

CAT Machynlleth

Building Performance Assessment and Evaluation 12 May 2015

PART 3.1

BPE CASE STUDY

Feeding forward:

National Trust to Woodland Trust

Bill Bordass and Adrian Leaman

the Usable Buildings Trust

www.usablebuildings.co.uk

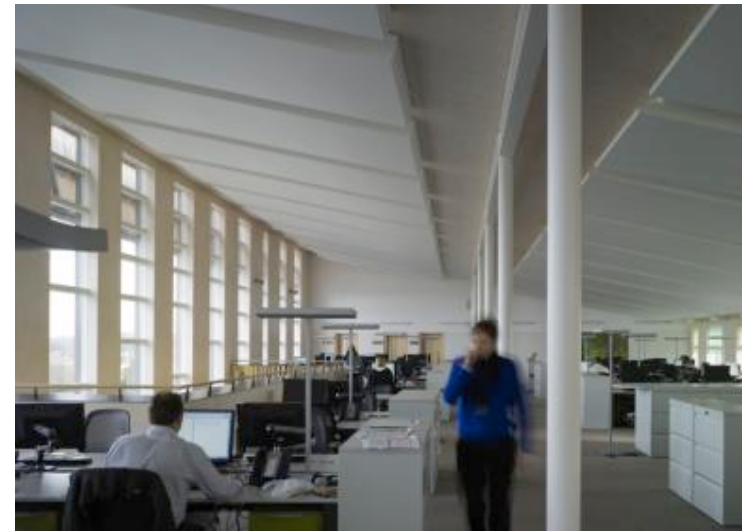
CASE

National Trust to Swindon 2005, POE 2007



STUDY

Woodland Trust Grantham 2010, BPE 2014



2006-07 Mini-Probe at Heelis *National Trust Headquarters, Swindon*

Offices, catering facilities for staff & public, central IT server, shop.

Client and design intent for a sustainable building, including:

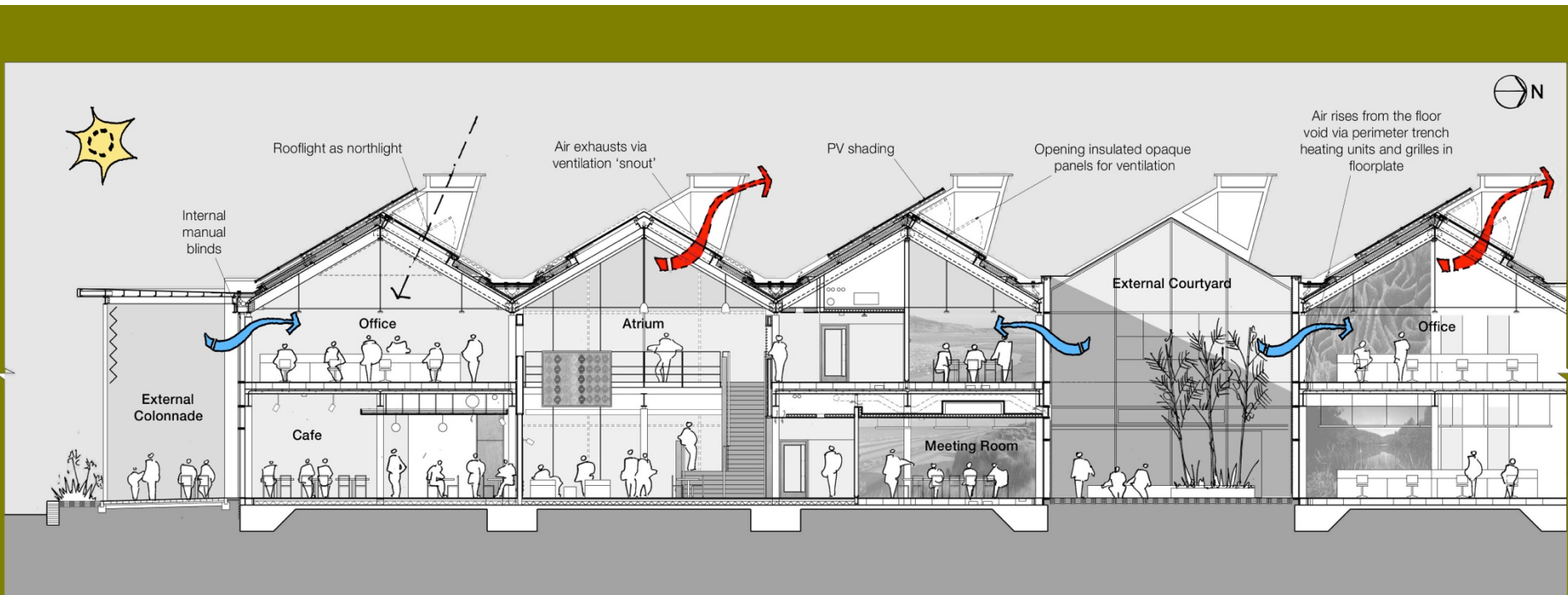
- Deep plan (with courtyards) for good communications.
- Low rise (2 storey) with rooflights for natural light and ventilation.
- Automatic natural ventilation with low energy mechanical backup.
- Large photovoltaic array.
- Expectations managed using a matrix of features vs. aspirations.

