FR2

Refurbishment and extension of Gambetta professional high school, France

1 Photo

Figure 1: View of the main façade after refurbishment

2 Project summary

Project objectives:
The project aimed to adapt and refurbish the existing building and add an extension in order to give a more functional school building.

Short project description:
The school is located in an urban environment. The existing building is a U-shape building with concrete façades like most constructions of the 1930's. It was first used as a primary school and a kindergarten. It suffered from a lack of space, poor comfort levels and sanitary problems.
The new building has the following main features:

- A U-shape block (existing building: 2 floors) along the main road, in addition to a basement where there is a conference room.
- The extension is an arched shape building (new building: 3 floors) connected to the old building at the stairs area. Within the new functional distribution, new classrooms are located within the new extension while the existing building contains administration offices and some classrooms.
- Sport activity area is located in the inner space defined by the arched shape.

3 Site

France, Bourgoin Jallieu, suburb of Lyon, latitude: 45.6°N, longitude: 5.72°E, altitude: 254 m.
Mean annual temperature: 11.5°C, mean winter temperature: 5.6°C from 1/10 to 20/05, DD = 2528 (base = 18°C).

4 Building description /typology

4.1 Typology / Age

Typology/Age	Pre 1910	1910-1930	1930-1950	1950-1970	1970-
The side corridor school			●		

School grades: school for technical teaching

4.2 General information

Year of construction: The building which was renovated was built in 1930
Year of renovation (as described here): The work in the school building (refurbishment and extension) started in the summer break 1993 and was finished in the summer 1995
Total area: 9213 m^2
Number of pupils: between 520 and 540. There are 35 classrooms and 4 practical rooms.

Typical classroom:
size: between 35 and 50 m^2
window/glass areas: between 4.5 and 10 m^2
number of pupils: between 26 and 28

Hours of operation:
Administration : 9h30 per day, 5 days per week
Library: 9h30 per day, 5 days per week
Classrooms: 7h per day, 5 days per week
Kitchen: 9:00 pm to 3:00 pm, 5 days per week

