Post Occupancy Evaluation (POE)


Environmental Building News™
The Leading Source for Environmentally Responsible Design & Construction
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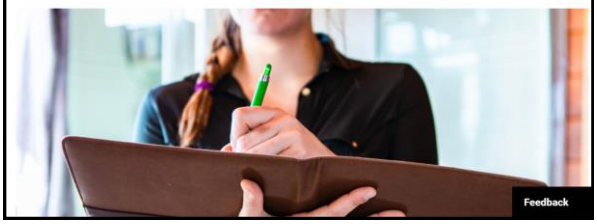
Why Post-Occupancy Review Is the Future of Design (And How It Can Serve You Now)

A radical new paradigm is on the way for engaging with projects after they're "completed" —and clients couldn't be happier.

1

RIBA calls for post-occupancy tests on all publicly funded schemes

7 OCTOBER 2020 · BY WILL ING



2

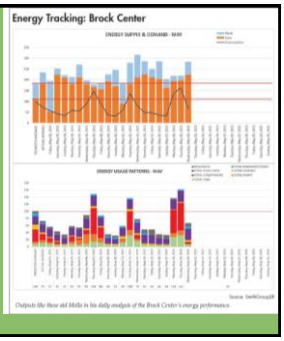
Building Well	
Integrated Design	Design Intent
Commissioning	Equipment Check
Post Occupancy Evaluation	Operations Check

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.

3

Some architects do test their design intent.

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.



4

HOK surveyed the occupants.

Consolidated Forensics building

HOK

Washington, D.C.

Operable shades were added to labs at HOK's Consolidated Forensics building in Washington, D.C., after the firm's comfort survey revealed higher daylight levels than occupants were accustomed to.

Photo © Alan Karchmer

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5

ZGF was paid in full after building met performance goals.

Federal Center South building

ZGF

Seattle, Washington

ZGF's Federal Center South building in Seattle was completed in 2012 under a design-build contract that included financial incentives for hitting performance targets. The final 0.5 percent of the budget was released to the project team once it had been determined that the building met goals for energy use, water consumption, and comfort.

Photo © Benjamin Benschneider

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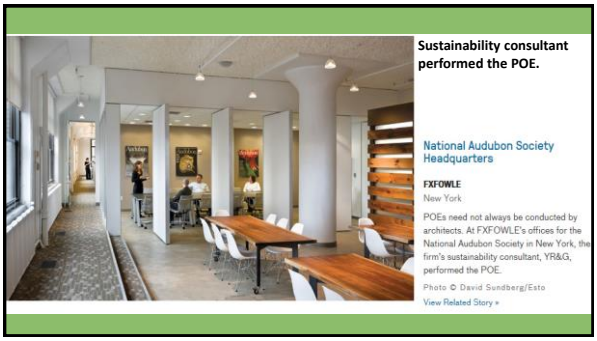
Sustainability consultant performed the POE.
National Audubon Society Headquarters
FXFOWLE
New York
POEs need not always be conducted by architects. At FXFOWLE's offices for the National Audubon Society in New York, the firm's sustainability consultant, YR&G, performed the POE.
Photo © David Sundberg/Esto
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7


EDR tracks all its LEED projects.
Dr. Nancy Foster Florida Keys Environmental Center
Eskew+Dumez+Ripple
Key West, Florida
Eskew+Dumez+Ripple decided to try to track the performance of all its LEED projects after energy use skyrocketed at its Dr. Nancy Foster Florida Keys Environmental Center in Key West. The problem, caused by a building-management system software glitch, has since been resolved.
Photo © Timothy Hursley
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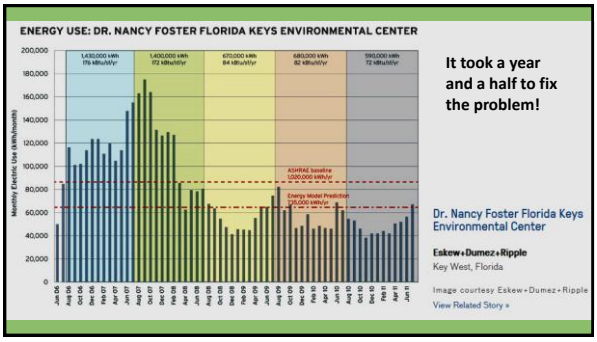
8