Procured as a pre-let:

- Scheme design by Feilden Clegg Bradley (FCBS, architects), Max Fordham (building services), Adams Kara Taylor (structural).
- After RIBA Stage D, design team novated to: Aim Investments (investor), Kier Ventures (developer), Moss (contractor).

Awards 2006: BCO Innovation, Civic Trust Sustainability, RIBA Sustainability.

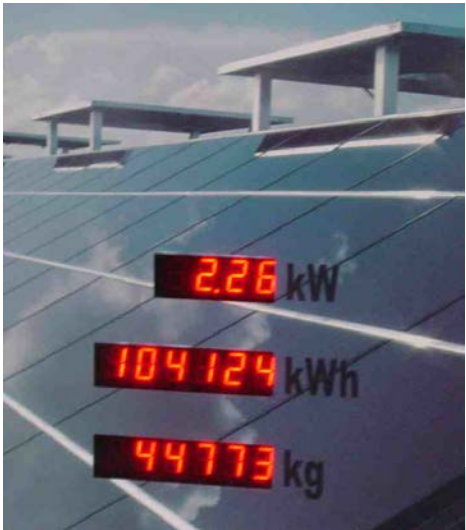
FCBS spent the RIBA prize money on the POE, plus a bit for a party!



Heelis office interior



Heelis: some environmental systems



SO, HOW ARE YOU DOING?

xx building analysis

11.07 bsjonline.co.uk

Heelis, the National Trust's HQ in Swindon, is two years old. Senior engineer at Max Fordham Guy Nevill, who helped design it, takes a look at how it's been performing



Heelis POE 2006-7: some conclusions

- DAYLIGHT: design should take account of indoor appearance, not just desktop illuminance. *Added wall washing would save lighting energy.*
 - SPECIAL AREAS: Energy in server room and kitchen accounted for more than half the CO₂ emissions. *Need more design & management attention.*
 - METERING & MONITORING: More attention needed. *Automated in 2012.*
 - HEATING & HOT WATER: *Performance disappointing.*
 - ENERGY MANAGEMENT. Improved in 2007, deteriorated 2008-2012, now improving. *Scope for more savings, including reduced night loads.*
 - SUMMER COMFORT. Occupant survey shows satisfaction improved in 2007, owing to cooler weather, better control and management. *Reportedly better still now, after control upgrades in 2012-13*
 - WINTER COMFORT. Improved: window controls were fine-tuned in 2007. *The control system was replaced in 2012, allowing individual adjustment.*
 - OCCUPANT SATISFACTION: Heelis (2007) had the best overall score in the BUS database for “green” buildings with deep floorplates (*but simpler, shallower buildings tend to perform better, with better perceived control*).
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Feeding forward from Heelis to the Woodland Trust HQ, Grantham

Followed in the footsteps of Heelis, with FCBS, Max Fordham, *and the CEO of Woodland Trust who joined from the National Trust.*

SOME LESSONS INCORPORATED IN THE DESIGN (2008):

- Make it simpler: *controls, shallow plan, naturally ventilated*
 - Task-ambient lighting in main offices.
 - More energy-efficient ICT, *with thin clients.*
 - Rudiments of Soft Landings, *though not rigorously adopted.*
 - Early appointment of Facilities Manager.
 - Managed move-in process, *with newsletters from the FM.*
 - Follow-through, *with successful bid to TSB for evaluation.*
-

