# Retrofit of a university building in Rome, Italy

IT1

## 1 Photo

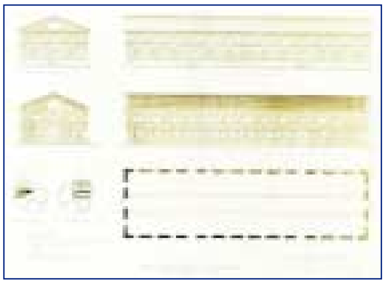


**Figure 1:** Left: View of the University building from the internal court.
Above: Plans of the original building

## 2 Project summary

The main objective of this intervention consisted of the implementation of projects for conserving, reusing and showing to best effect the industrial archaeology buildings inside the 'ex Mattatoio' compound in Rome, bordering the river Tevere, an architectural urban complex formerly used as slaughter houses. The proposed reuse took place within the fabric of the existing building and did not require extensive alteration, rebuilding or extensions. The emphasis was on preserving the character of the industrial building as much as possible. In detail we directed our attention to one external wing of the built complex assigned to house three lecture rooms and one auditorium of Università Roma III.

## 3 Site

The complex is situated within the urban area of Rome, Italy, in a climate where winter temperatures will vary from a minimum of –2 °C to a daytime average temperature of about 9 °C. Temperatures during the spring and fall will vary between 6.5 °C to 26 °C. The summer Temperatures will range from 18 °C to 34 °C.
Latitude: 41.54°. Longitude: 12.29°. Altitude: 20 m.
Heating Degree Days: 1415 (20°C basis).

# 4 Building description /typology

## 4.1 Typology / Age

| Typology/Age | Pre 1910 | 1910-1930 | 1930-1950 | 1950-1970 | 1970- |
|---|---|---|---|---|---|
| Slaughter House | ● | | | | |
| Lecture halls conversion | | | | | ● |

## 4.2 General information

*Year of construction:* 1888-1891
*Year(s) of renovation:* 2000 Phase I
*Total floor area:* 1200 $m^2$
*Number of pupils:* 500
*Number of lecture rooms:* 3
*Number of Auditoria:* 2
Typical classroom
*Size:* 320 $m^2$
*Window/glass areas:* 74 $m^2$
*Number of pupils:* 80
*Hours of operation:* Majority of the building is operated 12 hours a day 5 days a week

## 4.3 Architectural drawings

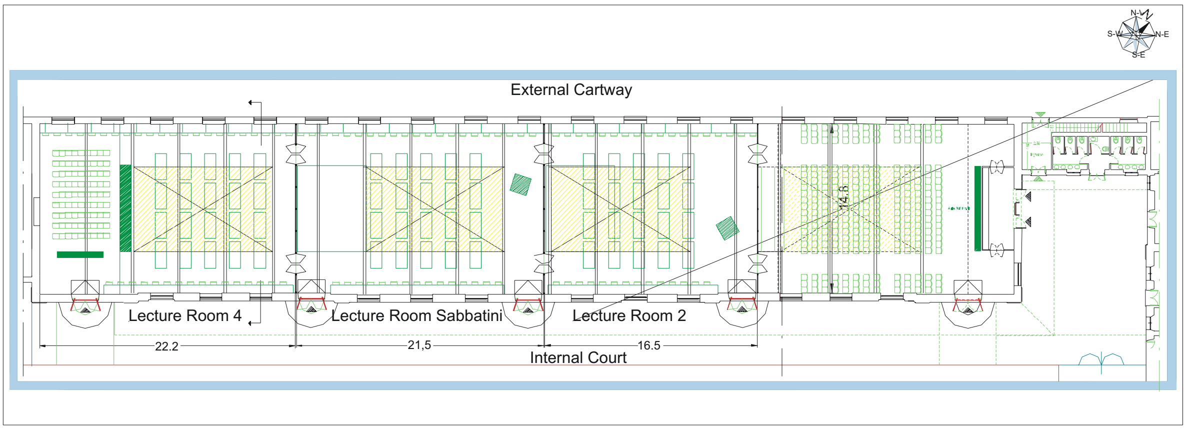
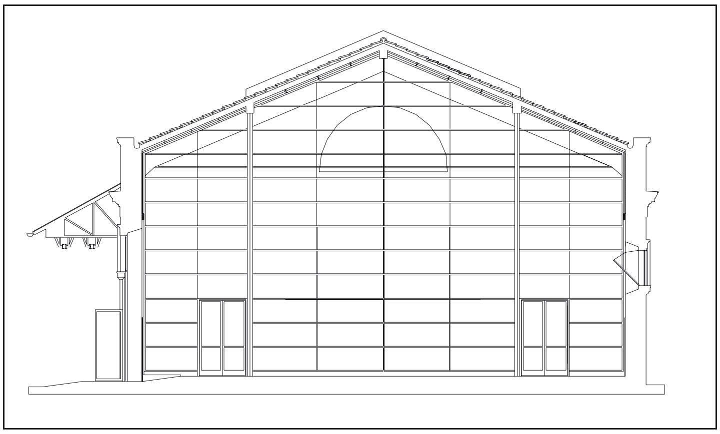