ENERGY USE: DR. NANCY FOSTER FLORIDA KEYS ENVIRONMENTAL CENTER
Monthly Electric Use (kWh/month)
ASHRAE baseline 1,000,000 kWh/yr
Energy Model Prediction 570,000 kWh/yr
It took a year and a half to fix the problem!
Dr. Nancy Foster Florida Keys Environmental Center
Eskew+Dumez+Ripple
Key West, Florida
Image courtesy Eskew+Dumez+Ripple
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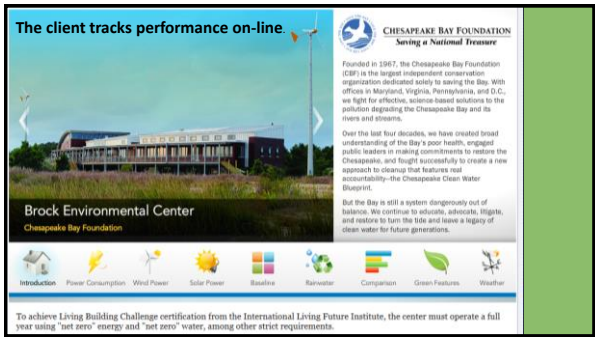
9



10

Brock Center's On-Line Dashboard

11

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/brock-center/dashboard

12

Integrated Design Prerequisites per LEED v4

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

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LEED v4 BD+C: New Construction

EA Prerequisite Fundamental Commissioning and Verification

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

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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.


Assessing window performance at Florida Solar Energy Center

INTERNATIONAL LIVING FUTURE INSTITUTE™

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

15

POE Investment in Person-hours vs. Firm billings

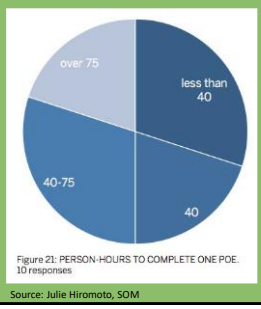


Figure 21: PERSON-HOURS TO COMPLETE ONE POE.
10 responses

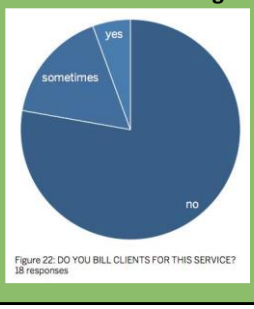


Figure 22: DO YOU BILL CLIENTS FOR THIS SERVICE?
18 responses

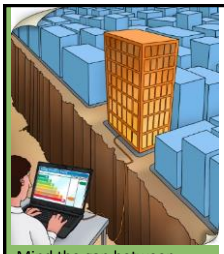
Source: Julie Hiromoto, SOM

16

POE Components

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

17



Mind the gap between modeled and actual energy use.

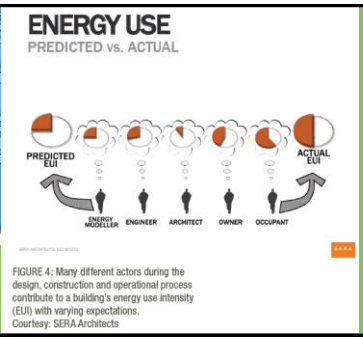
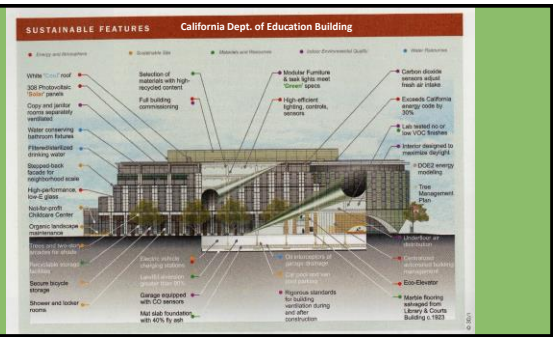


FIGURE 4: Many different actors during the design, construction and operational process contribute to a building's energy use intensity (EUI) with varying expectations.
Courtesy: SERA Architects

18



19

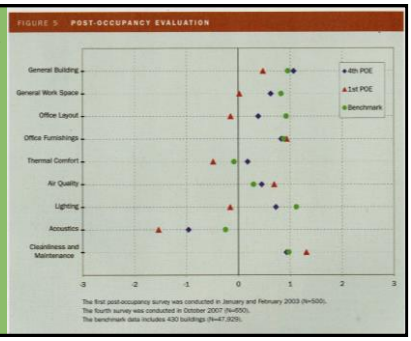
Why do more than one POE?

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.