Simplifications undertaken

taking advantage of feedback from the Heelis POE

ITEM	NATIONAL TRUST Heelis	WOODLAND TRUST
Procurement	Pre-let D&B after Stage D	Conventional contract
Building envelope	Steel frame with a variety of infill and cladding systems.	Cross-laminated timber envelope with concrete stiffening/ thermal mass.
Heating	Bespoke system with three boilers, one condensing.	Three modular condensing boilers in packaged set.
Hot water	Calorifier fed by boiler plant. Bespoke controls	Calorifier fed by boiler plant. Controls packaged with boilers.
Ventilation & Cooling	Mixed mode: automated windows and background mechanical ventilation.	Naturally ventilated with manual & motorised windows, automated night cooling and CO2 control.
Lighting	Deep plan, mostly toplit, plus perimeter windows. Lighting management system.	Narrow plan, perimeter windows. Task lights with manual control. Time switched ambient lights, with reception over-ride.
Office equipment	PCs, many laptops. Centralised printing.	Mostly “thin clients” with a few PCs. Centralised printing.
Server room cooling	Airside “free” cooling plus chilled water.	Chilled water only, using packaged chiller with waterside free cooling.

Technology Strategy Board

(now called Innovate UK)

Building performance evaluation (BPE) programme



Woodland Trust: *cross-laminated timber construction with added thermal mass*

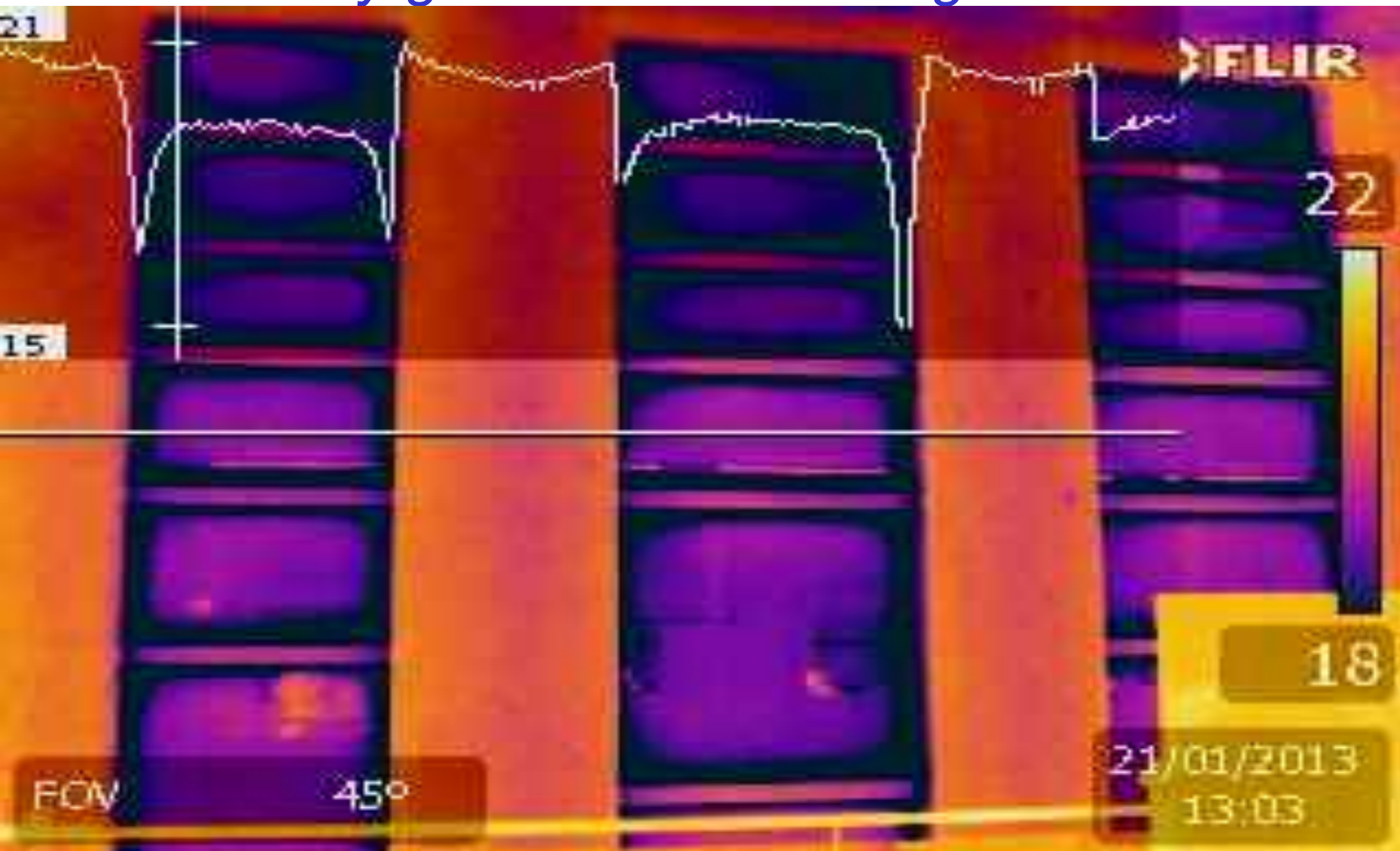






Woodland Trust Fabric

Generally good. Windows might be better

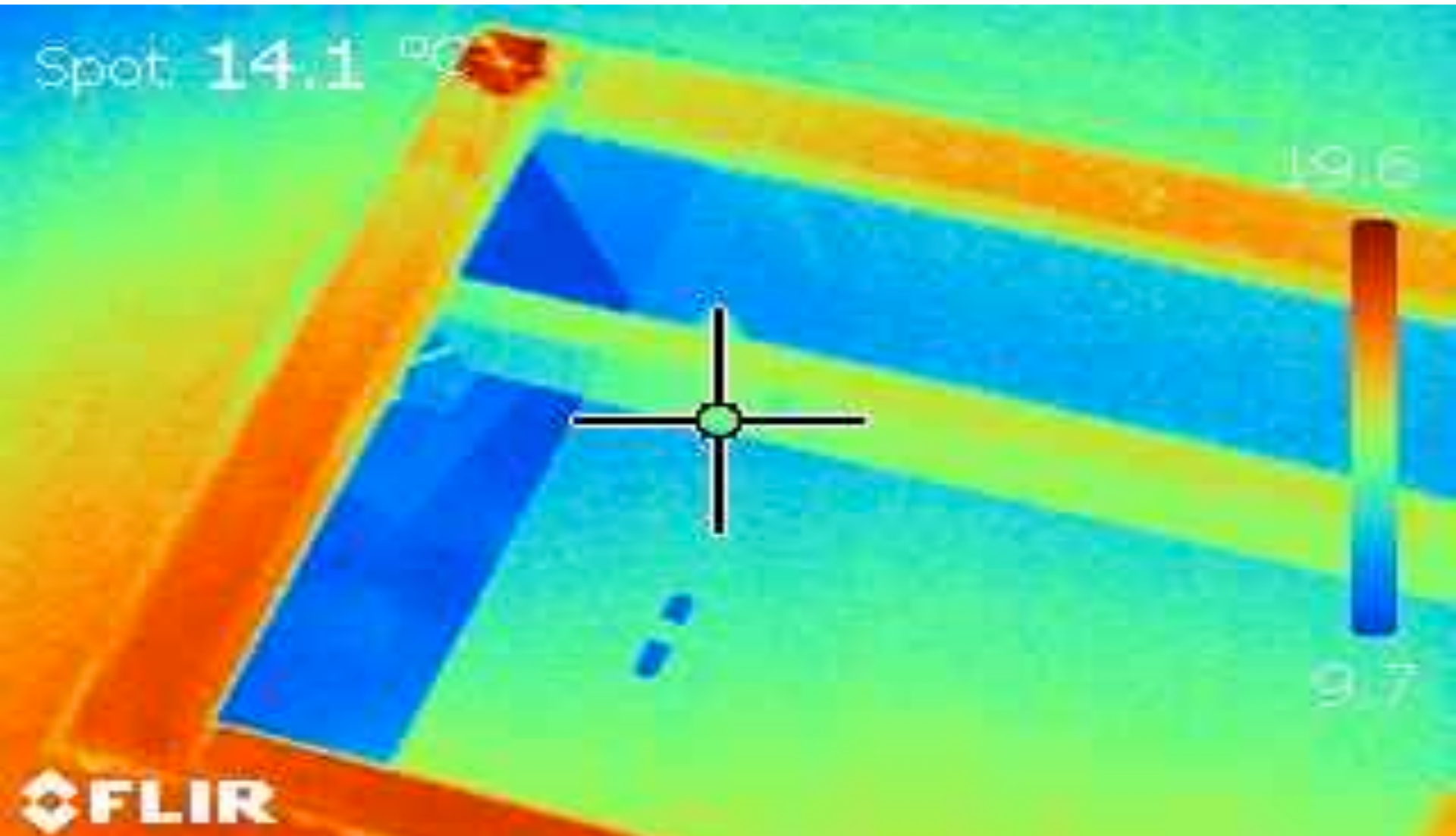


Heelis' steel-framed construction had many thermal bridges



Woodland Trust Fabric

Don't leave ends of trench heaters open



Woodland Trust

Energy overview

- Low gas consumption
but hot water still somewhat wasteful.
 - Interior lighting much better than benchmark
but scope remains for better efficiency and control.
 - Modest office equipment load due to thin clients
