ENERGY REPORT

FOR

WILLIAM KNIBB CENTRE

Ref: 15-2241
Jul 2016
V1.1 - Final
# ENERGY REPORT
## WILLIAM KNIBB CENTRE

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Appendices
1.0 **Executive Summary**

The site is located at Montague Street, Kettering, Northamptonshire. The proposal is for refurbishments within parts of the existing 1920’s Victorian building, along with refurbishment in parts of the more modern side (1960’s). The current building is a multi-storey building, which is to be partly refurbished. Evidence of services show that parts of the building dates back to 1951 (64 years), with revisions made in 1984.

To minimise the energy footprint the development will provide the following:

- *High level of external insulation.*
- *Air tight building (target air permeability rate of 10m3/m2.hr).*
- *Photocell dimming in office and meeting areas.*
- *Lighting efficiency average of 100 luminaire lumens per circuit watt average across building with photocell dimming in offices and meeting room areas.*
- *Gas fired boiler with an efficiency of 96%.*
- *Hot water heater with an efficiency of 91%.*
- *Mechanical Ventilation in all office and meeting room areas (heat recovery units).*
- *Existing Air Conditioning units as installed*
- *Existing radiators re-piped in Victorian building and new heating systems within the 1960’s building (radiators in all areas with UFH within toilet cores).*
- *U-values and specific fan capacities as shown in the BRUKL document attached to the Appendix.*
The table below highlights the annual fuel consumption of this assessment.

<table>
<thead>
<tr>
<th>Development Details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development name/reference</strong></td>
<td>William Knibb Centre</td>
</tr>
<tr>
<td>Development description (e.g. number and type of residential units)</td>
<td>Offices</td>
</tr>
<tr>
<td>sqm Gross Internal Floor Area (GIFA)</td>
<td>1426</td>
</tr>
<tr>
<td>Site electricity demand per annum (kWh)</td>
<td>21,790.98</td>
</tr>
<tr>
<td>Site delivered gas demand per annum (kWh)</td>
<td>49,409.97</td>
</tr>
<tr>
<td>Predicted site CO2 emissions per annum (kg)</td>
<td>21,706.46</td>
</tr>
<tr>
<td>Source of kWh/CO2 emission data</td>
<td>TAS v9.3.2</td>
</tr>
</tbody>
</table>
2.0 **Introduction**

The Sustainable Energy Report has been prepared to support the planning application part refurbishment of the existing building. Two models will be created and evaluated to establish the performance of the existing building, and that of thereafter the improvements have been made.

*The approach taken during the consideration for this development is as follows:*

*“baseline” – The existing building energy performance as it stands. All existing services are used to establish a general running of day to day service, with all existing rooms.*

*“be lean” – passive methods used to reduce projected energy including improved thermal performance through improved U-values, reduced air leakage and optimisation of useful solar gains through adjusting building fabrics. Consideration to reduce building services energy consumption through the implementation of energy equipment such as low energy lighting, low loss hot water storage vessels, adaptive heating and hot water controls, and heat recovery ventilation systems.*

This Energy Statement sets the parameters of detailed design, but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability of various technologies for the proposed development.
3.0 **Site Location**

The site is located at Montague Street, Kettering, Northamptonshire. The proposal is for refurbishments to parts of the building for the William Knibb Centre. The current layout is a combination of two buildings: a 1920’s Victorian structure and a 1960’s block build structure. The Victorian structure is a single storey building, which is to be partly refurbished, alongside the more modern structure which is also to be partly refurbished.

The property is considered that it will be constructed to a high standard, with u-values well in excess of building regulations minimum and air tightness meeting the minimum requirement of $5\text{m}^3/\text{m}^2\cdot\text{hr}$. 

![Existing Site Layout](image-url)
4.0 **Planning Policy**

The building currently has an overall Display Energy Certificate (DEC) performance rating of 73 and falls within band C, with heating rated at 150 and Electricity rated at 16. The models will produce two BRUKL documents and two EPC certificates for the existing and proposed builds.

The development will be subject to the requirements of Building Regulations Part L2B, Conservation of fuel and power in existing buildings other than dwellings, 2013. The two models will be simulated as existing and after refurbishment of services. The difference between the two models will be discussed and evaluated, which will give an idea of the reduction in energy usage.
5.0 **Existing Building**

5.1 **Carbon Emissions**

**Baseline**

The baseline predictions are based on the existing 3no. gas fired Broag Seagold cast iron sectional boilers, each rated at 262kW. A standard efficiency of 85% has been used to model the three boilers installed approximately 19 years ago (1996). The gas fired boilers serve the existing radiators, fan convectors and the hot water system, which were selected for use in the SBEM calculations. This provided a base line energy level with which to compare other solutions. The base line energy is based upon a Part L compliant building.

TPES have produced a dynamic simulation 3D model to determine energy consumption and carbon emissions, and to assist with a comparison to a newly refurbished building.

<table>
<thead>
<tr>
<th>William Knibb Centre – Target Emissions Rate (TER)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Energy Consumption (kWh/year)</strong></td>
</tr>
<tr>
<td>Heating (per m²)</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
</tr>
<tr>
<td>DHW (per m²)</td>
</tr>
<tr>
<td><strong>Total (per m²)</strong></td>
</tr>
<tr>
<td><strong>Total (per annum)</strong></td>
</tr>
<tr>
<td><strong>Annual Carbon Emissions (kgCO2/year)</strong></td>
</tr>
<tr>
<td>Heating (per m²)</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
</tr>
<tr>
<td>DHW (per m²)</td>
</tr>
<tr>
<td><strong>Total (per m²)</strong></td>
</tr>
<tr>
<td><strong>Total Area (m²)</strong></td>
</tr>
<tr>
<td><strong>Total (per annum)</strong></td>
</tr>
</tbody>
</table>

**TABLE 5.1**

As the first part of this report is to examine the existing building performance, the U-vales of the existing building have been calculated as shown in table 5.2 below:
<table>
<thead>
<tr>
<th>Element</th>
<th>U-value (W/m² K)</th>
<th>Maximum Allowable U-value (W/m² K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Walls</td>
<td>1.66</td>
<td>0.35</td>
</tr>
<tr>
<td>Ground Floors</td>
<td>0.95</td>
<td>0.25</td>
</tr>
<tr>
<td>Roofs</td>
<td>2.82</td>
<td>0.25</td>
</tr>
<tr>
<td>Windows</td>
<td>2.98</td>
<td>2.2</td>
</tr>
<tr>
<td>Doors</td>
<td>3.09</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**TABLE 5.2**

The full BER calculation sheets are enclosed in the Appendix A to support the above figures. These figures respond to a typical development with construction thermal properties and system selection to ensure that the unit complies with Building Regulations Part L2B. As the building is very old, it was expected the U-values would be unachievable.