**Figure 2:** Above: Floor plan of the three lecture halls
Right: Side elevation



## 5 Previous heating, ventilation, cooling and lighting systems

The heating/cooling system consists of two Heat Pumps of 60kW.
The ventilation system consists of two extractor fans of 3300 $m^3/h$ per room.
The lighting system consists of 8 lamps in each classroom and 10 in the main auditoria.

## 6 Retrofit energy saving features

### 6.1 Energy saving concept

Floor renovation gave the opportunity for the installation of a radiant floor system; this system is available in both the heating and cooling seasons. The heating/cooling plant consists of two heat pumps of 60 kW each.
Attention was paid to the exploitation of daylight, by means of preserving the existing skylights on the roof. On the other hand, in order to reduce the amount of daylight when projecting slides, and in order to reduce the risk of overheating, adjustable shading devices were recently installed (2001) over the skylights.

### 6.2 Building

Pre-existing brick walls are 70 cm thick. The roofs of the three lecture rooms partly consist of large skylights: 104 $m^2$ in each room.
In order to preserve the original features of the building and in order to exploit daylight, these skylights were preserved and the original transparent glazing was replaced with white cellular polycarbonate.
Double glazed units (Ug=2.8 W/$m^2$ °C) were installed in the windows of the vertical NW and SE external walls.
Since the external structures had satisfactory thermal performance no particular effort was made to improve the thermal insulation of the walls.
Attention was paid to the renovation of the roof, where the U value was improved by means of the use of an extra internal insulation layer (CELENIT). The choice of this component was also intended to improve the acoustical comfort.

### 6.3 Heating

The heating plant consists of a radiant pavement powered by two heat pumps.

### 6.4 Ventilation

The ventilation system is a hybrid natural and mechanical; indirect/direct regenerative system using 100% outside air. The ventilation system consists of manually opening windows on the SE and NW walls.
This is complemented by two low pressure fans in each room (approx 3300 $m^3/h$, operating in extract mode), located on the top of the roof (9.75 m above floor level).

### 6.5 Lighting

Lighting systems were replaced with current energy efficient technology.

## 7 Resulting Energy Savings

*Heating:* Data not available
*Cooling and Ventilation:* Data not available
*Lighting:* Data not available.

## 8 User evaluation

*Indoor air quality:* Indoor air quality was generally good, during the midwinter season also.
*Quality of daylight / artificial light:* The amount of daylight was reported to be pleasant and well distributed into the space. The artificial light also is well working and no glare or insufficient lighting complaints were reported.
*Sound quality:* The sound quality of the lecture rooms is normal, no particular problem of noise or reverberation has been observed. Because of the dimensions of lecture rooms sometime is necessary the use of the amplifier system.
*General feeling:* The overall opinion about indoor environment is quite good. The building is often frequented by students not only during lectures but also for meeting, studying, and parties.
*Technical functionality:* No particular problems were reported.
*Architectural quality:* The quality of the intervention is quite good, the external shape of the building was not modified.

