“Office building Rijkswaterstaat” is a demonstration project for the Dutch Sustainable and low-energy building programme and has been awarded in the EU Thermie programme. A variety of ecological measures are applied in the office building such as the reuse of building materials, a minimum of installation for ventilation, a heat pump for floor and wall heating and a solar collector system for DHW.

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**General Data**

**Principal:** Rijksgebouwendienst Zuid-West

**Architect:** OpMAAT – Delft

**Constructor:** Bliek en Vos BV – Terneuzen

**Installer:** Imtech projects – Goes/Sas van Gent

**Energy concept:** Cauberg-Huygen R.I. BV – Amsterdam, Hulst-D3BN – Amsterdam, Bravenboer en Scheers – Terneuzen

**Hand-over:** January 2000

**Building Data**

**Building Envelope:**
- **U (W/m²K):**
  - facade: 0.38
  - roof: 0.24
  - floor: 0.34
  - glazing: 1.6

**Air tightness:** not measured, the qv10- value as used in calculations is:

$$qv10 = 170 \text{ dm}^3/\text{s (n}_{50} \sim 5.8)$$

**Volume:** 6120 m³

**Floor area:** 1750 m²

**Specific heat load:** 21 W/m³

**Specific cooling load:** not applicable

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[Image of a map of the Netherlands with the location of Terneuzen highlighted]
GENERAL DESCRIPTION

The building is equipped with a minimum of building services. As a consequence of the absence of natural gas delivery facilities, an electric heat pump uses canal water as a heat source and delivers heat for the low temperature wall and floor heating system.

A natural ventilation system with advanced electronically controlled inlet grids provides fresh air. There is a large central chimney for exhaust air.

A solar collector system produces the DHW for the building and 54 m² of PV cells generate part of the electricity. The wastewater of the building is cleaned in a helophyte filter on the building site.

DESCRIPTION OF INSTALLATIONS

OVERVIEW

Heat generation: Electric heat pump
Heat source: Surface water of nearby canal
Emission system: Wall + floor heating (50/40 °C)
Costs of heating system: 118000 €
DHW: Solar collector with storage tank
Ventilation: Natural ventilation

INTERNAL COMFORT

The heating system performed very well and showed quick regeneration of set point temperatures after a two-hour cooling down period from open window venting. Overheating during wintertime occurred due to the control of temperatures with air temperature based thermostats. Users can individually control their room temperature, and they need an adjustment period to get used to the new heating system.

ADVANCED NATURAL VENTILATION

Climate room measurements showed that the incoming air in the office rooms could cause thermal comfort problems (draught) due to falling of cold air just beside the facade. Based on extensive tests the addition of perforated shelves with 100 mm borders under the inlets reduced this draught problem significantly.

The supply grills in the facade run short of capacity by 10 % at a pressure difference of 1 Pa. The overflow provisions from office rooms to the atrium seemed to have an adequate capacity. The atrium showed venting rates of $n=4.5$ to $n=7.6$ h⁻¹, depending on the use of office rooms and atrium windows. The exhaust capacity of the central chimney varied from $9000 \text{ m}^³/\text{h}$ to $15000 \text{ m}^³/\text{h}$ with the inner grill opened. Average venting rates for three office rooms varied from $n=1.6$ to $n=2.4$ h⁻¹, all above the standard requirement of $n=1.5$ h⁻¹.

EXPERIENCES - MEASUREMENTS

NLD 5.1. The working principle of the advanced natural ventilation system of RWS Terneuzen.
ENERGY CONSUMPTION
In relation to the internal comfort and the daylight situation, sensitivity calculations were carried out to the parameters influencing the energy consumption. A combination of constructive measures and energy efficient building services leads to an EPC (energy performance factor) that counts only 45% of the legal requirements (Figure NLD 5.2).

AIR TIGHTNESS
The air tightness of a single office room, determined by a blower door test, showed a significantly bad performance. Extra losses from infiltration are expected to be in the order of 200–300% of the design starting point. Afterwards, measures have been carried out to improve the air tightness. Nevertheless, it turned out to be quite difficult to realise a good performance on this aspect for currently available high sustainable construction methods. There is a need for the developing of standard construction systems and building details for sustainable buildings.

THERMAL COMFORT
Thermal comfort measurements have been carried out in three office rooms, the entrance desk and three locations in the atrium. Due to moderate summer conditions, no overheating was found. In general, all PMV’s were found in the range of −0.5 < PMV < +0.5, which demonstrates an ideal thermal comfort situation. The relative humidity levels showed a good performance.

EXPERIENCES - USERS
The perception of the users was interviewed by setting out an inquiry to all the employees. The questions in the inquiry were similar to inquiries conducted earlier in a large block of office buildings (reference block). Some remarkable results are:

<table>
<thead>
<tr>
<th>RWS Office</th>
<th>Refer. Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complaints on dry air</td>
<td>0%</td>
</tr>
<tr>
<td>Complaints on air quality</td>
<td>0%</td>
</tr>
<tr>
<td>Draught</td>
<td>22%</td>
</tr>
<tr>
<td>Eye annoyance</td>
<td>4%</td>
</tr>
<tr>
<td>Stufiness</td>
<td>4%</td>
</tr>
<tr>
<td>Temperature fluctuations</td>
<td>8%</td>
</tr>
<tr>
<td>Overheating</td>
<td>19%</td>
</tr>
<tr>
<td>Dust in the air</td>
<td>0%</td>
</tr>
<tr>
<td>Noise hindrance (from the interior)</td>
<td>22%</td>
</tr>
</tbody>
</table>

LITERATURE