The existing building incorporates radiators and fan convectors, along with air conditioning units serving a fraction of the building. The U-values do not comply with Part L 2013, and so the existing services provide an increase in the carbon emissions over the target emission rate (TER). The results have been shown in table 5.3 below:

**William Knibb Centre – Building Emissions Rate (BER)**

<table>
<thead>
<tr>
<th></th>
<th>Annual Energy Consumption (kWh/year)</th>
<th>Annual Carbon Emissions (kgCO₂/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating (per m²)</td>
<td>126.29</td>
<td>27.28</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
<td>0.73</td>
<td>0.37</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
<td>15.33</td>
<td>7.76</td>
</tr>
<tr>
<td>DHW (per m²)</td>
<td>4.35</td>
<td>0.94</td>
</tr>
<tr>
<td>Total (per m²)</td>
<td>146.73</td>
<td>36.36</td>
</tr>
<tr>
<td>Total Area (m²)</td>
<td>1430.87</td>
<td>1430.87</td>
</tr>
<tr>
<td>Total (per annum)</td>
<td>209,951.56</td>
<td>52,026.43</td>
</tr>
</tbody>
</table>

**TABLE 5.3**
6.0 **Proposed Build**

6.1 **Carbon Emissions**

**Baseline**

The baseline for the refurbished building incorporated standard high efficiency gas fired boilers serving underfloor heating in WC areas, standard intermittent local extract fans and heat recovery units for use in the SBEM calculations. This provided a base line energy level with which to compare other solutions. The base line energy is based upon a Part L compliant building.

TPES have produced a dynamic simulation 3D model to determine energy consumption and carbon emissions.

This Energy Statement sets the parameters of detailed design, but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability and feasibility of various technologies for the proposed development.

<table>
<thead>
<tr>
<th>William Knibb Centre – Target Emissions Rate (TER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Consumption (kWh/year)</td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Heating (per m²)</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
</tr>
<tr>
<td>DHW (per m²)</td>
</tr>
<tr>
<td>Total (per m²)</td>
</tr>
<tr>
<td>Total Area (m²)</td>
</tr>
<tr>
<td>Total (per annum)</td>
</tr>
</tbody>
</table>

**TABLE 6.1**
Be Lean

Energy used by the building during its life is a key producer of CO2 and therefore the reduction in energy is important to provide a sustainable development.

The main consideration is the thermal performance of the buildings envelope. A high level of insulation is proposed to ensure that the energy used for heating the building is minimised. It is our view that it is better to put resources into ensuring the building is well insulated and air tight, rather than the addition of technology to a poor performing base building.

The initial proposal is to aim for an insulation level to achieve the following u-values for the external envelope:

<table>
<thead>
<tr>
<th>Element</th>
<th>U-value (W/m² K)</th>
<th>Maximum Allowable U-value (W/m² K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Walls</td>
<td>0.29</td>
<td>0.35</td>
</tr>
<tr>
<td>Ground Floors</td>
<td>0.16</td>
<td>0.25</td>
</tr>
<tr>
<td>Roofs</td>
<td>0.18</td>
<td>0.25</td>
</tr>
<tr>
<td>Windows</td>
<td>1.65</td>
<td>2.2</td>
</tr>
<tr>
<td>Doors</td>
<td>1.61</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**TABLE 6.2**

An air test target of 5m³/m².hr for the air permeability of the building has been set as a target due to the improved installation and material. An air pressure test will be required for the building on completion.

The full BER calculation sheets are enclosed in the Appendix A to support the above figures. These figures respond to a typical development with construction thermal properties and system selection to ensure that the unit complies with Building Regulations Part L2B.

The proposed design should minimise the carbon emissions of the proposed development, with other proposed energy saving measures including:

- Lighting
  A target of 100% of all lighting shall be low energy. This is a target figure of 80 luminaire lumens per circuit watt. Corridors, stores, toilets, etc will have automatic presence detection and offices, meeting and circulation areas with daylight shall have automatic daylight dimming.
• Ventilation

The scheme is based around a mechanical ventilation system in offices and meeting areas in the form of heat recovery units, due to single sided natural ventilation. Natural ventilation will also be considered, where applicable, achieved via openable windows. Local extract fans will be modelled in toilet areas and store rooms.

The toilet extract fans will have a maximum specific fan power of 0.5W/l/s and air handling units will achieve 1.9W/l/s

• Equipment specification

The initial scheme uses time and temperature controlled zones with a high efficiency boiler. The hot water system will be direct gas-fired with a minimum efficiency of 91%.