## 9 Renovation costs

The overall renovation cost was around 1.400.000.000 Lit in 2000, that means around €700.000. In that price the lecture room furniture is included (most of it is purpose designed and fixed to the internal walls). The overall cost can be broken down into:
Wall and roof refurbishment, adding of a new insulation layer on internal roof surface: €80.000
Floor refurbishment with radiant floor installation: €102.000
New windows, doors and skylights, and internal glazed walls: €240.000
External adjustable shading devices: € 110.000
Installation of 2 new heat pumps, pipes and valves: €15.500
New electrical plant, with internal and external lighting systems and 2 extractors per lecture room: €16.500

## 10 Experiences/Lessons learned

The most important lesson learned is that the reuse of industrial buildings as educational is possible and not expensive. Of course in this case the costs were reduced because the structure was not damaged and because the typology of previous activities did not require a building environmental requalification.
More over the intervention was quite simple, no air conditioning plant was installed and the choice of a very simple hybrid ventilation system certainly gave a contribution in reducing retrofit costs.
The overall users evaluation is that the indoor environment quality is good. Some complaints of drafts during winter were registered, due a incorrect doors operation. The low temperature radiant floor system has proven to be efficient in providing good thermal conditions, but due the high building thermal mass, the control strategy has to be carefully planned. It has been observed that plant switch off during the weekend and vacancies caused extended periods of thermal discomfort when the building was reopened.
Daylight is largely exploited and it has a positive effect on electric energy consumption. The external solar shading system give an important contribution in daylight optimisation and in reducing overheating phenomena: quite high indoor temperatures were observed. Night cooling has been seldom exploited during summer: that is because it has not been installed an automatic control of ventilation system: that should be the main improvement of this building. Radiant floor system was seldom used as a cooling system also. In this cases, because no air de-humidification system was installed, condensation phenomena were observed.

### 10.1 Energy use

Because this building is a "reuse" case Study, a comparison between pre and post-retrofit situation is not possible.
As mentioned above the heating plant consists of two air to air heat pumps 60 kW each. The two years of monitoring phase gave good results, the average heating consumption remained under 40 kWh/m$^2$ a.
The cooling consumption was quite low also, but in this case it was due to a reduced usage of the plant.
Electrical energy consumption for lighting was around 10 kWh/m$^2$ a. This figure includes the energy consumption for outdoor lighting.

### 10.2 Impact on indoor climate

Thermal: Indoor thermal conditions were reported as satisfactory during the heating season.
Some draft and sudden incoming cold air problems were reported due to incorrect door opening in the early morning during the heating season. At the beginning of the heating season some complaints were reported because of incorrect management of the heating plant: because of the large thermal mass, on Monday, after a weekend switch off period, the temperature was too low.
IAQ: Improvement in reducing the Carbon Dioxide level

### 10.3 Economics

### 10.4 Practical experiences of interest for a broader audience

### 10.5 Resulting design guidance

## 11 General data

**11.1 Address of project**
Rome, Italy.

**11.2 Existing or new case study**
*Project initiation:* 1999
*Design completed:* 2000
*Renovation construction completed:* Phase I – 2000; Phase II – 2001
*Monitoring and evaluation:* Phase I – 2001; Phase II – Ongoing

**11.3 Date of report / revision no.**
October 2002 / Revision 2.

## 12 Acknowledgements

*Builder:* Università Roma III
*Architect:* prof. Francesco Cellini
*Engineer:* Eugenio Cipollone
*National, international support programmes:* N/A
*Contact:* Luciano Scacchi
*Author (of this description):* Marco Citterio, Carlo Romeo

## 13 References