but they and the phones shouldn't stay on 24/7.
 - Large energy use in the server room and its cooling
in hindsight the equipment may have been over-specified and its cooling system too elaborate.
-

Lighting worked well. Uniform size workstations had some problems.



Lighting in context (*modest use of task lighting, even on a dark winter evening*)





Glare can come from surprising places

22 Time control of ambient lights inaccessible

*Control ergonomics - an architectural problem:
don't leave it all to the engineer, or the contractor!*



Key issue: ICT energy use

Higher than Heelis, in spite of all the effort



55% of the building's CO₂ emissions were from server room and its cooling.

Thin clients accentuate this

Future cloud computing will push this load upstream.

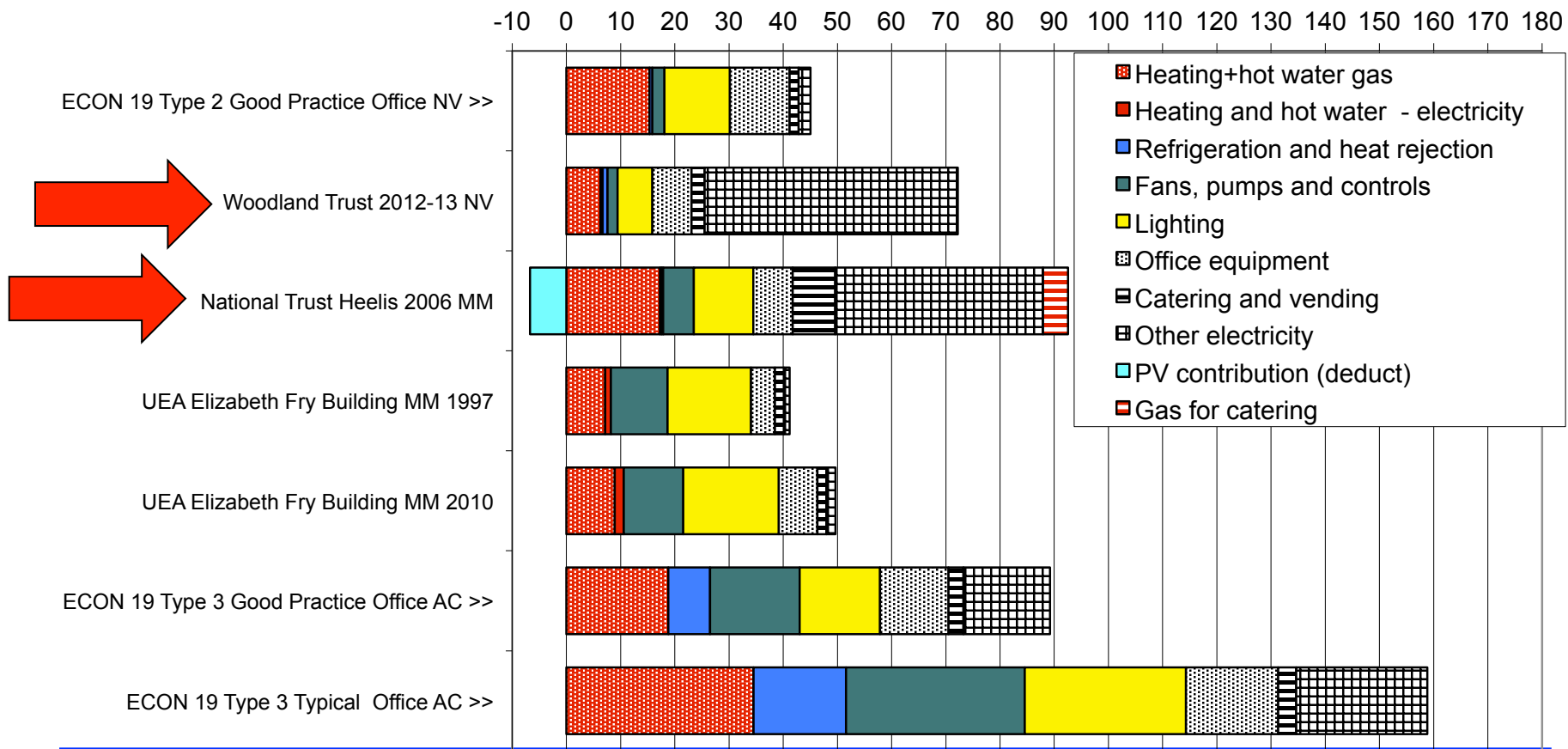
Contrast this with the push for energy supply to move downstream having headed upstream during its rise.

