Crawley Library - BPE Findings

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BPE Project Team

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  Oxford Brookes University

- Penoyre & Prasad LLP  
  Architects

- West Sussex County Council  
  Property owners, managers, end users

- Ramboll  
  Sustainability consultants
BPE study elements

- Building services & energy systems
- Sub-metering arrangements
- Thermographic survey
- Energy use
- Occupant survey and interviews
- Review of controls
- Aftercare, operation, maintenance and management

Recommendations / Lessons Learnt
Crawley Library

- Internal gross floor area: 4470m²
- Open to public since December 2008
- EPC A Rating (25), BREEAM Very Good (potentially excellent) 60% CO2 reduction over Part L
- DEC Grade D
Crawley Library - Layout

4 storey building stepping down to 2 storeys at North & East

Library: 2,700 m²
Registry services: 500 m²
Social services: 380 m²
Offices: 900 m²

Occupancy:
Monday to Friday  8am - 5pm
Saturday (Library)  9am - 7pm
Key

1 entrance foyer
2 coffee bar
3 enquiries
4 express collection
5 children's library
6 audio visual
7 "head space"
8 large print & spoken word
9 reserve stock
10 loading and security
11 staff work
12 plant
13 interview rooms
14 waiting area
15 conference rooms
Low energy approach

- Extensive thermal mass
- Night time cooling
- Thermal zoning
- High performance glazing
- Flexible ‘mixed-mode’ ventilation system
- Natural stack effect through atrium
- Excellent natural day lighting
- Biomass boiler and solar water heating
- BMS with 27 sub-meters
Building services & energy systems
Heating & cooling

• Heat distribution through library areas and office above takes place via underfloor pipework.

• Heat distribution in the registry services section primarily via radiator system.

• Chilled water cooling system serves series of air handling units and fan coil units, and provides primary cooling for the underfloor heating/cooling system.
Ventilation

- Primarily Mechanical Ventilation through floor voids in four storey section.
- Traditional ductwork system in two storey section
- Heat recovery in Air Handling Units (AHUs) to recover waste heat.
- Mechanical ventilation in GF social services rooms and FF meeting rooms
- Naturally ventilated offices and ceremony rooms in FF

Legend:
- = NATURALLY VENTILATED
- = RAISED UNDER FLOOR SUPPLY, RETURN VIA ATRIUM
- = TOILET EXTRACT WITH MECH MAKE-UP
- = MECH VENT FOR OCCUPANCY
- = 4 PIPE FAN COIL UNITS WITH MECH VENT
- = IT SERVER ROOM
mixed-mode system developed from Portsmouth University Library
Monitoring of energy use
Annual energy consumption

**Energy supplies excluding renewables**

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Energy consumption (kWh/m²/annum)

- **Gas:** building performs 73% better (lower) than the raw CIBSE TM46 benchmark and 73.5% better than the DEC benchmark.

- **Electricity:** building performs 39% worse (higher) than the raw CIBSE TM46 benchmark and 31% worse than the DEC benchmark.
Annual carbon emissions

- Emissions figure of 77.4 kgCO₂/m² is 6% worse (higher) than the raw CIBSE TM46 benchmark and almost equal to the DEC benchmark.
Monthly electricity use by end-use

Monthly electricity consumption by end use (October 2013-January 2014)

- Monthly electricity consumption for lighting ranges between 12,000-12,8000kWh and between 7,500-9,000 for small power.
- Catering in café consumes around 3,300kWh per month and the chiller consumes between 4,000-6,000 kWh per month.
Environmental monitoring equipment

- Data collection Hub
- Internal Temperature & RH
- Internal CO₂ levels
- External Temperature & RH
Internal temperatures in most spaces remain between comfort levels (20-25°C)
Internal temperatures remain between comfort levels (20-25°C)
Lowest temperatures in FF ceremony room
During summer temperature rises slightly above the comfort zone
CO₂ levels remain below the ASHRAE recommended limit of 1000ppm indicating good quality of air.
Occupant survey & interviews
Overall findings

- 71% response rate
- Quality of light & design are the most appreciated elements
- High temperatures perceived during summer which cross-relates with monitoring data.
- Negative perception on ventilation in offices
Aftercare, operation, maintenance & management
Review of O&M manual and Logbook

- Lack of **adequate documentation of information** on management, maintenance and operation.

- Missing volumes from O&M manual: Volume 7 ‘Maintenance Instructions and Logbooks’ and Volume 8 ‘Fault tracing Charts’

- Logbook not kept up to date. No log of breakdowns, repairs and maintenance.

- Sub-meters were difficult to locate - drawings with the metering and sub-metering arrangements missing from the contractor’s electrical and mechanical specification documents.
Reliability, maintenance and management

- No BMS maintenance contract (Proactive Preventive Maintenance) was put in place, with the result that issues with operation of the heating and cooling system could not be resolved quickly.

- Lack of continuity and adequate handover between building managers

- FM team struggled to keep low carbon systems running – biomass and solar thermal – because of the necessary maintenance requirements.
Building operations and controls

- BMS system did not have a user-friendly interface.
- Management team has limited understanding of BMS controls and software. They often override the BMS settings using the control panel in the plant room.
- Inadequate commissioning of the BMS system and its trend logging facility has resulted in managers not being able to control heating, ventilation and cooling levels throughout the building.
- Occupants don’t have sufficient control over their environment; they can’t make any significant changes and they rely on automatic sensors throughout the rooms and remotely-fixed environmental conditions.
Key findings

- **Performance of building fabric**: Abnormalities in the building fabric revealed by thermographic survey matched users’ comments relating to cold drafts and unheated spaces.

- **Review of handover process and commissioning**: Inadequacies in commissioning combined with frequent changes of FM staff and lack of ongoing maintenance of BMS have led to heating and ventilation systems operating at sub-optimal level.

- **Performance and usability of systems and controls**: The purpose of most controls were clear, well labelled and intuitive to use providing a relatively high level of user control with the exception of BMS and mechanically controlled windows to offices. Daylight sensors triggering lights to be on the majority of time.
Key findings (contd.)

• **Occupant surveys and environmental conditions:** Building design is appreciated by the occupants. Most of the spaces presented a stable temperature pattern. CO2 concentrations were below recommended limit of 1000ppm, indicating adequate indoor air quality.

• **Carbon emissions and energy use:** Building performed very well in terms of gas consumption (80% lower than benchmarks) but electricity was 23% higher than CIBSE benchmark and 14% higher than DEC benchmark. Highest electricity end-use was lighting. Even with high levels of daylighting automatic daylight sensors are triggering lights to be on almost continuously.
Wider Lessons

- Unplanned changes to space usage can result in poor internal environmental conditions e.g. use of archive space as offices.

- Inadequate handover training and documentation and frequent FM staff leads to lack of understanding of the services and systems installed and ability to properly manage building.

- Lack of a proper building manager in place during a BPE can make it not possible to implement any recommendations for improvement.

- Design simpler buildings that don’t rely on complex BMS programmes to operate!