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Rocky Mountain Institute Innovation Center, Basalt, CO

ZGF Architects

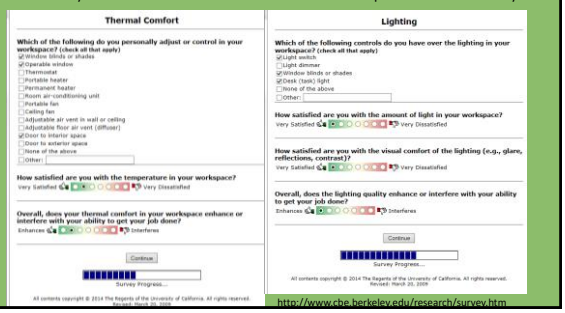
ENERGY PERFORMANCE

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.

Commissioning Blurb RMI-article-http://www.architectmagazine.com/post-occupancy-study-rockymountain-institute?utm_source=newsletter&utm_content=&utm_medium=email&utm_campaign=ABU_112117%20(1)&he=3800532aeffc75bb97271eeda04ed659237a0f93

21

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



http://www.cbe.berkeley.edu/research/survey.htm

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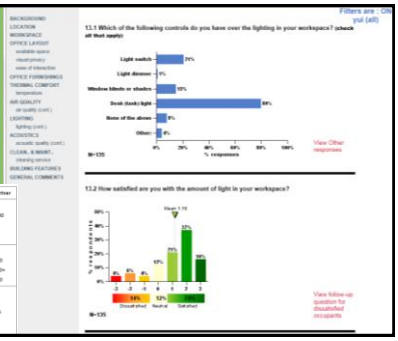
CBE Survey reports are viewed through an automatic on-line reporting tool.



Implementation and Development Task	CBE Partner	Non Partner
Survey Implementation		
Implementation per building per survey	$0*	$1000
Content Development, Web Formatting, and Testing		
Add existing module (per module)	10	$300
Add new or customized module (per page)	$3000+	$3000+
Add Graphic Floorplan Legend	$300	$300
Reporting		
Automatic building survey reporting	10	$0
Reporting with benchmarking**	10	N/A

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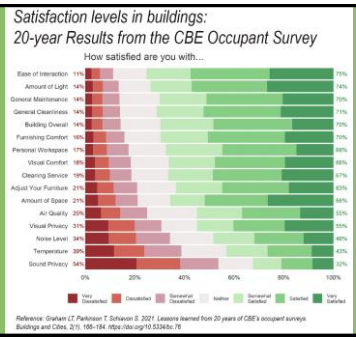
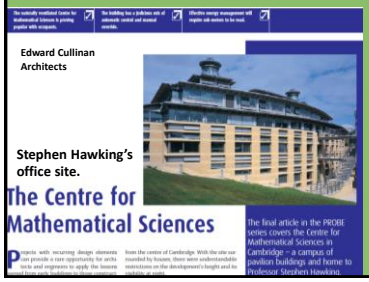


Reference: Graham LT, Parkinson T, Schiavon S. 2021. Lessons learned from 20 years of CBE's occupant surveys. *Buildings and Cities*, 2(1), 166–184. https://doi.org/10.5334/bc.76

24

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



Edward Cullinan Architects

Stephen Hawking's office site.

The Centre for Mathematical Sciences

The final article in the PROBE series covers the Centre for Mathematical Sciences in Cambridge – a campus of pavilion buildings and home to Professor Stephen Hawking.

Results from occupant satisfaction survey

25

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 de-bug 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

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Soft Landings why bother?

Soft Landings:

Provides a unified vehicle for engaging with outcomes throughout the process of briefing, design and delivery. It dovetails 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 days of occupation and provides a natural route for post-occupancy evaluation.

It costs very little, well within the margin of competitive bids. During design and construction, Soft Landings helps performance-related activities to be carried out more systematically. There is some extra work during the three-year aftercare period, but the costs are modest 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.

Joseph Leckie School, Walsall

Southwark Schools PFI programme, London

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2018 AIA COTE Top Ten Winner:
Ortleib's Bottling House, Philadelphia
-aka Kieran Timberlake's office
Magic arrows diagram.
Experiment in natural cooling!
• Natural ventilation
• Night ventilation
• Daylighting
Rooftop weather station

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Roast:
Smart phone, cloud-based POE Tool.