ICT energy efficiency consultant recommended for future projects.

Woodland Trust energy performance expressed as annual CO₂ emissions

Annual CO₂ emissions comparison

kg/m² Treated Floor Area at UK CO₂ factors of 0.194 for gas and 0.55 for electricity

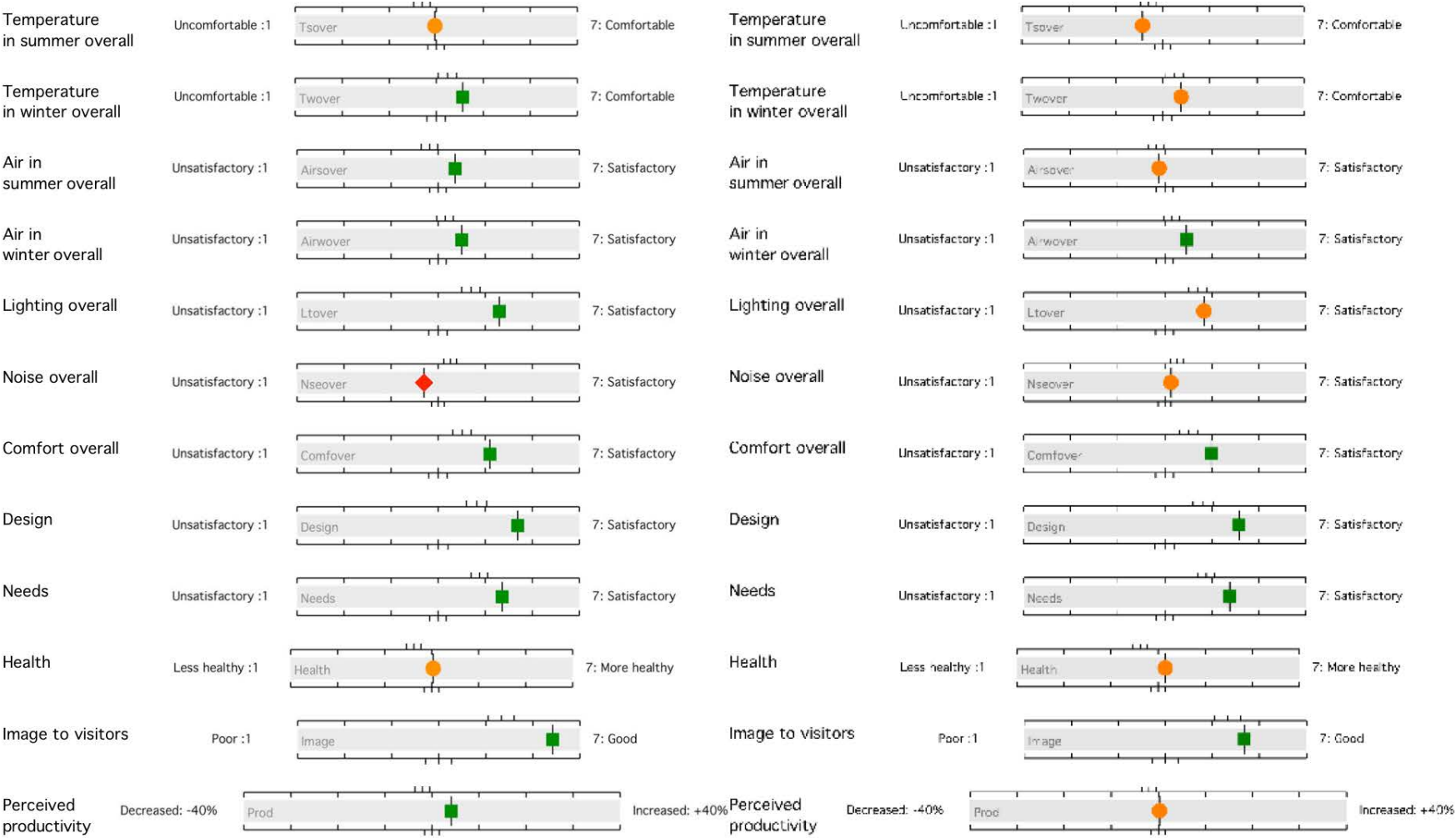


See B Bordass, P Burgon, H Brough & M Vaudin, Trees of knowledge, CIBSE Journal 20-26 (October 2014).

