Z Smith, AIA, Eskew+Dumez+Ripple (EDR) who has a background in physics, says that in his former field, “You have a hypothesis, and then you test it.” He was surprised to find out that architecture isn’t really like that. “It seems like all architects do is make hypotheses, and they’ve never tested them.” So when it’s time to design the next project and the one after that, they just do the same thing over and over without knowing whether it had worked the first time.

Perkins+Will used its own Atlanta headquarters at 1315 Peachtree to develop a rigorous process for pre- and post-occupancy evaluation. Smith Group tracks daily energy production and use at the Chesapeake Bay Foundation’s Brock Environmental Center.

Some architects do test their design intent.
HOK surveyed the occupants.

ZGF was paid in full after building met performance goals.

Sustainability consultant performed the POE.
The client tracks performance on-line.

Brock Center’s On-Line Dashboard

Dashboard allows checking various performance issues in real time as well as looking at performance history.

See: http://www.cbf.org/about-cbf/offices-operations/bruck-center/dashboard

To achieve Living Building Challenge certification from the International Living Future Institute, the center must operate a full year using net-zero energy and net-zero water across all its operations.
Owner's Project Requirements
The owner's project requirements (OPR) include the following elements, at a minimum:
- Owner and user requirements
- Environmental and sustainability goals
- Energy efficiency goals
- Indoor environmental quality requirements
- Equipment and system expectations
- Building occupant operations and maintenance personnel requirements
- Building envelope requirements

Basis of Design
The basis of design (BOD) includes the following elements, at a minimum:
- Specific codes, standards, and guidelines considered during design
- Information regarding ambient conditions
- Usage assumptions
- Operations and maintenance assumptions
- Performance criteria from OPR
- Design and operations narratives
- Equipment make and model used as basis of drawings and specifications
- Envelope design criteria

Commissioning Activities
The commissioning authority (CxA) has completed the following tasks for all mechanical, electrical, plumbing, and renewable energy systems:
- Developed and implemented a commissioning plan
- Confirmed incorporation of commissioning requirements into the construction documents
- Developed construction checklists
- Developed a system test procedure
- Verified system test execution
- Maintained an issues and benefits log throughout the commissioning process
- Prepared a final commissioning process report
- Documented all findings and recommendations and reported directly to the project owner throughout the process

Integrated Design Prerequisites per LEED v4

What a POE measures
A full post-occupancy evaluation will likely examine several of the following:
- Energy and water performance
- Performance of the indoor environment—air quality, thermal comfort, acoustics, lighting, and ventilation
- Usability of systems and spaces
- Occupant behavior

The team then compares measured data, interview and focus group results, and ethnographic observations to the original design intent in order to determine the success of each factor evaluated.

The Living Building Challenge requires a POE 12 months after full occupation.
POE Components

1. Utility meter readings or bills
2. On site measurements
3. Occupant surveys

Mind the gap between modeled and actual energy use.
Why do more than one POE?

Motivation for:
• Occupants
• Building Managers

Tests equipment under different climate conditions.

Occupancy and climate change over time.

POE results for California Dept. of Education building.

EDR tracks all its LEED projects.

Dr. Nancy Foster Florida Keys Environmental Center

Educom-3EEceople

Estero-D'Arrigo

Florida Keys

Environmental Center in Key West. The problem, caused by a building management system software glitch, has since been resolved.

Educom & Timothy Hurst

View Related Story
It took a year and a half to fix the problem!

ENERGY PERFORMANCE
So how has the building performed? Based on RMI’s research, the Innovation Center is one of the 20 most energy-efficient buildings in the country and, according to Energy Star data, uses 74 percent less energy than the average building in the same climate zone. Energy use in buildings is measured in British thermal units per square foot per year. The average U.S. office building has an energy use intensity (EUI) of 91, according to the U.S. Department of Energy’s 2012 Commercial Buildings Energy Consumption Survey. RMI initially set a target EUI of 19 for the Innovation Center, but that figure was updated to 17.2 during the design phase, when projections made it clear that energy use would be less. Based on data from the first year of occupancy, the EUI has turned out to be even lower: 15.9. "We’re exceeding our expectations," Carmichael says.

Rocky Mountain Institute Innovation Center, Basalt, CO

Energy Use: Dr. Nancy Foster Florida Keys Environmental Center

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UC Berkeley Center for the Built Environment’s On-Line Occupant Satisfaction Survey

Thermal Comfort
Which of the following do you personally adjust or control in your workplace?

- Window
- Radiator
- Fan
- Air conditioning
- Other

How satisfied are you with the temperature in your workplace?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

Lighting
Which of the following do you personally control in your workplace?

- Desk lamp
- Dimmer switch
- Control of the lights on
- Other

How satisfied are you with the level of light in your workplace?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

How satisfied are you with the visual comfort of the lighting (e.g., glare, uniformity, etc.)?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

How satisfied are you with the lighting quality compared with your ability to perform tasks in your workplace?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied
CBE Survey reports are viewed through an automatic online reporting tool.

