Newcastle University USB
Operational energy predictions vs. 1 year POE

Mark Dowson, Associate, BuroHappold
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Client: Newcastle University
Architect & interiors: Hawkins\Brown
MEP, structures, acoustics & fire: BuroHappold Engineering
Sustainability (client side): BuroHappold Engineering
Contractor: Bowmer & Kirkland
Contractor MEP engineer: NG Bailey
Sustainability (contractor): DSSR
Project Manager: Turner & Townsend
Landscapes: BD Landscapes
• Electrically led solution
  • Water-to-water heat pump system
  • Chilled beams providing cooling & fresh air
  • Heating from perimeter radiators
  • Naturally ventilated atrium with UFH
  • Solar PV and Solar PV-thermal
  • Gas condensing boilers for top-up
  • Over 4,000 sensors/metering points!
  • EPC “B” rating & 19% reduction in regulated CO₂
Part L vs. TM54 predictions

Energy use (kWh/m²) vs. DEC ratings:
- DEC D(85)
- DEC D(98)
- DEC C(75)
- DEC E(125)

Energy breakdown:
- Heating
- Cooling
- Auxiliary
- Lighting
- Hot water
- Equipment
- Other (lifts)
- Other (humidification)
- Renewable

Comparison between Part L (design and as-built) and TM54 scenarios.
TM54 vs. POE

0 500 1000 1500 2000 2500
MWh/year

TM54 prediction (Scenario 1)
- Humidification: 1%
- Cooling: 5%
- Lighting: 6%
- Lifts: 1%
- Pumps/collection/heat rejection: 15%
- Fans: 8%
- Heating: 7%
- Domestic hot water: 4%
- Catering: 10%
- Server rooms: 8%
- Small power: 31%

1st year POE result
- Humidification: 1%
- Cooling: 11%
- Lighting: 10%
- Lifts: 1%
- Pumps/collection/heat rejection: 10%
- Fans: 7%
- Server rooms: 10%
- Heating: 12%
- Domestic hot water: 6%
- Catering: 5%
- Other equipment: 3%
LIGHTING – The increased lighting usage is predominately associated with the increased out of hours and weekend usage. Also it is noted that some large areas such as the lecture theatre and event space that are not controlled on presence/absence detection are being left illuminated when not in use.
SMALL POWER – It is assumed that a combination of the following reasons have contributed to the lower small power usage:
- Students using battery from own laptop in communal areas.
- More lower power higher efficiency equipment than in the original assessment.
- Lower energy usage from projectors / vending machines etc than assumed.
- In the first year departments from other buildings may have been moved to the USB in stages resulting in lower occupancy at the start of the year.
HEATING – The original IES model assumed that a larger proportion of the building heat loss would have been offset by equipment meaning in reality more heating is required from the LTHW and would need to be injected from the LTHW boilers. The level of control is also plays a significant factor in heating energy usage. The original assessment was based on limiting the winter heating temperatures to 21°C. The user controls on site have full functionality to allow users to select temperatures up to 24°C in winter.
FANS – This is likely to be attributable to the additional demand control strategy that was implemented into the BMS strategy.
COOLING – From reviewing actual temperature data, summer weather has been warmer than typical meaning that an increase in cooling power would be expected associated with cooling incoming fresh air. In addition, similar to the heating, the original assessment was based on a minimum summer temperature of 22°C whereas the occupants have potential to set the cooling lower than this in the summer.
In the first year, the (draft) DEC rating with “standard occupancy” assumed was D(80). This is compared to the baseline TM54 model of D(85). Note that some computing suites in the building do have 24/7 access, however at present these extended hours have not been factored into the DEC. For information if the whole building were 24/7 access, then the DEC would be in the region of C(58).

CO₂ savings needed from the current D(80) position to achieve a DEC C rating or better

<table>
<thead>
<tr>
<th>DEC Position</th>
<th>% CO₂ Reduction Need to Enter Next Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC C (75)</td>
<td>6.4%</td>
</tr>
<tr>
<td>DEC B (50)</td>
<td>33.4%</td>
</tr>
<tr>
<td>DEC A (25)</td>
<td>68.8%</td>
</tr>
</tbody>
</table>
User satisfaction - temperature in summer

**Urban Sciences Building**
- Better than BUS midpoint (comfortable)
- Better than benchmark mean

**Claremont / Davsh Complex**

**Core Building**

**89 Sandyford Road**

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User satisfaction - temperature in winter

Urban Sciences Building
- Better than BUS midpoint (comfortable)
- Better than benchmark mean

Claremont / Davsh Complex

Core Building

89 Sandyford Road

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Real-time BMS data in the BIM model

https://3d.usb.urbanobservatory.ac.uk/
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Next steps

Using big data for intelligent real-time Asset Management & Diagnostics

BMS data visualisation

Fault finding and set-point interrogation
In-use target setting (kgCO₂/m²/year)

EPC RATING
(COMPLIANCE CALCULATION)

DEC RATING
(OPERATIONAL PERFORMANCE)

In-use target setting (kgCO₂/m²/year)

0 - 23 24 - 47 48 - 69 70 - 93 94 - 117 118 - 140 141+

Graphs generated from EPC data from 2008 – 2015 containing over 600,000 records and DEC data from 2010 – 2015 containing over 170,000 records. Filtering of results for "University" and "College" buildings. Target development from DEC benchmark for CIBSE T&NG University Campus building with typical energy use of 80 kWh/m²/year electricity and 240 kWh/m²/year fossil energy. Carbon dioxide factors of 0.216 kgCO₂/kWh and 0.519 kgCO₂/kWh applied.
Thank you!

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