BUS Occupant survey results

Woodland Trust 2012

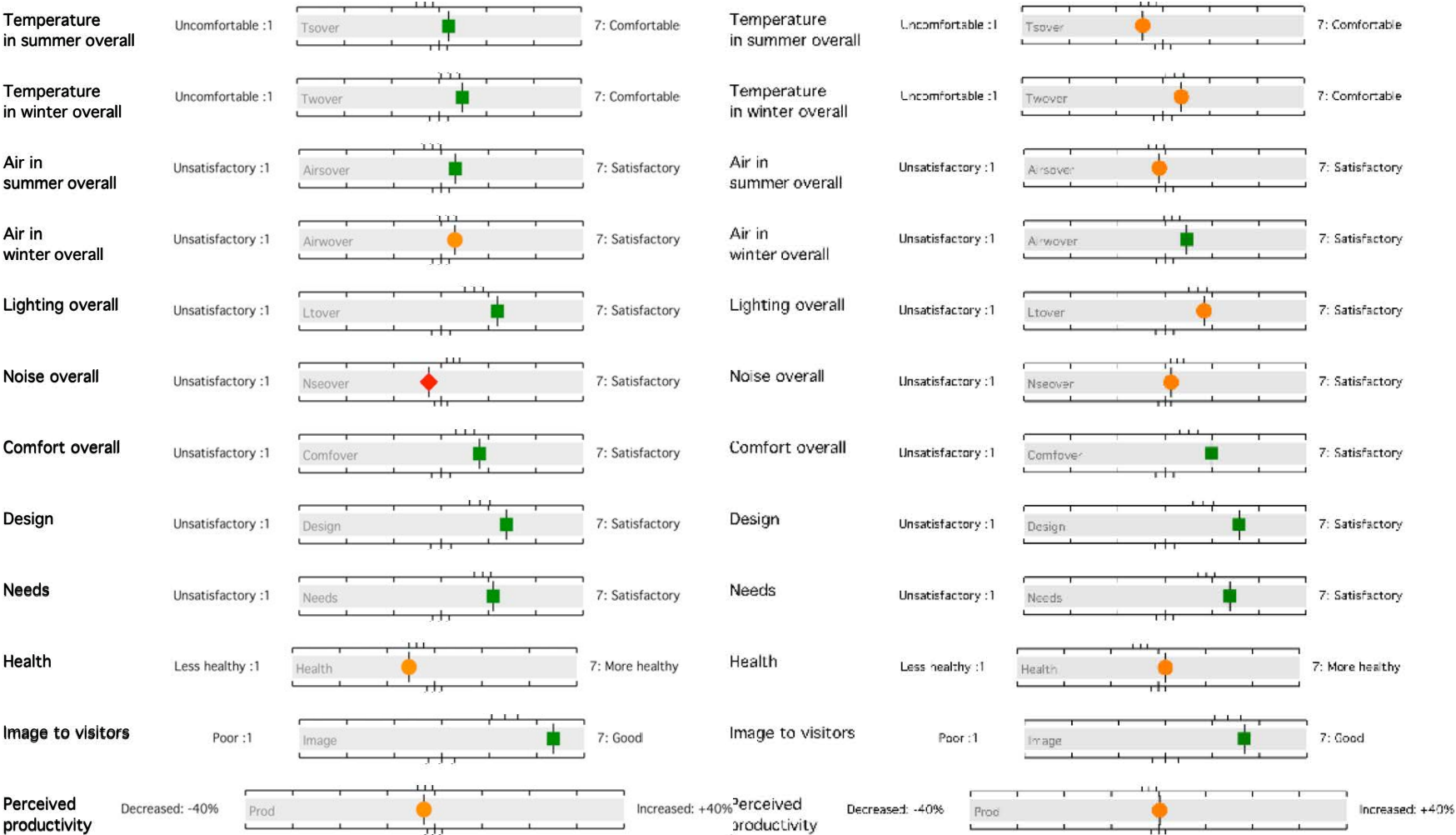
Heelis 2006



BUS Occupant survey results

Woodland Trust 2015

Heelis 2006





Natural ventilation control initially too coarse to avoid draughts. Night cooling needed fine tuning.
Needed considerable work in 2012-3

Spot

23.8

°C

FLIR

26.0



20.1

Time lapse IR photography
Friday night 21 September 2012

#2 00:05:00

Spot

19.7

°C

FLIR

21.3



13.5

Time lapse IR photography
Saturday Morning 22 Sep 2012

#115 09:30:00

Some things that have been learnt *from Heelis and the Woodland Trust*

- SIMPLER BUILDINGS and KIT: Considerable potential, but still needs care.
 - FINE TUNING IN THE FIRST YEAR OF OCCUPATION. Needs very different priorities from normal practices during the defects liability period.
 - NATURAL LIGHTING: Good, but glare can come from unexpected places.
 - ELECTRIC LIGHTING: Task-ambient strategy successful. Would benefit from more finesse in control, together with more efficient lighting generally.
 - HEATING: Woodland Trust uses much less gas. Further improvements planned. Hot water generation probably best separated from heating.
 - CONTROLS AND BMS: Still in need of much more attention to detail.
 - WINTER VENTILATION: Tricky to introduce controlled quantities in winter at the Woodland Trust. Mixed mode at Heelis may be more robust.
 - SUMMER VENTILATION AND COOLING. Optimisation required at the Woodland Trust, owing to control issues and security concerns.
 - WORKSTATION PLANNING: Needs flexibility. One size doesn't fit all.
 - ICT SYSTEMS: In spite of major efforts, ICT and the associated HVAC still dominates electricity use. Some tuning now happening, with specialist advice.
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Results of some of the simplifications

WOODLAND TRUST FEATURE	OUTCOME
PROCUREMENT: Conventional contract, with elements of Soft Landings.	Better attention to detail. Still difficult to get fine tuning done after handover.