The above items are generally achievable within the economic constraints of the project. The model was amended in accordance with the above figures to provide an enhanced building energy load. The improved parameters of the building achieve a 6.2% betterment over the target emission rate (TER). The revised energy table is shown below:

<table>
<thead>
<tr>
<th>William Knibb Centre – Building Emissions Rate (BER)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Annual Energy Consumption (kWh/year)</strong></td>
</tr>
<tr>
<td>Heating (per m²)</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
</tr>
<tr>
<td>DHW (per m²)</td>
</tr>
<tr>
<td>Total (per m²)</td>
</tr>
<tr>
<td><strong>Annual Carbon Emissions (kgCO₂/year)</strong></td>
</tr>
<tr>
<td>Heating (per m²)</td>
</tr>
<tr>
<td>Cooling (per m²)</td>
</tr>
<tr>
<td>Auxiliary (per m²)</td>
</tr>
<tr>
<td>Lighting (per m²)</td>
</tr>
<tr>
<td>DHW (per m²)</td>
</tr>
<tr>
<td>Total (per m²)</td>
</tr>
<tr>
<td><strong>Total Area (m²)</strong></td>
</tr>
<tr>
<td><strong>Total (per annum)</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**TABLE 6.3**
7.0 **Energy and Carbon Emissions Analysis**

The Target Emissions Rate (TER) must be achieved in order to comply with Part L of the Building Regulations. Table 5.1 shows the TER for the existing building, which will produce approximately 21,463 kgCO2 of carbon emissions and consume approximately 74,061 kWh of energy every year.

When measured against the actual building, the Building Emissions Rate (BER) will produce 52,026 kgCO2 of carbon emissions and consume approximately 209,951.56 kWh of energy every year.

From the results above, it can be concluded that the existing building does not meet the regulations of Part L 2013 Building regulations as the BER produces approximately double the TER carbon emissions and consumes approximately 3 times that of the energy.

The proposed building has refurbished U-vales, more energy efficient services and an improved air permeability rate. From table 6.1, it is shown the TER for the proposed building, will produce approximately 23,118 kgCO2 of carbon emissions and consume approximately 65,433 kWh of energy every year.

When measured against the actual building, the Building Emissions Rate (BER) will produce 21,706 kgCO2 of carbon emissions and consume approximately 71,209 kWh of energy every year.

From the results above, it can be concluded that the proposed building does meet the regulations of Part L 2013 Building regulations as the BER achieves a 6.2% betterment over the TER (as shown by the BRUKL document in Appendix B).

In order to find out if the proposed building performs better than the existing building, the two must be compared.

The energy consumed by the existing building is 209,951 kWh/yr compared to the proposed buildings 67,073.25 kWh/yr. This is a reduction of approximately 30%. 

The carbon emissions produced by the existing building is 52,026 kgCO2/yr compared to the proposed buildings 21,920 kgCO2/yr. This is a reduction in the production of carbon emissions by approximately 40%.

The graphs below represent the Energy Usage and Carbon Emissions production for the existing and proposed models.

![Energy Consumption Graph](image1.png)

**Figure 7.1**

![Carbon Emissions Rate Graph](image2.png)

**Figure 7.2**

8.0 **Final Proposal Summary**

It has already been established that the existing building will not meet Part L of the Building Regulations due to the age of the original building.
From the results above, it can be concluded that the proposed building does meet the regulations of Part L 2013 Building regulations as the BER produces approximately 40% less carbon emissions and consumes approximately 30% less energy.
Appendix A(i) – BRUKL Output
Existing Building BRUKL
Project name

William Knibb Centre

CDM Administration

Date: Wed Dec 09 15:38:09 2015

As designed

Administrative information

Building Details

Address: William Knibb Centre, Maontague Street, Kettering,

Certification tool

Calculation engine: TAS
Calculation engine version: "v9.3.3"
Interface to calculation engine: TAS
Interface to calculation engine version: v9.3.3
BRUKL compliance check version: v5.2.d.2

Owner Details

Name: 
Telephone number: 
Address: , ,

Certifier details

Name: Dharmesh Maisuria
Telephone number: 01494 771100
Address: Link House St. Mary's Way, Chesham, HP5 1HR

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

<table>
<thead>
<tr>
<th>CO₂ emission rate from the notional building, kgCO₂/m².annum</th>
<th>15.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target CO₂ emission rate (TER), kgCO₂/m².annum</td>
<td>15.2</td>
</tr>
<tr>
<td>Building CO₂ emission rate (BER), kgCO₂/m².annum</td>
<td>45.3</td>
</tr>
</tbody>
</table>

Are emissions from the building less than or equal to the target? BER > TER

Are as built details the same as used in the BER calculations? Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

<table>
<thead>
<tr>
<th>Element</th>
<th>U Limit</th>
<th>U Calc</th>
<th>U Calc</th>
<th>Surface where the maximum value occurs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall**</td>
<td>0.35</td>
<td>1.66</td>
<td>1.66</td>
<td>External Wall</td>
</tr>
<tr>
<td>Floor</td>
<td>0.25</td>
<td>0.95</td>
<td>0.95</td>
<td>Ground Floor</td>
</tr>
<tr>
<td>Roof</td>
<td>0.25</td>
<td>2.82</td>
<td>2.82</td>
<td>Roof</td>
</tr>
<tr>
<td>Windows***, roof windows, and rooflights</td>
<td>2.2</td>
<td>2.98</td>
<td>3.06</td>
<td>Type 4</td>
</tr>
<tr>
<td>Personnel doors</td>
<td>2.2</td>
<td>3.09</td>
<td>3.11</td>
<td>Elevation 5 Door</td>
</tr>
<tr>
<td>Vehicle access &amp; similar large doors</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>No vehicle doors in project</td>
</tr>
<tr>
<td>High usage entrance doors</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>No high usage entrance doors in project</td>
</tr>
</tbody>
</table>

U Limit = Limiting area-weighted average U-values [W/(m².K)]
U Calc = Calculated area-weighted average U-values [W/(m².K)]
U Calc = Calculated maximum individual element U-values [W/(m².K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability

<table>
<thead>
<tr>
<th>Air Permeability</th>
<th>Worst acceptable standard</th>
<th>This building</th>
</tr>
</thead>
<tbody>
<tr>
<td>m³/(h.m²) at 50 Pa</td>
<td>10</td>
<td>5*</td>
</tr>
</tbody>
</table>