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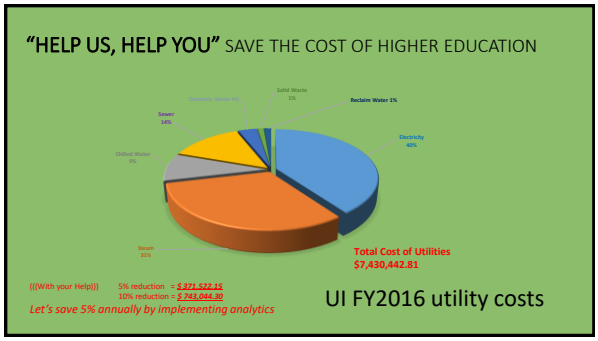
AGENTS OF CHANGE
ABOUT AoC • WORKSHOPS • ANNOUNCEMENTS • TOOLKITS • DOCUMENTS • CASE STUDIES • STAFF • LINKS
Documents
Workshop Documents >> Oberlin 2003 Team Presentations
Teaching Documents
Workshop Documents
Team 1: Chad Bard, Alison Kwok, Julia Salinas, Alfredo Fernandez-Gonzalez, Vidhi Agarwal, Mary Blakeney, Paul McKeever, Juan Reiser
Hypothesis: Daylighting is inadequate in the building during summer months
Document: view PowerPoint (7.5mb)
Team 2: Luke Eddins, Adil Sharag-Eldin, Jonathan Knowles, Jason Turnidge, Kathy Bash, Evrim Demir, Stephanie Horowitz, Emad Afifi
Hypothesis: Atrium air temperature will remain within the comfort range, atrium median radiant temperature will stray out of the comfort range, and surface temperature of the floor that gets direct solar radiation will always be warmer than the surface area that does not.
Document: view PowerPoint (5.3 mb)
Jane & Henry
Jamie & Anja with Kestrel

30


HPB
HIGH PERFORMING BUILDINGS
SUSTAINING by
PRESERVING

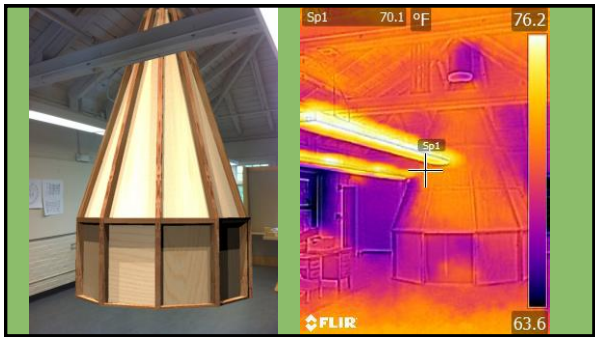
31


"HELP US, HELP YOU" SAVE THE COST OF HIGHER EDUCATION
Solid Waste 1%
Reclaim Water 1%
Sewer 14%
Electricity 40%
Chilled Water 0%
Steam 33%
Total Cost of Utilities
$7,430,442.81
{{{With your Help}}}
5% reduction = $ 371,522.15
10% reduction = $ 743,044.30
Let's save 5% annually by implementing analytics
UI FY2016 utility costs

32


ARCH 571 BUILDING PERFORMANCE EVALUATION
HAGLUND
TUES/THURS 2-3:15
SHOP CRIT
3CR
"DISCOVER THE SECRET LIFE OF BUILDINGS"
Look for it Spring 2023
GreenSource
-2.4 °C
-15.5

33


Sp1
70.1 °F
76.2
Sp1
FLIR
63.6

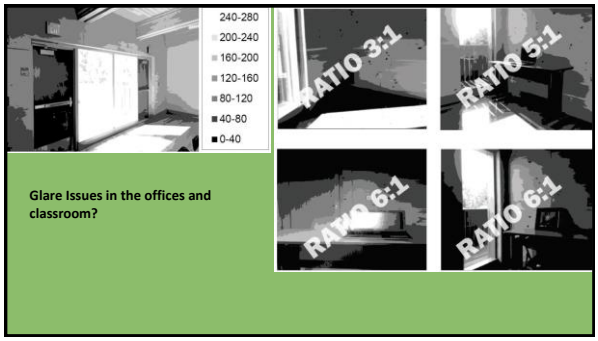
34


Reveley Classroom at
Pitkin Nursery

35


Office 4
Classroom
Lobby/Conference
Room
Office 1
Office 3
Office 2
2100 sqft. building
Shaded south windows

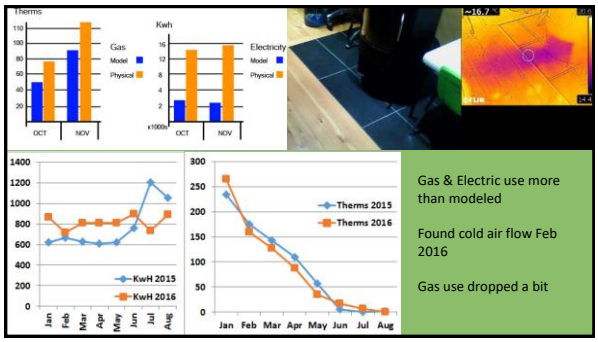
36


240-280
200-240
160-200
120-160
80-120
40-80
0-40
RATIO 3:1
RATIO 5:1
RATIO 6:1
RATIO 6:1
Glare Issues in the offices and classroom?