FABRIC: Cross-laminated timber envelope with concrete stiffening and thermal mass.	Insulation and airtightness much improved. Steelwork thermal bridges eliminated.
HEATING: Three modular condensing boilers in packaged set.	Some difficulties with packaged controls, including integration with BMS.
HOT WATER: Calorifier fed by boiler plant, using packaged controls.	Waste from heat leakage into heating system. <i>Separate hot water preferable.</i>
VENTILATION: Naturally ventilated with manual & motorised windows, automated night cooling and CO2 control.	Extensive fine tuning required of night ventilation and CO2 control. <i>Revised control strategy was simpler than design.</i>
LIGHTING: Mostly windows. Manual task lights. Time switched ambient lights with reception over-ride.	Energy use reduced. Use of task lighting modest. <i>More user-friendly time switches would have lowered ambient lighting use.</i>
ICT: Mostly “thin clients” with a few PCs. Centralised printing.	No energy saving overall. Need for thin clients, IP phones etc to be off overnight.
SERVER COOLING: Chilled water only. Packaged chiller with waterside free cooling.	Proved complicated, unreliable, difficult to maintain. DX backup had to be added.



“The Woodland Trust are lucky to have got less complication than most.

It is difficult enough to cope with the complication we have got.”

MANDY LOOSE
Facilities Manager

Conclusion: *Cost plus to cost minus*

LESS CAN DO MORE:

- With less kit.
- With lower capital cost.
- With lower operational and maintenance cost.
- With high occupant satisfaction in the right context.

HOWEVER, ALL GOOD PROJECTS NEED:

- Effective client and team leadership.
 - A well-integrated design; and a well-integrated team.
 - Design for usability and manageability.
 - Managing expectations throughout the process.
 - More effort, particularly after handover.
-

Architect Rab Bennetts and Usable Buildings
consultant Bill Bordass put forward
a modest proposal for sustainable design

**'Keep it simple
and do it well'**

www.usablebuildings.co.uk

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