* Buildings with less than 500 m² total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 m³/(h.m²) at 50 Pa.
Building services
The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES |
| Whole building electric power factor achieved by power factor correction | >0.95 |

1- Natural Vent with Radiators

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.85</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Extract with Radiators (9 Zones)

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.85</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- Radiators Only

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.85</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- New DHW Circuit

<table>
<thead>
<tr>
<th>Water heating efficiency</th>
<th>Storage loss factor [kWh/litre per day]</th>
</tr>
</thead>
<tbody>
<tr>
<td>This building</td>
<td>0.85</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.9*</td>
</tr>
</tbody>
</table>

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

<table>
<thead>
<tr>
<th>ID</th>
<th>System type in Non-domestic Building Services Compliance Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Local supply or extract ventilation units serving a single area</td>
</tr>
<tr>
<td>B</td>
<td>Zonal supply system where the fan is remote from the zone</td>
</tr>
<tr>
<td>C</td>
<td>Zonal extract system where the fan is remote from the zone</td>
</tr>
<tr>
<td>D</td>
<td>Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery</td>
</tr>
<tr>
<td>E</td>
<td>Local supply and extract ventilation system serving a single area with heating and heat recovery</td>
</tr>
<tr>
<td>F</td>
<td>Other local ventilation units</td>
</tr>
<tr>
<td>G</td>
<td>Fan-assisted terminal VAV unit</td>
</tr>
<tr>
<td>H</td>
<td>Fan coil units</td>
</tr>
<tr>
<td>I</td>
<td>Zonal extract system where the fan is remote from the zone with grease filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone name</th>
<th>ID of system type</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC G 10</td>
<td></td>
<td>0.3</td>
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</table>

Zone | Standard | Standard |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<td>WC G 10</td>
<td>0.3</td>
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</table>
### General lighting and display lighting

<table>
<thead>
<tr>
<th>Zone name</th>
<th>Luminaire</th>
<th>Lamp</th>
<th>Display lamp</th>
<th>General lighting [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard value</td>
<td>60</td>
<td>60</td>
<td>22</td>
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</tr>
<tr>
<td>Meeting Room G 1</td>
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<td>-</td>
<td>-</td>
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<td>Meeting Room G 2</td>
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<td>Meeting Room G 8</td>
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### General lighting and display lighting

<table>
<thead>
<tr>
<th>Zone name</th>
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<th>Lamp</th>
<th>Display lamp</th>
<th>General lighting [W]</th>
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<td>WC F 14</td>
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<tr>
<td>Tea Point/Kitchen G 9</td>
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<td>Corridor G 25</td>
<td>-</td>
<td>55</td>
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<td>35</td>
</tr>
<tr>
<td>WC G 17</td>
<td>-</td>
<td>55</td>
<td>-</td>
<td>46</td>
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</table>

### Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

<table>
<thead>
<tr>
<th>Zone</th>
<th>Solar gain limit exceeded? (%)</th>
<th>Internal blinds used?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Room G 1</td>
<td>NO (-31%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 2</td>
<td>NO (-54%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 7</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Meeting Room G 8</td>
<td>NO (-24%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 11</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Meeting Room G 13</td>
<td>NO (-63%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 26</td>
<td>NO (-57%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 27</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Meeting Room F 4</td>
<td>NO (-7%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F 8</td>
<td>NO (-59%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room S 3</td>
<td>NO (-4%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room S 7</td>
<td>NO (-68%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 4</td>
<td>NO (-64%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 5</td>
<td>NO (-4%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 14</td>
<td>NO (-64%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 15</td>
<td>NO (-63%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 16</td>
<td>NO (-62%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G 18</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Office F 7</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Office S 5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Zone</td>
<td>Solar gain limit exceeded? (%)</td>
<td>Internal blinds used?</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Office S 6</td>
<td>NO (-37%)</td>
<td>NO</td>
</tr>
<tr>
<td>Gym F 13</td>
<td>YES (+17%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G 28</td>
<td>NO (-24%)</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Criterion 4: The performance of the building, as built, should be consistent with the calculated BER**

Separate submission

**Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place**

Separate submission

**EPBD (Recast): Consideration of alternative energy systems**

<table>
<thead>
<tr>
<th>Were alternative energy systems considered and analysed as part of the design process?</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is evidence of such assessment available as a separate submission?</td>
<td>NO</td>
</tr>
<tr>
<td>Are any such measures included in the proposed design?</td>
<td>NO</td>
</tr>
</tbody>
</table>
## Technical Data Sheet (Actual vs. Notional Building)

### Building Global Parameters

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area [m²]</td>
<td>1431</td>
<td>1431</td>
</tr>
<tr>
<td>External area [m²]</td>
<td>6360</td>
<td>6360</td>
</tr>
<tr>
<td>Weather</td>
<td>NOR</td>
<td>NOR</td>
</tr>
<tr>
<td>Infiltration [m³/hm@50Pa]</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Average conductance [W/K]</td>
<td>12143</td>
<td>1827</td>
</tr>
<tr>
<td>Average U-value [W/m²K]</td>
<td>1.91</td>
<td>0.29</td>
</tr>
<tr>
<td>Alpha value* [%]</td>
<td>6.83</td>
<td>6.83</td>
</tr>
</tbody>
</table>