The Usable Buildings Trust offers occupant satisfaction surveys and has written case studies (PROBE) on twenty surveyed and POE’d buildings.

Stephen Hawking’s office site.

2018 AIA COTE Top Ten Winner: Ortleb's Bottling House, Philadelphia -aka Kieran Timberlake's office

- Natural ventilation
- Night ventilation
- Daylighting

Magic arrows diagram.

Rooftop weather station

Results from occupant satisfaction survey
Roast:
Smart phone, cloud-based POE Tool.

PROBE led to Soft Landings: the process
In simple terms Soft Landings requires clients to appoint designers and constructors to stay involved with their new building beyond practical completion and into the critical initial period of occupation. This will assist building managers during the first months of operation, help fine-tune and debug the systems, and ensure the occupiers understand how to control and best use what they have been given. This is followed by a longer, less intensive period of aftercare lasting for up to three years, to monitor energy use and occupant satisfaction, and to check on the operation of systems that might need seasonal fine-tuning. At the end of three years the building’s steady performance can be fairly judged against the targets set at design, and any discrepancies accounted for.
This extended duty of care requires Soft Landings to be considered at the outset, and embedded in all client requirements and design deliberations. It also needs to be adopted by the builder so that good intentions are not unnecessarily sacrificed for reasons of cost or time.

Stage 1: Inception and briefing
Stage 2: Design development and review
Stage 3: Pre-handover
Stage 4: Initial aftercare
Stage 5: Years 1-3 extended after care and POE

Soft Landings - why bother?

Soft Landings: Provides a useful vehicle for engaging with outcomes throughout the process of briefing, design and delivery. It deals with energy performance certification, building logbooks, green leases, and corporate social responsibility. It can run alongside any procurement process. It helps design and building teams to appreciate how buildings are used, managed and maintained.

It provides the best opportunity for producing low carbon buildings that meet their design targets. It includes fine-tuning in the early part of occupation and provides a critical read for post-occupancy evaluation.

It can be very beneficial when the design is complete. Design and construction, Soft Landings helps performance-related objectives to be carried out and measured systematically. There is some extra work during the three-year aftercare period, but the gains are evident in relation to the value added to the client’s building.

Most of all, Soft Landings creates virtuous circles for all and offers the best hope for truly integrated, robust and sustainable design.
"HELP US, HELP YOU" SAVE THE COST OF HIGHER EDUCATION

Total Cost of Utilities $71,430,442.81

Let's save 5% annually by implementing analytics

UI FY2016 utility costs
Glare issues in the offices and classroom?

Infrared images of exterior and interior of east wall:
- Insulation gap?
- Crawlspace heat loss?
Gas & Electric use more than modeled
Found cold air flow Feb 2016
Gas use dropped a bit

Post-POE Feedback

From the Classroom building:
I spoke with the other employees and here are the following changes that have been made:
· Increased the temperature differential so the building isn't constantly heating or cooling all the time.
· Added blinds on all of the office windows. We will be adding blinds to the classrooms to help maintain temperatures and help with the echo issue.
· Keep the stove air intake vent closed.

From the Architect:
The research also reinforced the importance of building commissioning. The students found an unconnected vent pipe that was allowing outside air to pour into the building. The simple correction will save a tremendous amount of energy over the lifetime of the building. Patano Studio Architecture will take the results from this research and implement the data on future projects.

Architects Chris Patano (l) and Eric Barr at the opening, Fall 2014

2016-17 Arch 571 POEs of Education and IRIC lead to two student papers and presentations:
· PLDC 2017 in Paris
· PLEA 2017 in Edinburgh

...and then follow-up work in Arch 570 lead to a paper presented at Eco-Architecture 2018 at Brockenhurst, New Forest, UK, and so well-written it was published in a journal.
LEED GOLD BUT NOT EQUAL: TWO CASE STUDY BUILDINGS

Baja, Filamez C.; Baradaran, Sanaa; Freeman, Miranda A.; Gray, Allison J.; Haglund, Bruce T.; Hanaa, Hanna R.; Opatola, Oluwabukola R.

Architecture Program, University of Idaho, USA

Integrated Research and Innovation Center (IRIC)

View from the southwest

Education Building (ED)

View from the southwest

The authors' experiences in the Leadership in Energy and Environmental Design (LEED) and Building Research Environment were combined in their article. They highlight the importance of considering the whole life cycle of a building, from design to demolition, in order to achieve sustainability goals. The article discusses the LEED certification process and the various strategies that can be employed to achieve it. It also emphasizes the importance of integrating sustainability into the design process from the outset, in order to create buildings that are not only energy-efficient, but also cost-effective and socially responsible. The authors provide examples of case studies from their own experience to illustrate these points.