**PROBE BUILDING, LIMELETTE, BELGIUM**

<table>
<thead>
<tr>
<th>Building name:</th>
<th>PROBE (Limelette)</th>
<th>Year of completion:</th>
<th>1975</th>
<th>Year of retrofit:</th>
<th>1997</th>
<th>Type of building:</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Team:</strong></td>
<td>Architect (renovation): Y. Wauthy</td>
<td>Research &amp; Design: Belgian Building Research Institute (BBRI – CSTC – WTCB)</td>
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**SITE DATA**

<table>
<thead>
<tr>
<th>Design conditions</th>
<th>Design conditions</th>
<th>Average wind speed (m/s)</th>
<th>Prevailing wind direction</th>
<th>Terrain shielding</th>
<th>Dust pollution</th>
<th>Noise pollution</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Altitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>winter</td>
<td>summer</td>
<td>1.8</td>
<td>S-W</td>
<td>open</td>
<td>no</td>
<td>No</td>
<td>50.4 °N</td>
<td>4.31°E</td>
<td>106</td>
</tr>
<tr>
<td>T</td>
<td>T</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
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<td>n.a.</td>
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<td>g/kg</td>
<td>g/kg</td>
<td>n.a.</td>
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*Design philosophy for IAQ and Thermal Comfort and issues of concern for this building.*

The PROBE building is a renovated office building located on the test site of the Belgian Building Research Institute (BBRI) at Limelette in a rural and very quiet environment. The main facades of this two-storey building are west and east oriented. About 30% of the façade surface is glazed. The exterior walls are non-insulated brickwork cavity walls and the building has a flat roof. The interior space is subdivided into cellular offices.

PROBE stands for Pragmatic Renovation of Office buildings for a Better Environment. The main objectives of the renovation were the reduction of energy demand and the improvement of indoor thermal comfort in both summer and wintertime. The Walloon Region and several industrial partners have funded the refurbishment.
The building has two ventilation systems with totally different objectives covering air quality ventilation and summer cooling:

**Air Quality Ventilation**: Air quality is maintained using an infrared-controlled mechanical ventilation system. Fresh air is mechanically supplied into each office at 25 m$^3$ per hour per person, and is extracted from the toilets. Every office has its own infrared presence sensor which restricts supply ventilation to periods in which the office is occupied. This leads to a reduction of ventilation losses of 35%. Airtight ductwork and a well-regulated fan are important conditions for the proper operation of this system.

**Intensive Night Ventilation**: The major problem of the existing building was overheating in summer. To tackle it, an overall strategy was chosen: passive measures (solar shading, roof insulation, intelligent lighting) and intensive night ventilation. The objective of this intensive ventilation is to cool down the internal mass of the building with cold external air. By cooling the mass, improved day-time thermal comfort can be achieved. For night cooling in summer, high rates of natural ventilation (14 volumes per hour on average) are developed by means of large grilles located on both sides of the building.

**Principle of hybrid ventilation**

The ventilation system in the PROBE building is a hybrid ventilation system because a natural (for summer comfort) and a mechanical ventilation (for IAQ) system coexist. Currently, there is no interaction between the two systems, which each have their own goals.

In Annex 35, control strategies such as switching from mechanical to natural ventilation during day-time under certain circumstances, will be investigated and implemented.

**Components used to solve main issues or problems**

**IAQ control**

Mechanical ventilation system with infrared presence detection. An interesting feature of this device is that it is completely autonomous (no wiring) so that it is also very well suited for retrofitting projects.

**Thermal Comfort: active measures**

Large grilles for night ventilation, with protection against rain, insects and burglary.

The thermal mass must be accessible. In the PROBE building, there is no false floor and no false ceiling.

**Thermal Comfort: passive measures**

Solar shading: vertical external screens, through which only 15% of the solar radiation passes on the west side, and awnings through which 50% of the solar radiation passes on the east side.

Insulation (7.5 cm of rockwool) of the roof which reduced the heat gain through solar radiation by 63%.

Intelligent lighting: the installed power was reduced from 22 W/m² to 9.5 W/m². Independent integrated luminance sensors are used to dim the lighting according to the luminance level on the desk.

**Energy conservation**

Low-e gas filled double glazing (central U-value = 1.1 W/m².K) and insulated roof.
Installation of new fuel boiler and improvement of the regulation system.

**Temperature control**
Thermostatic radiator valves.

**Control of air flow rate**
The windows on the east façade can be opened in two different positions.

**Control Strategies**

*Mechanical ventilation* is controlled by an infrared presence detection. The user has no way to interfere with it.

**Intensive night ventilation:** The grilles must be manually opened by the occupants when they leave their office in the evening and (eventually) closed on their arrival in the morning.

**Shading devices:** Each facade is automatically controlled by a meteorological station according to the prevailing solar radiation, wind, rain and temperature conditions. This control can be manually overruled by the user.

** Heating:** A thermostat on each side controls the central heating system. The thermostatic radiator valves give the users the opportunity to adjust the heating to their needs.

**Overall performance**
Monitoring activities during the summer of 1997 and 1998 have shown significant improvement in thermal comfort thanks to the application of the intensive night ventilation strategy, coupled with an efficient control of the solar gains and the reduction of the internal thermal load. It has for instance been measured that the indoor temperature remained below 27°C when the outdoor temperature was above 31°C.