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

### Building Use

#### % Area Building Type

<table>
<thead>
<tr>
<th>Building Type</th>
<th>% Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1/A2 Retail/Financial and Professional services</td>
<td>100</td>
</tr>
<tr>
<td>A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways</td>
<td></td>
</tr>
<tr>
<td>B1 Offices and Workshop businesses</td>
<td></td>
</tr>
<tr>
<td>B2 to B7 General Industrial and Special Industrial Groups</td>
<td></td>
</tr>
<tr>
<td>B8 Storage or Distribution</td>
<td></td>
</tr>
<tr>
<td>C1 Hotels</td>
<td></td>
</tr>
<tr>
<td>C2 Residential Inst.: Hospitals and Care Homes</td>
<td></td>
</tr>
<tr>
<td>C2A Secure Residential Inst.</td>
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</tr>
<tr>
<td>C2 Residential Inst.: Universities and colleges</td>
<td>100</td>
</tr>
<tr>
<td>C2 Residential Inst.: Residential schools</td>
<td></td>
</tr>
<tr>
<td>C2 Residential Inst.: Residential spaces</td>
<td></td>
</tr>
<tr>
<td>D1 Non-residential Inst.: Community/Day Centre</td>
<td></td>
</tr>
<tr>
<td>D1 Non-residential Inst.: Libraries, Museums, and Galleries</td>
<td></td>
</tr>
<tr>
<td>D1 Non-residential Inst.: Education</td>
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<tr>
<td>D1 Non-residential Inst.: Primary Health Care Building</td>
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</tr>
<tr>
<td>D1 Non-residential Inst.: Crown and County Courts</td>
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</tr>
<tr>
<td>D2 General Assembly and Leisure, Night Clubs and Theatres</td>
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</tr>
<tr>
<td>Others: Passenger terminals</td>
<td></td>
</tr>
<tr>
<td>Others: Emergency services</td>
<td></td>
</tr>
<tr>
<td>Others: Miscellaneous 24hr activities</td>
<td></td>
</tr>
<tr>
<td>Others: Car Parks 24 hrs</td>
<td></td>
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<tr>
<td>Others - Stand alone utility block</td>
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</tbody>
</table>

### Energy Consumption by End Use [kWh/m²]

<table>
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<tr>
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<th>Actual</th>
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<tbody>
<tr>
<td>Heating</td>
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<td>Auxiliary</td>
<td>1.74</td>
<td>1.62</td>
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<td>Lighting</td>
<td>19.61</td>
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<tr>
<td>Hot water</td>
<td>1.31</td>
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<td>Equipment*</td>
<td>40.17</td>
<td>40.17</td>
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<td><strong>TOTAL</strong></td>
<td>181.17</td>
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* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

### Energy Production by Technology [kWh/m²]

<table>
<thead>
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<tbody>
<tr>
<td>Photovoltaic systems</td>
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<tr>
<td>Wind turbines</td>
<td>0</td>
<td>0</td>
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<td>CHP generators</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Solar thermal systems</td>
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### Energy & CO₂ Emissions Summary

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<tbody>
<tr>
<td>Heating + cooling demand [MJ/m²]</td>
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<tr>
<td>Primary energy* [kWh/m²]</td>
<td>258.89</td>
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<td>Total emissions [kg/m²]</td>
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* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.
### HVAC Systems Performance

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<tr>
<th>System Type</th>
<th>Heat dem [MJ/m²]</th>
<th>Cool dem [MJ/m²]</th>
<th>Heat con [kWh/m²]</th>
<th>Cool con [kWh/m²]</th>
<th>Aux con [kWh/m²]</th>
<th>Heat SSEEF</th>
<th>Cool SSEER</th>
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<td>809.4</td>
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<td>264.5</td>
<td>0</td>
<td>1.7</td>
<td>0.85</td>
<td>0</td>
<td>0.85</td>
<td>0</td>
</tr>
<tr>
<td>Notional</td>
<td>181</td>
<td>0</td>
<td>61.4</td>
<td>0</td>
<td>1.8</td>
<td>0.82</td>
<td>0</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

**Key to terms**

- **Heat dem [MJ/m²]** = Heating energy demand
- **Cool dem [MJ/m²]** = Cooling energy demand
- **Heat con [kWh/m²]** = Heating energy consumption
- **Cool con [kWh/m²]** = Cooling energy consumption
- **Aux con [kWh/m²]** = Auxiliary energy consumption
- **Heat SSEFF** = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
- **Cool SSEER** = Cooling system seasonal energy efficiency ratio
- **Heat gen SSEFF** = Heating generator seasonal efficiency
- **Cool gen SSEER** = Cooling generator seasonal efficiency ratio
- **ST** = System type
- **HS** = Heat source
- **HFT** = Heating fuel type
- **CFT** = Cooling fuel type
The BCO can give particular attention to items with specifications that are better than typically expected.

### Building fabric

<table>
<thead>
<tr>
<th>Element</th>
<th>$U_{Typ}$</th>
<th>$U_{Min}$</th>
<th>Surface where the minimum value occurs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>0.23</td>
<td>1.66</td>
<td>External Wall</td>
</tr>
<tr>
<td>Floor</td>
<td>0.2</td>
<td>0.95</td>
<td>Ground Floor</td>
</tr>
<tr>
<td>Roof</td>
<td>0.15</td>
<td>1.5</td>
<td>Internal Ceiling</td>
</tr>
<tr>
<td>Windows, roof windows, and rooflights</td>
<td>1.5</td>
<td>2.36</td>
<td>Elevation 5, FF 10</td>
</tr>
<tr>
<td>Personnel doors</td>
<td>1.5</td>
<td>3.08</td>
<td>Elevation 4 Door</td>
</tr>
<tr>
<td>Vehicle access &amp; similar large doors</td>
<td>1.5</td>
<td>-</td>
<td>No vehicle doors in project</td>
</tr>
<tr>
<td>High usage entrance doors</td>
<td>1.5</td>
<td>-</td>
<td>No high usage entrance doors in project</td>
</tr>
</tbody>
</table>

$U_{Typ}$ = Typical individual element U-values [W/(m² K)]

$U_{Min}$ = Minimum individual element U-values [W/(m² K)]

* There might be more than one surface where the minimum U-value occurs.

