PL2

Retrofitting of the Faculty of Electrical Engineering Building, Poznan University of Technology, Poland

1 Photo

Figure 1: Faculty of Electrical Engineering Building after retrofitting

2 Project summary

The building was built in 1975 as a multi-storey, central corridor building for the Faculty of Electrical Engineering. There are 64 classrooms in the building and in total they can accommodate approximately 1900 students. Classrooms occupy about 21.7% of the building area, office rooms 40.7%, corridors 29.7%, while the remaining 7.9% is devoted to social rooms and other remaining purposes.

The project described includes retrofitting of the building envelope (new windows and improving the U-values of walls) and the modernisation of the heating system.
It was completed in November 2001.

3 Site

The building is located in Poznan, Poland, near the river Warta. It is surrounded by lower buildings (four-storey) excluding one twin building (they are connected by covered passage with additional lecture rooms).
Latitude: 52.25 °N, *longitude:* 16.55 °E, *altitude:* 94 m.
Temperate transitional climate.
Mean annual temperature: 8.0 °C, mean winter temperature: 2.6 °C (October-April)

4 Building description /typology

4.1 Typology / Age

Mega–structure university building. 1975
Educational level: University

4.2 General information

Year of construction:	1975
Year of renovation:	2001
Total floor area (m^2):	14 420
Classrooms area (m^2):	3 130
Number of pupils:	1 930
Number of classrooms:	64
Typical classroom	
size (m^2) :	49
windows/glass area (m^2):	15 (ca 60% of the outer wall)
number of pupils:	36

Hours of operation: 12 hours a day, 170 days per year, 1/4 of building; 8 hours a day, 280 days per year, remaining 3/4 of building.

4.3 Architectural drawings

None available

5 Previous heating, ventilation, cooling and lighting systems

Heating:
Hot water, two pipe, up-feed, pressurised central heating system with circulation pump and cast iron radiators. Distribution system is divided into two sections (western and eastern), each supplied from the city heat distribution network through the heat exchangers' plant. The lack of thermostatic valves caused random room temperatures and drafts - the only method of temperature regulation was to open or close a window, which sometimes affected air quality.

Ventilation:
Natural, every classroom has at least one exhaust grille, fresh air supplied through windows.
Inefficient, demands some attention to windows maintenance - opened windows assure proper amount of supply air to otherwise sealed rooms. Thermal comfort is hard to obtain.

Lighting:
Typical fluorescent lamps (ca 80 lumens/Watt).

6 Retrofit energy saving features

6.1 Energy saving concept
The main goal was to minimise heat losses by improving the building envelope. To assure temperature control in sealed rooms all radiators were equipped with thermostatic valves.

6.2 Building
Casing walls between construction ribs were insulated with 10cm of polystyrene (Styrofoam), construction ribs were insulated with 5cm polystyrene. The roof was insulated with 10cm of polystyrene.
In every case the insulation was added to the outside.
Old windows (wooden frame, two separate panes) were replaced with new ones (PVC-frame, double glazed sealed units).

6.3 Heating
Every plenum heater was equipped with a thermostatic valve.

7 Resulting Energy Savings
Energy consumption before and after:

		Before	*After*
Heating:	peak demand	1,954.5 kW	1,383.8 kW
	annual consumption	1,841,130 kWh/a	1,303,558k Wh/a

Both initial and resulting energy demands are calculated using technical guidelines which are legally binding in Poland.
(some data from measurements will be available later). Expected energy use will be 70.8% of initial value.

8 User evaluation
Indoor air quality
In general terms *(Dry, humid, smelly, etc.):* good if windows are slightly open, stuffy and smelly if windows are closed accidentally (as described above)

Irritations (eyes, nose, throat, skin, ..):	no
Quality of daylight / artificial light:	both good
Sound quality:	good
General feeling:	
General well being:	good
Headache:	no
Difficult to concentrate?	no

Technical functionality: thermostatic valves are easy to adjust and provide sufficient temperature control even with various window positions. New windows are easy to operate, providing better natural ventilation.
Architectural quality: Improved appearance.

Below: The twin building - Faculty of Mechanical Engineering Building (the same appearance as the Faculty of Electrical Engineering Building before retrofitting)

Faculty of Electrical Engineering Building after retrofitting.

9 Renovation costs

Specific cost per technology:

Wall insulation:	1 200 000	PLN
Window replacement:	1 300 000	PLN
Roof insulation:	46 000 PLN	
Thermostatic valves:	60 000 PLN	

10 Experiences/Lessons learned

10.1 Energy use

Monitored since October 2002 using Kulu software – no conclusions till now

10.2 Impact on indoor climate

Thermal:	significant
IAQ:	weak (problems occur less frequently)
Drafts:	significant

10.3 Economics

No information

10.4 Practical experiences of interest for a broader audience

No information

10.5 Resulting design guidance

11 General data

11.1 Address of project

ul. Piotrowo 3A
60-965 Poznan
POLAND

11.2 Existing or new case study

Project initiation:	
Design completed:	
Renovation construction completed:	November 2001
Monitoring and evaluation completed:	

11.3 Date of report / revision no.

15.04.2002

12 Acknowledgements

Builder:	Jedynka Poznan S.A.
Architect:	Malgorzata Matusiewicz, Malgorzata Schmidt
Engineer:	
National, international support programmes:	

Author (of this description): Fabian Cybichowski, Radoslaw Górzenski

13 References

Jaroslaw Fidor, master thesis "The multi-criteria analysis of thermal modernization and heat source selection for Poznan University of Technology buildings."