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Designing for in-use Performance *not just compliance*

Bill Bordass bill@bordass.com

Usable Buildings *www.usablebuildings.co.uk*

Structure of the talk

- 1. Background
- 2. What can we do?
- 3. Soft Landings
- 4. Design for Performance

BACKGROUND

Background

- We're in a declared **Climate and Environment Emergency**
- Energy used in buildings is responsible for some 30% of global greenhouse gas emissions.
- Building construction and alteration accounts for another 10%.
- Poor building location could well add much the same again, in terms of unnecessary use of transportation systems.

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In the 20th Century ... we built a really inefficient environment with the greatest efficiency ever known to man. ANDY KARSNER, Assistant Secretary, Department of Energy, USA (2007). We are much better at improving performance in the virtual world - *than in the real one*



SOURCE: Hellman cartoon for B Bordass, Flying Blind, Association for the Conservation of Energy & OXEAS (2001)

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"Missing feedback is a common cause of system malfunction" **DONELLA MEADOWS**

"Designers seldom get feedback, and only notice problems when asked to investigate a failure." ALASTAIR BLYTH CRISP Commission 00/02

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"Our engineers don't design for use, they design to the rules" PARTNER Leading UK M&E Consultants, 2020 "I've seen many low-carbon designs, but hardly any low-carbon buildings" ANDY SHEPPARD, Arup, 2009



SOURCE: Hellman cartoon for W Bordass, Flying Blind, Association for the Conservation of Energy & OXEAS (2001)

... hence these conclusions from the 2010-14 Innovate UK Building Performance Evaluation programme

- Significant problems with integrating new technologies, especially configuring and optimising BMSs.
 Insufficient thought given to how occupants need to use them. >
- "Controls are ... a minefield." and they were usually too complicated.
- Maintenance, control and metering problems, especially with biomass boilers, PVs and solar heating.
- Multiple systems fighting each other: e.g. cooling vs heating, or different systems jockeying for control.



SOURCE: J Palmer & P Armitage, BPE Programme, Early finding from non-domestic projects, Innovate UK (Nov 2014)

Which echo those from the 1980s

Tales of the unexpected

Office buildings claimed to be energy efficient, in reality often fall short of their quoted performance because of simple calculation errors and unknown energy-consuming extras. Matthew Coomber reports.

BUILDING owners beware – your energy-efficient building may not be as efficient as you have been led to believe.

Bill Bordass, an independent energy consultant and something of a guru in the field of energy efficient design, claims many offices are touted as energy efficient, but turn out not to be on closer examination.

He is helping to prepare a series of case studies of energy use in offices as part of the Energy Efficiency Office's Best Practice programme.

The studies detail energy usage and cost figures for each energy consumption elements missing or had recorded building areas much larger than that actually serviced," he says.

Errors in calculation had arisen either through mismeasurement of floor area or a failure to understand what constitutes the treated area, that is, the area of a building that consumes energy, in whatever form.

"We found that energy researchers have a tendency to look in great detail at where the energy goes, but will often ask somebody else for a building area." Usually rounded up or Bordass says some people measure energy consumption by the whole building, some by building services only, and some by landlord's building services only. "This can produce great discrepancies when you come to measure the floor area and the devices properly," Bordass notes.

In addition, tenants can be confused about who pays for services, resulting in the doubling-up or omission of important elements of the energy bill.

The next problem concerns the assumptions that the people

SOURCE: M Coomber, *Tales of the Unexpected*, Building Magazine 38-39 (17 August 1990).

BREEAM for offices was introduced in 1990, but performance gaps persisted...

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Data from the winner of the Green Building of the Year Award 1996



SOURCE: see discussion in S Curwell et al, Green Building Challenge in the UK, Building Research+Information 27(4/5) 286 (1999).

We found that people were often ignoring the simple things

Optimising the irrelevant

by Bill Bordass

Why is the hi-tech office failing to meet users' needs? Is it the technology or the design process that's at fault? Bill Bordass identifies some of the problems and offers some solutions.

hen people think of designing low energy buildings, they tend to fall into one of two traps. One is: "If we get the principles right, everything will automatically follow" or, "all you need is a lovely new bit of technology and it will solve the world's problems".

However, when you actually start looking at and analysing buildings they don't tend to give you the same messages. For example, when designing an energy efficient building, do we know what is meant by 'energy efficiency'? Evaluations on the basis of delivered energy consumption give misleading results, as all fuels are weighted



Figure 1: Lighting at the NMB Bank in Amsterdam, proving that lighting control problems are not confined to the UK.