4.3 Architectural drawings

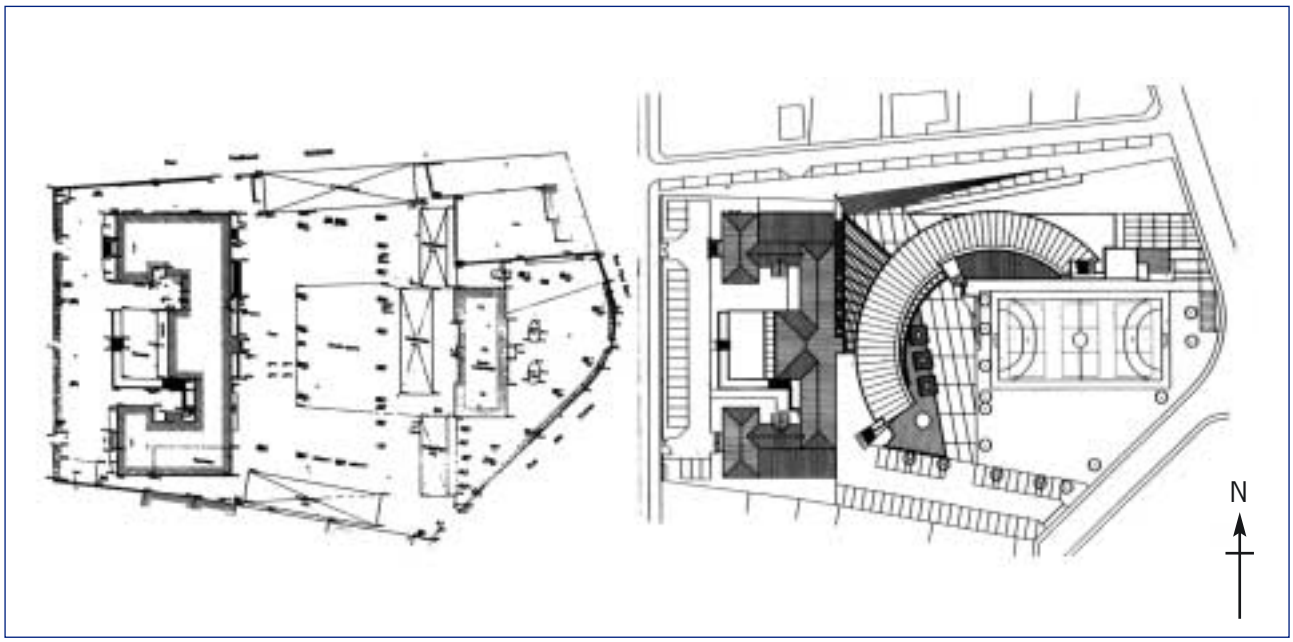

Figure 2: *Left:* Site plan before refurbishment
Right: Site plan after refurbishment

Figure 3: *Left:* View of the school before refurbishment
Right: View after refurbishment

5 Previous heating, ventilation, cooling and lighting systems

For the heating system, 3 oil-fired boilers were originally installed in the basement of the building. No major retrofitting had been done. Pipework and radiators dated from the time of construction.
There was no mechanical ventilation system, air renewal being only by openings windows.
Daylighting was exclusively provided by façade openings with no external shadings. Suspended luminaires with fluorescent tubes were used for artificial lighting. The power of artificial lighting installed did not comply with the French Requirements.

6 Retrofit energy saving features

6.1 Energy saving concept

Energy saving was not the main aim of this project, but energy conservation for space heating should be achieved thanks to better insulation of the envelope and the change of the type of fuel used for heating.

6.2 Building

The retrofit project included the insulation of vertical walls and the replacement of the single-glazed windows by double glazing in different frames (wood for the new building and PVC for a part of the old one). The connection between the old and the new parts is by vertical stairs and horizontal walkways.

6.3 Heating

The oil boilers were converted to gas available on site. Within the existing heating system, the two older boilers were replaced by more powerful ones in order to satisfy the additional needs due to the extension. Hot water radiators (made of steel) contribute to the heat diffusion at a controlled temperature in the different parts of the school. A number of old radiators were replaced and new pipework was insulated. Some thermostatic valves are used to take into account the specific internal gains for each space.
Hot water is distributed to the rooms at a variable temperature depending on the zone of the building. Domestic hot water for the kitchen and the lavatories is also produced by the heat exchanger through an intermediate storage vessel.

6.4 Ventilation

Supply and extract mechanical ventilation is used for the kitchen, practical rooms and classrooms. The equipment is installed on the roof. Connection to building levels is provided by vertical ducts. There is mechanical extraction with an exhaust hood in the kitchen.
There is no air treatment to cool, dehumidify or preheat air to the classrooms and the offices.
For the residential part, mechanical supply is used. Air inlets are located in the living room and the bedrooms and extraction is from the kitchen, WC and bathroom.
A BMS is installed to manage heating, ventilation and alarms.

6.5 Lighting

Electrical and lighting systems were completely renovated in accordance with French Requirements. External solar protection systems were installed.

Artificial lighting types:
Hall: spots and projectors
Corridors: ceiling mounted luminaires (surface mounted)
Offices, classrooms: surface mounted luminaires
Blackboards: wall washers
Kitchen and technical rooms: surface mounted, waterproof
All luminaires are fitted with high efficiency ∅26 fluorescent tubes

Lighting controls:
Hall, corridors and stairs: push button on each side
Lavatories: occupancy sensor in the entrance lobby
Other rooms: push button, switch at the entrance
Blackboards: switch located near the blackboard

7 Resulting Energy Savings

From the energy bill, the average energy consumption is:
Energy consumption before the present refurbishment for 1990:
Heating : 399051 kWh (108 kWh/m^2.y)
Electricity: 159446 kWh (43 kWh/m^2.y)

Energy consumption after refurbishment for 1997:
Heating : 726838 kWh (79 kWh/m^2.y)
Electricity: 236310 kWh (25 kWh/m^2.y)

8 User evaluation

User satisfaction regarding the refurbished building was studied with a questionnaire. The surveyed sample included 74 students in 3 classrooms, but no administrative staff.