### Air Permeability

<table>
<thead>
<tr>
<th>m²/(h·m²) at 50 Pa</th>
<th>Typical value</th>
<th>This building</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix A(ii) – BRUKL Output
Proposed Building BRUKL
Administrative information

Building Details
Address: ,

Certification tool
Calculation engine: TAS
Calculation engine version: "v9.3.3"
Interface to calculation engine: TAS
Interface to calculation engine version: v9.3.3
BRUKL compliance check version: v5.2.d.2

Owner Details
Name: ,
Telephone number: ,
Address: ,

Certifier details
Name: ,
Telephone number: ,
Address: ,

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

<table>
<thead>
<tr>
<th>CO₂ emission rate from the notional building, kgCO₂/m².annum</th>
<th>16.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target CO₂ emission rate (TER), kgCO₂/m².annum</td>
<td>16.2</td>
</tr>
<tr>
<td>Building CO₂ emission rate (BER), kgCO₂/m².annum</td>
<td>15.2</td>
</tr>
<tr>
<td>Are emissions from the building less than or equal to the target?</td>
<td>BER =&lt; TER</td>
</tr>
<tr>
<td>Are as built details the same as used in the BER calculations?</td>
<td>Separate submission</td>
</tr>
</tbody>
</table>

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

<table>
<thead>
<tr>
<th>Element</th>
<th>Uₜ-limit</th>
<th>Uₜ-calc</th>
<th>Uᵢ-calc</th>
<th>Surface where the maximum value occurs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall**</td>
<td>0.35</td>
<td>0.29</td>
<td>0.29</td>
<td>External Wall</td>
</tr>
<tr>
<td>Floor</td>
<td>0.25</td>
<td>0.16</td>
<td>0.24</td>
<td>Exposed Floor</td>
</tr>
<tr>
<td>Roof</td>
<td>0.25</td>
<td>0.18</td>
<td>1.31</td>
<td>Internal Ceiling</td>
</tr>
<tr>
<td>Windows***, roof windows, and rooflights</td>
<td>2.2</td>
<td>1.65</td>
<td>1.87</td>
<td>Elevation 5, FF 10</td>
</tr>
<tr>
<td>Personnel doors</td>
<td>2.2</td>
<td>1.61</td>
<td>1.61</td>
<td>Elevation 4 Door</td>
</tr>
<tr>
<td>Vehicle access &amp; similar large doors</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>No vehicle doors in project</td>
</tr>
<tr>
<td>High usage entrance doors</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>No high usage entrance doors in project</td>
</tr>
</tbody>
</table>

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability

<table>
<thead>
<tr>
<th>m³/(h.m²) at 50 Pa</th>
<th>Worst acceptable standard</th>
<th>This building</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10*</td>
<td></td>
</tr>
</tbody>
</table>

* Buildings with less than 500 m² total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 m³/(h.m²) at 50 Pa.
Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | NO |
| Whole building electric power factor achieved by power factor correction                  | >0.95 |

1- Extract with Heating (8 Zones)

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Nat Vent + Rads

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- Mech Vent + Rads (15 Zones)

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>-</td>
<td>-</td>
<td>1.1</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>1.1^</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- Rads Only

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

5- VRF + Rads (3 Zones)

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>4.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>2.6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

6- VRF only (Meeting Room G2)

<table>
<thead>
<tr>
<th>Heating efficiency</th>
<th>Cooling efficiency</th>
<th>Radiant efficiency</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system</td>
<td>0.96</td>
<td>4.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.91*</td>
<td>2.6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.
<table>
<thead>
<tr>
<th>Water heating efficiency</th>
<th>Storage loss factor [kWh/litre per day]</th>
</tr>
</thead>
<tbody>
<tr>
<td>This building</td>
<td>0.96</td>
</tr>
<tr>
<td>Standard value</td>
<td>0.9*</td>
</tr>
</tbody>
</table>

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

<table>
<thead>
<tr>
<th>ID</th>
<th>System type in Non-domestic Building Services Compliance Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Local supply or extract ventilation units serving a single area</td>
</tr>
<tr>
<td>B</td>
<td>Zonal supply system where the fan is remote from the zone</td>
</tr>
<tr>
<td>C</td>
<td>Zonal extract system where the fan is remote from the zone</td>
</tr>
<tr>
<td>D</td>
<td>Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery</td>
</tr>
<tr>
<td>E</td>
<td>Local supply and extract ventilation system serving a single area with heating and heat recovery</td>
</tr>
<tr>
<td>F</td>
<td>Other local ventilation units</td>
</tr>
<tr>
<td>G</td>
<td>Fan-assisted terminal VAV unit</td>
</tr>
<tr>
<td>H</td>
<td>Fan coil units</td>
</tr>
<tr>
<td>I</td>
<td>Zonal extract system where the fan is remote from the zone with grease filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone name</th>
<th>SFP [W/(l/s)]</th>
<th>HR efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ID of system type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>WC G9</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>WC G11</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>WC G14</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Food Drink F11</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>WC G15</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>WC G16</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Food and Drink G8</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Food and Drink G21</td>
<td>0.3</td>
<td>-</td>
</tr>
</tbody>
</table>

General lighting and display lighting

<table>
<thead>
<tr>
<th>Zone name</th>
<th>Luminous efficacy [lm/W]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Luminaire</td>
</tr>
<tr>
<td></td>
<td>Standard value</td>
</tr>
<tr>
<td>Meeting Room G2</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room G3</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room G6</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room G7</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room G19</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room F4</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room F12</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room S2</td>
<td>100</td>
</tr>
<tr>
<td>Meeting Room S4</td>
<td>100</td>
</tr>
<tr>
<td>Circ - Corridor G5</td>
<td>-</td>
</tr>
<tr>
<td>Circ - Corridor G17</td>
<td>-</td>
</tr>
<tr>
<td>Circ - Corridor G20</td>
<td>-</td>
</tr>
<tr>
<td>Circ - Corridor F8</td>
<td>-</td>
</tr>
<tr>
<td>Circ - Corridor S8</td>
<td>-</td>
</tr>
</tbody>
</table>
### General lighting and display lighting

