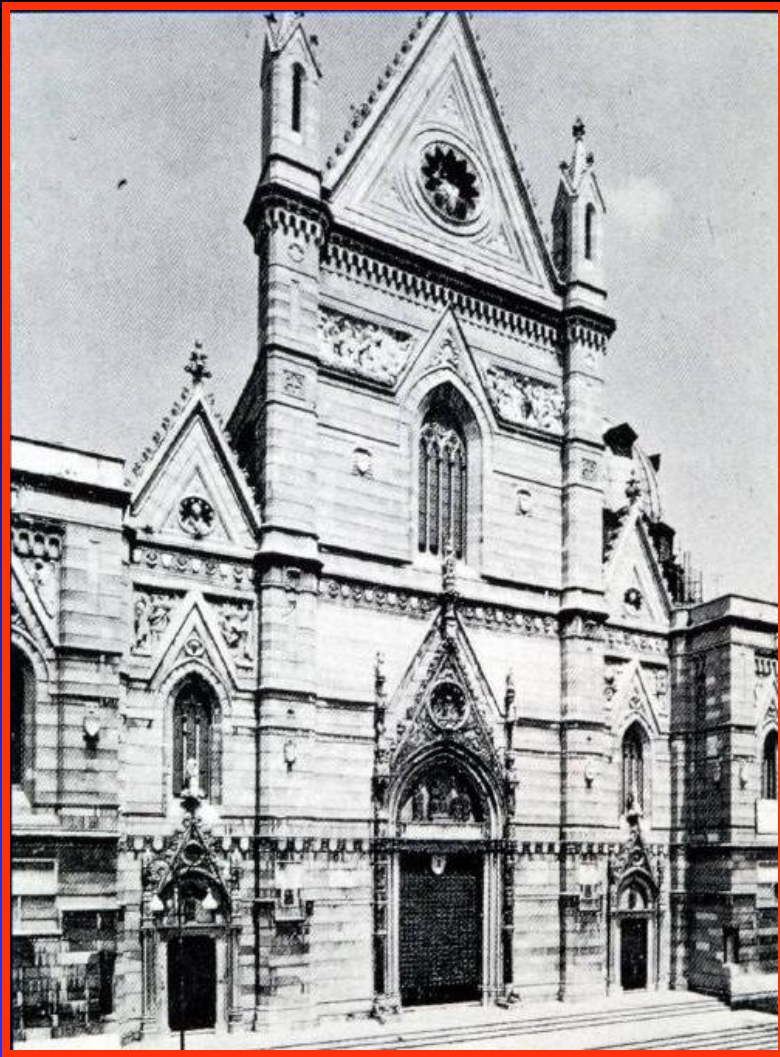




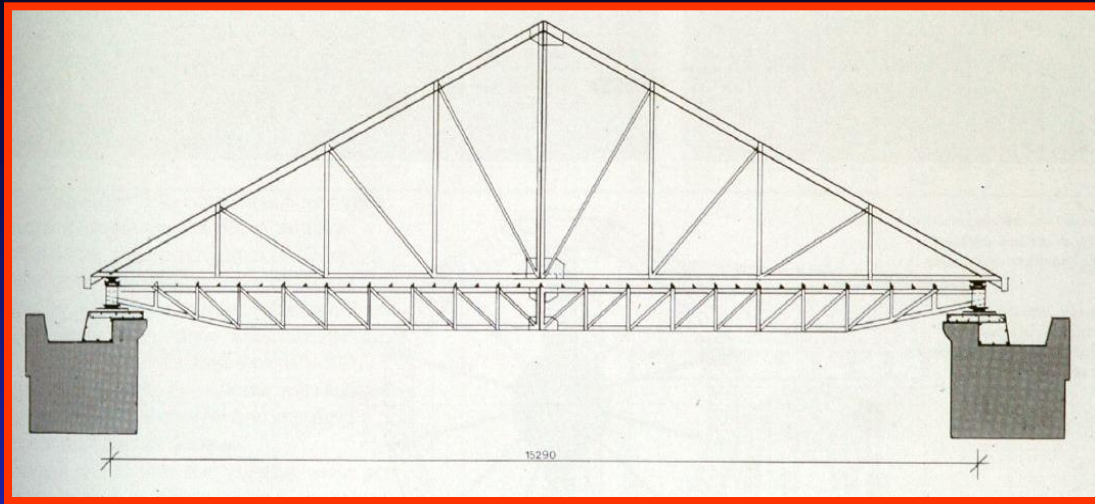
**The new roof of the old  
“Fabbrica d’armi” Palace  
(Mongiana-Calabria, Italy)**