Analysis of the answers shows that:
About indoor air quality, 58% think it is acceptable
In general terms: Sensation of enclosed space for 60% of the occupants, 60% feeling dusty
Problem of static electricity: none
Dry, humid, smelly, etc: Strong smell sometimes for 31% people, dusty for 20%.
About thermal comfort, there is sometimes some problems of low/high temperature probably linked to the control of the heating system.

In general terms: Level of temperature is good for 31%, and acceptable for 54%
Overheating problems: for 65% in the afternoon and 70% because of the sun
Coolness feeling: for 46% of the occupants in the morning

About the quality of daylight and artificial light: Overall satisfaction, 31% have quoted sometimes problem of poor light at the blackboard and 49% problem of reflections or glare from the blackboard.
About acoustics: No problem was reported about the equipment, but dissatisfaction relative to noise from outside (82%), noise from corridors (50%) and noise from neighbouring rooms (38%).
The general feeling of surveyed people focus on:
General well being: tiredness is frequently quoted as often happening (45%) or sometimes (43%)
Dullness in the head: 26% often have, 34% sometimes
Headache: 28% often have, 50% sometimes
Difficulty to concentrate: 14% often, 43 % sometimes
Irritation, stuffy or runny noise: 11% often have, 30% sometimes
Usually they do not associate these symptoms with the school building except headache, tiredness and dullness in the head.

9 Renovation costs

Total renovation cost: €5.56 million

Envelope	*Building works:* €2,900,000
	Windows : €720,000
Systems	*Lighting and electrical appliances:* €660,000
	HVAC: €430,000

10 Experiences/Lessons learned

10.1 Impact on indoor climate

Thermal: Regarding the temperature, the set point temperatures as designed are not fulfilled, especially set-back temperature seems to be too high in the classrooms (between 20°C and 24.5°C).

Humidity: The relative humidity seems to be acceptable in the classrooms (between 40% and 60%).

IAQ: Problems of indoor air quality have been reported by the surveyed people for the toilets (50%), the gym and the changing rooms (41%). This could be a result of the ventilation strategy.

Figure 4: *Far left:* View from the blackboard
Left: View from the openings

Lighting: A lighting diagnosis has been conducted in 4 classrooms (2 computer rooms located on the first floor and 2 classrooms on the second floor). The opening index (ratio glazing/total area) is between 11% and 22%.

We also noticed the following problems:
- Insufficient daylighting level at the deeper areas of the rooms where the daylighting factor is below 2%.
- deficient or insufficient solar protection systems
- In some classrooms, the power of artificial lighting installed is above the recommended value by the French Requirements

10.2 Practical experiences of interest for a broader audience

Good: More space for the same number of pupils.
Supply and extract mechanical ventilation.
Natural lighting with light wall-covering.
Artificial lighting controls with occupancy sensors.
BMS for heating, ventilation, lighting and alarms.

Bad: Problems of reflections or glare from the blackboard.
Problems of noise from outside and corridors.
Problems of reverberation for speech intelligibility in some classrooms.
Solar controls not efficient enough to prevent summer overheating.

10.3 Resulting design guidance

Additional or more efficient solar protection system and optimized lighting controls with more efficient luminaires could decrease the brightness and avoid solar overheating.
False ceiling could be installed to minimize reverberation in classrooms.

11 General data

11.1 Address of project

Lycée professionnel Gambetta
14, avenue Gambetta
38003 Bourgoin-Jallieu
FRANCE

11.2 Project dates

Project initiation: summer 1993
Renovation construction completed: summer 1995

11.3 Date of report / revision no.

May 2002

12 Acknowledgements

Builder: Region Rhone Alpes
Architect: Ferrand-Sigal
Engineer: TPS PEYRARD
Economist: VOUTAY
Coordination: OCTB
Author (of this description): N. Adra, R. Cantin - LASH/ENTPE