<table>
<thead>
<tr>
<th>Zone name</th>
<th>Luminaire</th>
<th>Lamp</th>
<th>Display lamp</th>
<th>General lighting [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard value</td>
<td>60</td>
<td>60</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Office G1</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>306</td>
</tr>
<tr>
<td>Office F2</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>109</td>
</tr>
<tr>
<td>Store G10</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Store F9</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>WC G9</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td>WC G11</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>WC G14</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>WC F10</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>WC F15</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>58</td>
</tr>
<tr>
<td>Food Drink F11</td>
<td>-</td>
<td>60</td>
<td>-</td>
<td>41</td>
</tr>
<tr>
<td>Circ - Stairs G18</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Circ - Stairs F1</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>Circ - Stairs F7</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td>Circ - Stairs S1</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>Circ - Stairs S6</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>Photo Copy F18</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>194</td>
</tr>
<tr>
<td>Plant Room S7</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>130</td>
</tr>
<tr>
<td>WC G15</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td>Circ - Stairs G25</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>Circ - Entrance G4</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>17</td>
</tr>
<tr>
<td>Circ - Entrance G23</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>Store G12</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Store G13</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>Store G24</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>WC G16</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>Food and Drink G8</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>84</td>
</tr>
<tr>
<td>Food and Drink G21</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>274</td>
</tr>
<tr>
<td>Circ - Corridor G26</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>26</td>
</tr>
<tr>
<td>Meeting Room F13</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>260</td>
</tr>
<tr>
<td>Meeting Room F14</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>180</td>
</tr>
<tr>
<td>Meeting Room F17</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>172</td>
</tr>
<tr>
<td>Meeting Room F19</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>177</td>
</tr>
<tr>
<td>Open Office F3</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>560</td>
</tr>
<tr>
<td>Open Office F5</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>510</td>
</tr>
<tr>
<td>Open Office F16</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>1135</td>
</tr>
<tr>
<td>Open Office S3</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>510</td>
</tr>
<tr>
<td>Open Office S5</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>579</td>
</tr>
</tbody>
</table>

### Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

<table>
<thead>
<tr>
<th>Zone</th>
<th>Solar gain limit exceeded? (%)</th>
<th>Internal blinds used?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Room G2</td>
<td>NO (-69%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G3</td>
<td>NO (-60%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G6</td>
<td>NO (-48%)</td>
<td>NO</td>
</tr>
<tr>
<td>Zone</td>
<td>Solar gain limit exceeded? (%)</td>
<td>Internal blinds used?</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Meeting Room G7</td>
<td>NO (-43%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room G19</td>
<td>NO (-71%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F4</td>
<td>NO (-53%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F12</td>
<td>NO (-48%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room S2</td>
<td>NO (-54%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room S4</td>
<td>NO (-53%)</td>
<td>NO</td>
</tr>
<tr>
<td>Circ - Corridor G5</td>
<td>NO (-99%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office G1</td>
<td>NO (-48%)</td>
<td>NO</td>
</tr>
<tr>
<td>Office F2</td>
<td>NO (-70%)</td>
<td>NO</td>
</tr>
<tr>
<td>Food Drink F11</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Photo Copy F18</td>
<td>NO (-38%)</td>
<td>NO</td>
</tr>
<tr>
<td>Food and Drink G8</td>
<td>NO (-36%)</td>
<td>NO</td>
</tr>
<tr>
<td>Food and Drink G21</td>
<td>NO (-24%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F13</td>
<td>NO (-35%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F14</td>
<td>NO (-56%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F17</td>
<td>NO (-30%)</td>
<td>NO</td>
</tr>
<tr>
<td>Meeting Room F19</td>
<td>NO (-37%)</td>
<td>NO</td>
</tr>
<tr>
<td>Open Office F3</td>
<td>NO (-29%)</td>
<td>NO</td>
</tr>
<tr>
<td>Open Office F5</td>
<td>NO (-66%)</td>
<td>NO</td>
</tr>
<tr>
<td>Open Office F16</td>
<td>NO (-44%)</td>
<td>NO</td>
</tr>
<tr>
<td>Open Office S3</td>
<td>NO (-33%)</td>
<td>NO</td>
</tr>
<tr>
<td>Open Office S5</td>
<td>NO (-75%)</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Criterion 4: The performance of the building, as built, should be consistent with the calculated BER**

Separate submission

**Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place**

Separate submission

**EPBD (Recast): Consideration of alternative energy systems**

<table>
<thead>
<tr>
<th>Were alternative energy systems considered and analysed as part of the design process?</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is evidence of such assessment available as a separate submission?</td>
<td>NO</td>
</tr>
<tr>
<td>Are any such measures included in the proposed design?</td>
<td>YES</td>
</tr>
</tbody>
</table>
## Building Global Parameters

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area [m²]</td>
<td>1426</td>
<td>1426</td>
</tr>
<tr>
<td>External area [m²]</td>
<td>6359</td>
<td>6359</td>
</tr>
<tr>
<td>Weather</td>
<td>NOR</td>
<td>NOR</td>
</tr>
<tr>
<td>Infiltration [m³/hm@50Pa]</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Average conductance [W/K]</td>
<td>1709</td>
<td>1878</td>
</tr>
<tr>
<td>Average U-value [W/m²K]</td>
<td>0.27</td>
<td>0.3</td>
</tr>
<tr>
<td>Alpha value [%]</td>
<td>6.91</td>
<td>6.91</td>
</tr>
</tbody>
</table>

* Percentage of the building’s average heat transfer coefficient which is due to thermal bridging

## Energy Consumption by End Use [kWh/m²]

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>26.11</td>
<td>14.96</td>
</tr>
<tr>
<td>Cooling</td>
<td>0.18</td>
<td>0.22</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>3.21</td>
<td>4.54</td>
</tr>
<tr>
<td>Lighting</td>
<td>11.89</td>
<td>16.96</td>
</tr>
<tr>
<td>Hot water</td>
<td>8.54</td>
<td>9.2</td>
</tr>
<tr>
<td>Equipment*</td>
<td>36.96</td>
<td>36.96</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>49.92</td>
<td>45.88</td>
</tr>
</tbody>
</table>