SOURCE: Bill Bordass, Optimising the Irrelevant, CIBSE Journal, 32-34 (February 1993)

¹³ This continued through the 1990s: Some conclusions from the Probe POE studies

- They often perform worse than predicted, notably for energy and occupant satisfaction.
- Unmanageable complication is the enemy of good performance.
- Design intent is seldom communicated clearly to users and operators.
- Buildings are seldom tuned-up properly. Controls are often difficult to understand.
- Modern procurement systems make it difficult to pay attention to critical detail.

"The English spare no expense to get something on the cheap" ... NIKOLAUS PEVSNER



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KEY LESSONS: KEEP IT SIMPLE, DO IT WELL, FOLLOW IT THROUGH, TUNE IT UP, CAPTURE THE FEEDBACK

SOURCE: For more information, go the Probe section of www.usablebuildings.co.uk

Performance gaps are not just for energy: occupant survey, multi-award-winning school RED: below average; AMBER: Average; GREEN: Above average

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"... the architecture showed next to no sense. It leaked in the rain and was intolerably hot in sunlight. Pretty perhaps, sustainable maybe, but practical it is not." ... **STUDENT**

SOURCE: BUS Method survey of a building services engineering award-winning Academy school in South East England, 2009

And of course for fire which might change the whole culture



WHAT CAN WE DO ABOUT IT?

If you wanted to improve building performance in use, what would you do ...

- A. Focus on performance in use? OR
- B. Do lots of other things & hope performance will improve?

Why have we been barking up the wrong tree?

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		Technological complexity		
		More	Less	
Building management input	More	Type A Effective, but often costly	Туре D Rare, not replicable?	
	Less	Risky with performance penalties Type C	Effective, but often small-scale Type B	

Diagram first appeared in: Probe 19: Designer Feedback, Building Services, the CIBSE Journal, page E21 (March 1999).

		Technological complexity		
		More	Less	
Building management input		Туре А	Will ordinary	
	More	High Performance	people be able to look after them?	
	Less	Risky with performance penalties	Effective, but often small-scale	
		Туре С	Туре В	

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		High Performance		
		Risky with performance Se penalties	Simple Smart	
	Less		Sense and Science	
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		Technologica	Technological complexity	
		More	Less	
Building management input	More	Type A High Performance	Will ordinary people be able to look after them?	
Secure Type	A		Simple Smart	
Seek more Type B (and possibly Type D) Avoid Type C - unmanageable complication.		Big danger, especially for public buildings	Sense and Science	
			Туре В	

Diagram first appeared in: Probe 19: Designer Feedback, Building Services, the CIBSE Journal, page E21 (March 1999).

Make things simpler and do them better

"To define it rudely but not ineptly, engineering is the art of doing for 10 shillings what any fool can do for a pound" – THE DUKE OF WELLINGTON

Meanwhile, an additive approach to "sustainability" in the UK has made things more and more complicated

- Technical complication
- Legislative complication
- Contractual complication
- Bureaucratic complication
- Tick-box procedures: feature creep
- Complication for building users and managers

SO LESS TIME AND MONEY TO SPEND ON THE BASICS

UB's proposed sticky interventions: things with potential to snowball over time

Cultural adaptations, not just technical "solutions".

To create virtuous circles of continuous improvement.

MAKE IN-USE PERFORMANCE CLEARLY VISIBLE

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In a way that motivates people to strive to improve it. *This needs a well-informed technical infrastructure to help the plethora of different systems to converge, particularly for energy and carbon.*

CONSOLIDATE THE KNOWLEDGE DOMAIN OF BUILDINGS IN USE

Develop building performance as an independent knowledge domain, to gain the evidence and authority to inform practice and policymaking.

REVIEW PROFESSIONAL ETHICS AND PRACTICES

A shared vision for building-related professionals to collaborate in the public interest and engage properly with outcomes: *NEW PROFESSIONALISM*

CHALLENGES: 1

Narrowing gaps during design and construction

- **Design energy estimates need to COUNT EVERYTHING** under likely scenarios, *not subsets under often unrealistic standard conditions.*
- **Modelling** needs to predict outcomes and test robustness, not just compare options and verify compliance (at least in theory).
- **Constant reality-checking** in design, construction: *so the process converges onto outcomes, instead of diverging from design intent.*

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- **Constant reality-checking** in design, construction: *so the process converges onto outcomes, instead of diverging from design intent.*
- Engineering systems must be efficient over a wide range, including part loads, at night, and clash avoidance.
- Controls must be better specified, more usable and manageable. These are too often a blind spot.
- Effective sub-metering, to review outcomes against expectations.
- Greater attention to detail is necessary throughout: you can often make things simpler, if you do them better.