37


-1.2 °C
5.3
-6.0
FLIR
16.1 °C
21.8
13.2
FLIR
Infrared images of exterior and interior of east wall.
Insulation gap?
Crawlspace heat loss?

38


Therms
Gas
Model
Physical
OCT
NOV
Kwh
Electricity
Model
Physical
OCT
NOV
KwH 2015
KwH 2016
Jan Feb Mar Apr May Jun Jul Aug
Therms 2015
Therms 2016
Jan Feb Mar Apr May Jun Jul Aug
Gas & Electric use more than modeled
Found cold air flow Feb 2016
Gas use dropped a bit

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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

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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.

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LEED GOLD BUT NOT EQUAL: TWO CASE STUDY BUILDINGS

BAJA, FILMAE D. F.; BAJRACHARYA, SAINAZ; FREEMAN, MIRANDA A.; GRAY, ALLISON J.;
HAGLUND, BRUCE T.; KUIPERS, 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

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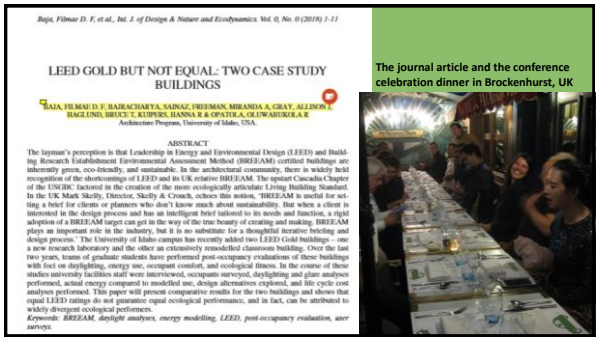

Baja, Filmar D. F, et al., Int. J. of Design & Nature and Ecodynamics. Vol. 0, No. 0 (2018) 1-11

LEED GOLD BUT NOT EQUAL: TWO CASE STUDY BUILDINGS

BAJA, FILMAR D. F, BAIRACHARYA, SAINAZ, FREEMAN, MIRANDA A, GRAY, ALLISON T, HAGLUND, BRUCE T, KUIPERS, HANNA R & OPATOLA, OLUWABUKOLA R
Architecture Program, University of Idaho, USA.

ABSTRACT

The layman's perception is that Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM) certified buildings are inherently green, eco-friendly, and sustainable. In the architectural community, there is widely held recognition of the shortcomings of LEED and its UK relative BREEAM. The upstart Cascadia Chapter of the USGBC factored in the creation of the more ecologically articulate Living Building Standard. In the UK Mark Skelly, Director, Skelly & Crouch, echoes this notion, "BREEAM is useful for setting a brief for clients or planners who don't know much about sustainability. But when a client is interested in the design process and has an intelligent brief tailored to its needs and function, a rigid adoption of a BREEAM target can get in the way of the true beauty of creating and making. BREEAM plays an important role in the industry, but it is no substitute for a thoughtful iterative briefing and design process." The University of Idaho campus has recently added two LEED Gold buildings – one a new research laboratory and the other an extensively remodelled classroom building. Over the last two years, teams of graduate students have performed post-occupancy evaluations of these buildings with foci on daylighting, energy use, occupant comfort, and ecological fitness. In the course of these studies university facilities staff were interviewed, occupants surveyed, daylighting and glare analyses performed, actual energy compared to modelled use, design alternatives explored, and life cycle cost analyses performed. This paper will present comparative results for the two buildings and shows that equal LEED ratings do not guarantee equal ecological performance, and in fact, can be attributed to widely divergent ecological performers.

Keywords: BREEAM, daylight analyses, energy modelling, LEED, post-occupancy evaluation, user surveys.

The journal article and the conference celebration dinner in Brockenhurst, UK

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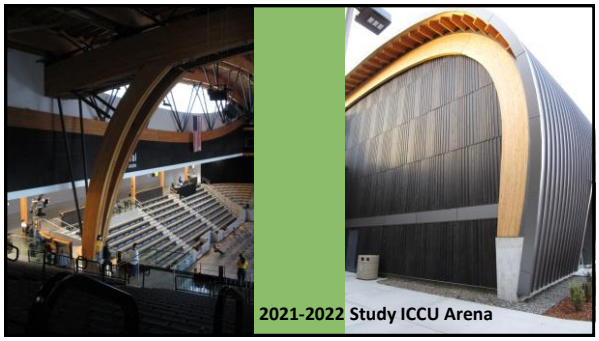

2021-2022 Study ICCU Arena

44