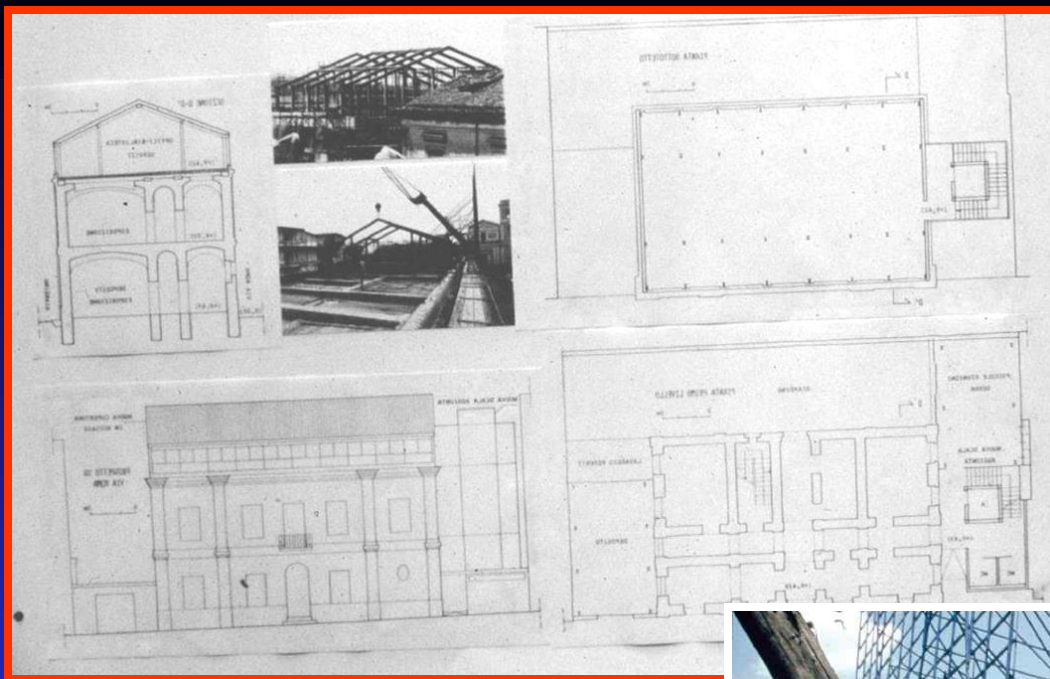


**The new roof of the  
Cathedral of Naples  
(Italy)**





## The new roofing system of the Cultural Centre of Succivo (Caserta, Italy)







**The new roofing system of the Cultural Centre of Succivo (Caserta, Italy)**



# The new roofing system of the Cultural Centre of Succivo (Caserta, Italy)

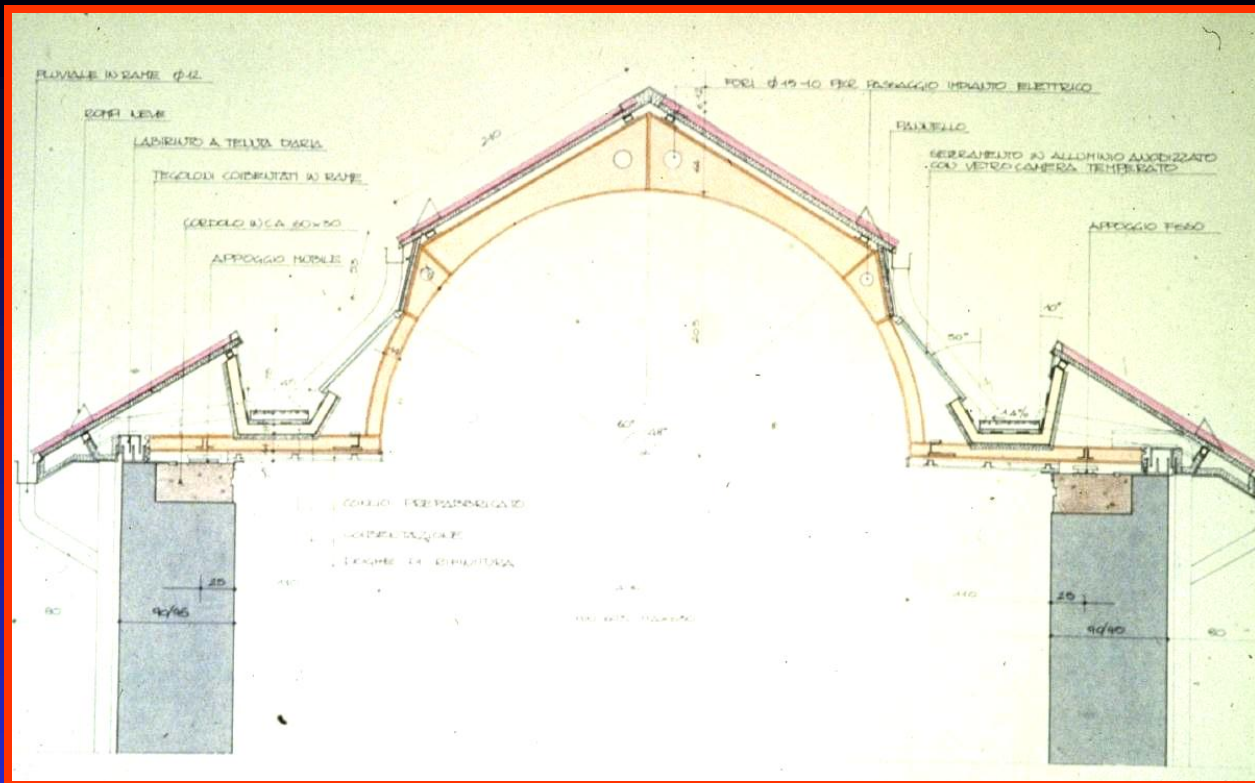




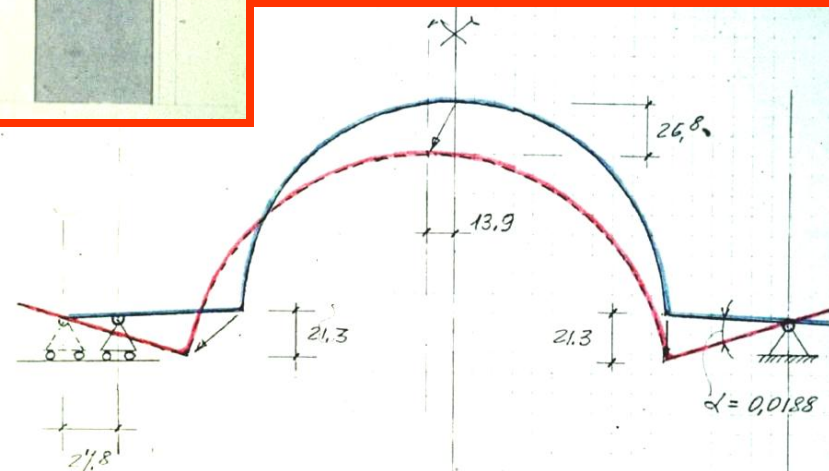


**The new roof of the  
“Gallery” of the Museum  
of Contemporary Art in  
Rivoli (Turin, Italy)**





## The new roof of the “Gallery” of the Museum of Contemporary Art in Rivoli (Turin, Italy)



SPOSTAMENTI DELLA STRUTTURA (mm)

$$\text{RAPPORTO FRECCIA/LUCE} : \frac{26,8}{6700} = \frac{1}{250}$$

$$\text{CARICHI DEGLI APPOGGI, SE BLOCCATI} : 2556 \text{ kg.}$$





**The new roof of  
the “Gallery” of  
the Museum of  
Contemporary  
Art in Rivoli  
(Turin, Italy)**





The end