Managing expectations and avoiding disappointments



NOTE: The current UK CO₂ factor for electricity is much smaller. BEIS reporting factor 0.23 kg CO2e/kWh (July 2020).

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CHALLENGES: 2 Narrowing performance gaps in use

- **Designers need to understand occupiers and managers better**, *and communicate design intent better to them.*
- **Procurement systems need to converge onto good outcomes** *not diverge from good intentions.*
- **Design and building teams must follow through after handover**, to help inform occupiers, review performance versus expectations, fine tune systems, troubleshoot, and oversee tenant fitout proposals.
- Further commissioning will be required once the building is in use, including fine-tuning, seasonal and "continuous" commissioning. Metering systems need commissioning too: often they haven't been.
- Buildings also need to be better managed to match supply and demand and minimise waste.
- Lessons learned must be captured, and fed back to as wide as possible an audience. This needs knowledge management systems.

SOFT LANDINGS

Getting more sense into procurement Soft Landings can reinforce critical stages

1. Inception and Briefing

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Appropriate processes, better relationships. Assigned responsibilities, including client. Well-informed targets related to outcomes.

- **2. Design and construction** Including expectations management.
- **3. Preparation for handover** *Better operational readiness.*
- **4. Initial aftercare** Information, troubleshooting, liaison, fine tuning, training.

5. Longer-term aftercare *monitoring, review, independent POE, feedback and feedforward.*

Can run alongside any construction procurement process



the SOFT LANDINGS FRAMEWORK

for better briefing, design, handover and building performance in-use



SOURCE: downloadable from www.usablebuildings.co.uk and www.softandings.org.uk

Soft Landings Stage 1: Inception and briefing

The most important stage, because it binds the team and sets the whole style of engagement with outcomes.

- However, clients have been reluctant to pay, thinking that the industry ought to be doing it anyway. *But it is a systemic problem.*
- Modern procurement methods have often salami-sliced things, making it difficult to maintain *the golden thread* of maintaining and refining design intent throughout a project and on into use.

FEEDBACK:

The project team should select a **Soft Landings Champion** or Champions, who can provide the leadership to help things along ...

these are in effect the new professionals.

Soft Landings Stage 2: Reviews during design and construction

- Set stretching but realistic expectations, *not pie-in-the-sky.*
- Manage them through the process.
- Undertake regular reviews and reality checks.
- Leave elbow room: this is systemic improvement, not exact science.

FEEDBACK:

- Any costs up to handover can usually be met by efficiency gains, though there may be a learning curve to pay for.
- Soft Landings Champion(s) can provide leadership, maintain the emphasis on outcomes, and remind project managers that it is not enough just to keep to time and budget.
- This must all be done in the sprit of learning, not blaming.

Soft Landings **Stage 3**: *Preparation for handover*

- A change in concept: Handover becomes an event within an extended *Finish* stage, not the point at which the design and building team sign off and walk away.
- **Preparation for operational readiness** includes not just the static and dynamic commissioning of the fabric and building services, but much closer engagement with the occupier's move-in and their management and maintenance team, *if they have one.*
- **Preparation for aftercare**, with representatives of the design and building team on site after handover. *The time allocation depends on the size and complexity of the project it might be one person for half a day a week or less, or much more.*
- If there is unfinished business, e.g. owing to a forced early handover, then the *golden thread* is easily carried through into STAGE 4: initial aftercare and fine tuning.

FEEDBACK: Early appointment of a facilities management team is not enough, they also need to be brought into the process deliberately.

Soft Landings Stage 4: Initial aftercare

- Design and building team members visit regularly: who and how many visits will depend on project.
- They need a home in the building where they are visible to occupants, not be hiding in the site hut.
- They explain the building to the users, in simple guides and in one or two introductory events.
- They help the management to take ownership, the occupier must take the initiative, not stand back.
- **They keep people informed,** e.g. via a newsletter on the organisation's website, e.g. alerting to any problems.
- **Troubleshooting and fine tuning can be undertaken,** the best insights have been where the soft landings team does some of its own work in the building and experiences its facilities.

FEEDBACK: Will contractors engage properly? Soft Landings priorities are very different from dealing with snags and defects.

Stage 4 aftercare may pay for itself: Intervention in a new secondary school



SOURCE: Buro Happold Engineers, Soft Landings Trials (2009).

Stages 4+5 can trap unintended consequences: Example: sprinkler frost protection in a primary school





In 2008-09, this frost thermostat (improperly set at 17° C on installation) energised the wall heater in the sprinkler pump room. Over a year, this wasted more electricity than the wind generator (intended to offset the entire building's annual heating energy use) produced.