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m²]

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic systems</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wind turbines</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CHP generators</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal systems</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

## Energy & CO₂ Emissions Summary

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating + cooling demand [MJ/m²]</td>
<td>95.18</td>
<td>74.45</td>
</tr>
<tr>
<td>Primary energy* [kWh/m²]</td>
<td>88</td>
<td>94.49</td>
</tr>
<tr>
<td>Total emissions [kg/m²]</td>
<td>15.2</td>
<td>16.2</td>
</tr>
</tbody>
</table>

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.
## HVAC Systems Performance

<table>
<thead>
<tr>
<th>System Type</th>
<th>Heat dem MJ/m²</th>
<th>Cool dem MJ/m²</th>
<th>Heat con kWh/m²</th>
<th>Cool con kWh/m²</th>
<th>Aux con kWh/m²</th>
<th>Heat SSEEF</th>
<th>Cool SSEEF</th>
<th>Heat gen SEFF</th>
<th>Cool gen SEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>182.7</td>
<td>0</td>
<td>54.5</td>
<td>0</td>
<td>3</td>
<td>0.93</td>
<td>0</td>
<td>0.96</td>
<td>0</td>
</tr>
<tr>
<td>Notional</td>
<td>188.7</td>
<td>0</td>
<td>41.6</td>
<td>0</td>
<td>3.9</td>
<td>1.26</td>
<td>0</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Actual</td>
<td>130</td>
<td>0</td>
<td>38.8</td>
<td>0</td>
<td>1.1</td>
<td>0.93</td>
<td>0</td>
<td>0.96</td>
<td>0</td>
</tr>
<tr>
<td>Notional</td>
<td>101.9</td>
<td>0</td>
<td>22.5</td>
<td>0</td>
<td>1</td>
<td>1.26</td>
<td>0</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Actual</td>
<td>65.9</td>
<td>0</td>
<td>19.7</td>
<td>0</td>
<td>5.5</td>
<td>0.93</td>
<td>0</td>
<td>0.96</td>
<td>0</td>
</tr>
<tr>
<td>Notional</td>
<td>33.5</td>
<td>0</td>
<td>7.4</td>
<td>0</td>
<td>8</td>
<td>1.26</td>
<td>0</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Actual</td>
<td>120.1</td>
<td>0</td>
<td>35.8</td>
<td>0</td>
<td>1.1</td>
<td>0.93</td>
<td>0</td>
<td>0.96</td>
<td>0</td>
</tr>
<tr>
<td>Notional</td>
<td>105.2</td>
<td>0</td>
<td>23.2</td>
<td>0</td>
<td>1.1</td>
<td>1.26</td>
<td>0</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Actual</td>
<td>93.2</td>
<td>26.9</td>
<td>27.8</td>
<td>1.7</td>
<td>2.1</td>
<td>0.93</td>
<td>4.5</td>
<td>0.96</td>
<td>4.5</td>
</tr>
<tr>
<td>Notional</td>
<td>40.6</td>
<td>24.9</td>
<td>9</td>
<td>1.9</td>
<td>1.1</td>
<td>1.26</td>
<td>3.6</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>[ST] No Heating or Cooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>134.5</td>
<td>40</td>
<td>40.1</td>
<td>2.5</td>
<td>0</td>
<td>0.93</td>
<td>4.5</td>
<td>0.96</td>
<td>4.5</td>
</tr>
<tr>
<td>Notional</td>
<td>60.4</td>
<td>63.9</td>
<td>13.3</td>
<td>4.9</td>
<td>0</td>
<td>1.26</td>
<td>3.6</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

### Key to terms

- **Heat dem [MJ/m²]** = Heating energy demand
- **Cool dem [MJ/m²]** = Cooling energy demand
- **Heat con [kWh/m²]** = Heating energy consumption
- **Cool con [kWh/m²]** = Cooling energy consumption
- **Aux con [kWh/m²]** = Auxiliary energy consumption
- **Heat SSEFF** = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
- **Cool SSEER** = Cooling system seasonal energy efficiency ratio
- **Heat gen SSEFF** = Heating generator seasonal efficiency
- **Cool gen SSEER** = Cooling generator seasonal energy efficiency ratio
- **ST** = System type
- **HS** = Heat source
- **HFT** = Heating fuel type
- **CFT** = Cooling fuel type
The BCO can give particular attention to items with specifications that are better than typically expected.

**Building fabric**

<table>
<thead>
<tr>
<th>Element</th>
<th>$U_{Typ}$</th>
<th>$U_{Min}$</th>
<th>Surface where the minimum value occurs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>0.23</td>
<td>0.29</td>
<td>External Wall</td>
</tr>
<tr>
<td>Floor</td>
<td>0.2</td>
<td>0.15</td>
<td>Ground Floor</td>
</tr>
<tr>
<td>Roof</td>
<td>0.15</td>
<td>0.18</td>
<td>Roof</td>
</tr>
<tr>
<td>Windows, roof windows, and rooflights</td>
<td>1.5</td>
<td>1.62</td>
<td>Type 4</td>
</tr>
<tr>
<td>Personnel doors</td>
<td>1.5</td>
<td>1.6</td>
<td>Elevation 5 Door</td>
</tr>
<tr>
<td>Vehicle access &amp; similar large doors</td>
<td>1.5</td>
<td>-</td>
<td>No vehicle doors in project</td>
</tr>
<tr>
<td>High usage entrance doors</td>
<td>1.5</td>
<td>-</td>
<td>No high usage entrance doors in project</td>
</tr>
</tbody>
</table>

$U_{Typ} = $ Typical individual element $U$-values [W/(m$^2$K)]

$U_{Min} = $ Minimum individual element $U$-values [W/(m$^2$K)]

* There might be more than one surface where the minimum $U$-value occurs.

**Air Permeability**

<table>
<thead>
<tr>
<th>$m^3/(h.m^2)$ at 50 Pa</th>
<th>Typical value</th>
<th>This building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>