Soft Landings **Stage 5**: *Monitoring, evaluation and feedback*

- Extended aftercare period, typically two or three years.
- Occupiers must take ownership and do most of the monitoring themselves. They may need motivating.
- Independent post-occupancy evaluation can be included, e.g. for occupant surveys, energy analysis, and structured discussions. Independent review & benchmarking can be helpful and reassuring.
- The findings can be fed through rapidly, e.g. to fine tune the systems, refine use and operation of the building and plan upgrades.
- The learning can also be spread much more widely, via the people and organisations involved, and beyond.

FEEDBACK: Often this has needed external funding. *How can we make it routine? The value that can be added is enormous.* We can't afford not to do it; and it can be done with a light touch.

Soft Landings: Everybody can win

- Better communication, proper expectations management, *fewer nasty surprises.*
- More effective building readiness. Less rework.
- Natural route for feedback and Post-occupancy evaluation, to improve the product and its performance in use.
- Teams can develop reputations for customer service and performance delivery, *building relationships, retaining customers, commercial advantage.*
- Vital if we are to progress towards more sustainable, low-energy, low-carbon, well-liked buildings and refurbishments, *closing the credibility gaps*.

SO WHAT IS STOPPING US?

- ATTITUDES: Everybody needs to be committed, starting with the client perhaps the biggest obstacle. The "golden thread" needs to be put in place.
- PROCESSES: There is a learning curve to pay for (probably best from marketing budgets), and the feedback has to be managed.
- TECHNIQUES: Independent POE surveys cost money (but not much).
- CAPACITY: We need facilitators, investigators, troubleshooters and fixers.
- MONEY: Particularly allocation for tune-up etc. after practical completion.
- *IMAGINATION: Often constrained by burgeoning bureaucracy!*

DESIGN FOR PERFORMANCE

THE REWARDS: Benefits of Design for Performance

- Brings people together: Bridges the gaps between procurement and operations.
- Improves what really matters: the final outcomes.
- Identifies and rewards what is proven to work in practice: Helps to cut out the "green bling".
- Addresses more than energy performance: *well-tuned buildings have better occupant satisfaction outcomes too.*
- Allows industry to develop cost-effective solutions that work, helping to stop regulations becoming too onerous.

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Design for Performance for landlord's services in UK rented offices

OUR RESOURCES



Design for Performance

A new approach to delivering energyefficiency in UK offices

The Design for Performance (DfP) initiative is an industry backed project established to tackle the performance gap and provide an approach, based on measurable performance outcomes, to ensure new office developments deliver on their design intent.



OUR MEMBERS

N* NABERS

SOURCE: www.betterbuildingspartnership.co.uk/our-projects/design-performance October 2020

Design for Performance The process

- Developer signs up to provide guaranteed in-use energy performance for the "Base Building" shared engineering services (mostly HVAC) and in all the common parts.
- All new members of the design, construction and management team sign up to a *Commitment Agreement*.
- Advanced modelling is used for the engineering systems, *including assessment of controls and "off-axis" scenarios.*
- The design is reviewed by *independent assessors.*
- Metering systems allow *outcomes* to be reviewed.
- The completed building is *fine-tuned* if necessary.
- Results are *benchmarked and reported*.

CONSULTANTS ARE COMING FORWARD TO SUPPORT THIS

Design for Performance - *Pioneers 2020*

Developer	Name	Location	NIA m ²	Complete
British Land	1 Broadgate	City of London	37,000	2024
Crown Estate	St James's Mkt	London	15,000	TBA
Derwent London	19-35 Baker St	London	19,000	2025
Gt Portland Estate	St Thomas Street	London	31,000	2025
Grosvenor	S Molton Triangle	London	13,500	TBA
Hermes MEPC	4 Angel Square	Manchester	18,500	2022
Hermes MEPC	Wellington Place	Leeds	21,300	2022
Landsec	Moorfields	London	48,000	2022
Landsec	Timber Square	London	32,000	2023
Lendlease	Turing Building	London	33,000	2023
L&G	Ralli Quays	Salford	12,500	2023
Royal London	Statesman House	Maidenhead	11,000	2023
Stanhope	2 Ruskin Square	Croydon	30,000	2023

SOURCE: www.betterbuildingspartnership.co.uk/our-projects/design-performance October 2020

Potential rewards in annual energy use: Office base buildings – London & Melbourne



SOURCE: R Cohen, P Bannister, B Bordass, NZE buildings in reality, not just in theory, REHVA Journal, 56-59 (May 2016).

Thank you Questions?



INPENING POILSI

www.usablebuildings.co.uk