

centerline

Newsletter of the Center for the Built Environment at the University of California, Berkeley

Summer 2015



THERMOSTAT WARS

Director's Note

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Dear Industry Partners and Friends,

We have had a busy summer here at CBE, one reason for our late publication of this summer's *Centerline*. Inside we offer insights on news media about the so-called "thermostat wars," project news, upcoming events, and new industry partner profiles.



This summer we welcomed Lindsay T. Graham, Ph.D., who is taking over the CBE Occupant Survey project, a key research topic in its own and also an important resource for CBE partners and others. It has been over a year and a half since we had a dedicated survey research lead, and Lindsay's training and expertise in psychology will add important breadth to our research team (more about Lindsay on page 11). I also wish to acknowledge the efforts of David Lehrer, who has managed our survey program during the interim. Our survey team's video pitch was selected as a winner of DOE's SunShot Catalyst Prize, which you can read about on page 8.

Sadly we bid farewell to Tyler Hoyt, who has been our expert energy simulator and the developer of CBE's widely used web-based tools such as the Thermal Comfort Tool and the new Setpoint Savings Calculator (see page 7). However, Tyler leaves us to work with Building Robotics, a company involved on several CBE projects, so we expect to have future opportunities to work with him and his new colleagues. We also wish to thank post-doctoral researcher Yongchao Zhai for his many contributions to CBE's field and laboratory studies, as he leaves for a faculty position in China.

We thank you for your interest and support, and hope to see many of you at our upcoming October membership events.

Sincerely,
Prof. Edward Arens
Director, CBE

Thermostat Wars

Recent media on comfort conflicts in the workplace



Heat records have been broken around the world this summer, and four western states in the U.S. are on track to record their warmest year ever. The mainstream media has responded with a string of articles and broadcasts about comfort in the workplace, in many cases engaging with faculty and researchers at CBE to provide expert insights.

In spite of the warm weather, many people are freezing in their offices, as noted in *The New York Times* article, “[Enduring Summer's Deep Freeze](#).” The phenomenon may be partly cultural, as cool temperatures may be used to represent power and luxury, and high-end retail boutiques are reliably chillier in summer than discount stores. Other culprits include thermostat settings that are not changed seasonally, and mechanical systems that are sized for peak summer conditions, further scaled up to provide additional margins of safety, and then operated without allowing them to be throttled back. The evidence of office temperatures being colder in summer than winter is not just anecdotal; it was documented by Lawrence Berkeley National Laboratory in a 2009 field study of 95 U.S. office buildings. The same study found that these low summer temperatures were also associated with increased symptoms of sick building syndrome.

The *Times* author quotes CBE Director, Professor Edward Arens, who

compares such mechanical systems to a souped-up car that cannot idle and is continually revved even when it isn't going anywhere. Prof. Arens points to one solution to the over-cooling program demonstrated in a [CBE field study that reduced airflow rates](#) in low-load situations, thus saving energy as expected, but surprisingly also reducing the rate of thermal discomfort

to employee fatigue, and how ideas borrowed from biophilia show that humans seek and enjoy a varied thermal environment. [She explains](#) that CBE's research on personal control of workplace comfort shows promise, for example using common desk or ceiling fans, as well as new ideas being tested such as CBE's heated and cooled chairs.

While the idea of building industry sexism may provide a hook for readers, recent media coverage may exaggerate the influence of gender on workplace comfort.

in summer by one half. The article also cites the solution offered by [Comfy](#), a phone or web app that allows people to influence their workspace temperature. The product was created by Building Robotics, a company launched by former UC Berkeley students, and one of CBE's current research collaborators.

Another look at America's air-conditioning addiction was provided in [John Hockenberry's July interview](#) with CBE Associate Director, Professor Gail Brager, on *The Takeaway* public radio program. Prof. Brager discusses how “thermal monotony” and a lack of air movement in offices can lead

Personal comfort solutions such as these are also described in the *Bloomberg Business* article, “[These Companies Claim They Can End Office Air-Conditioning Wars](#).”

The media on air conditioning really heated up in August, when an article in *The New Yorker* asked, “[Is Your Thermostat Sexist?](#)” The author claimed that for decades the “science of thermal comfort has discriminated against women,” citing a recent paper in the journal *Nature Climate Change*, that asserts that women prefer higher temperatures than men due to having a lower metabolic rate. The study from Maastricht University Medical Center

in the Netherlands found that female subjects had lower metabolic rates than the standard published rates for the same activity. The authors then suggested (but did not test) that this was perhaps one of the main reasons for women being too cold in office settings. The story gained momentum and appeared in [The New York Times](#), [Scientific American](#), [USA Today](#), [The Washington Post](#) and [Science News](#).

While the idea of building industry sexism may provide a come-on for readers, the media coverage of this otherwise reputable research exaggerates the influence metabolic rates have on women's comfort preferences. CBE Associate Director Gail Brager explains that the overcooling of offices in summer is making both men and women uncomfortable, and that "the difference in temperature preferences between individuals is far greater than the small differences that have been documented between demographic groups defined by gender, age or body type." Field studies that include thousands of subjects (orders of magnitude greater than the Maastricht study) show that many factors contribute to women's discomfort, including differences in clothing, body mass index, circulation and sweating. She notes that these differences in individual preference will require a paradigm shift in how we condition buildings, and that we should pursue "simple energy-efficient ways to give people more personal control of their own environments." The articles also incorrectly state that thermal comfort standards were based only on males,

when in fact the standards are based on subjective studies done with both men and women.

Finally, CBE industry partners at the U.S. General Services Administration (GSA) were also [featured in an article about the temperature control of federal buildings](#) in which over two million people work. In spite of operating buildings within standard temperature ranges, GSA's Kevin Kampschroer says that it is not possible to keep everyone comfortable, something made more difficult by the wide range of ages of federal workers, from baby boomers to millennials.

Kevin notes that surveys show that only about 60% of federal workers are satisfied with temperatures, which is consistent with [CBE's survey research findings](#), in which 42% of occupants are dissatisfied with temperature.

Media coverage of university research is generally beneficial in raising public awareness of important issues and the contributions of academia, in spite of the inevitable over-simplifications or inaccuracies. These articles about air conditioning and comfort are no exception; those of us involved in the technical aspects of comfort just have to keep our cool about them.

Links and Media

The New York Times, "Enduring Summer's Deep Freeze"

<http://www.nytimes.com/2015/07/05/sunday-review/enduring-summer-deep-freeze.html>

BloombergBusiness, "These Companies Claim They Can End Office Air-Conditioning Wars"

<http://www.bloomberg.com/news/articles/2015-07-23/these-companies-claim-they-can-end-office-air-conditioning-wars>

UC Berkeley News, "Curbing America's 'Addiction' to Air Conditioning"

<http://news.berkeley.edu/2015/07/17/curbing-americas-addiction-to-air-conditioning/>

The New Yorker, "Is Your Thermostat Sexist?"

<http://www.newyorker.com/tech/elements/is-your-thermostat-sexist>

The Washington Post, "These Two Men Control the Thermostat in 9,000 Federal Buildings"

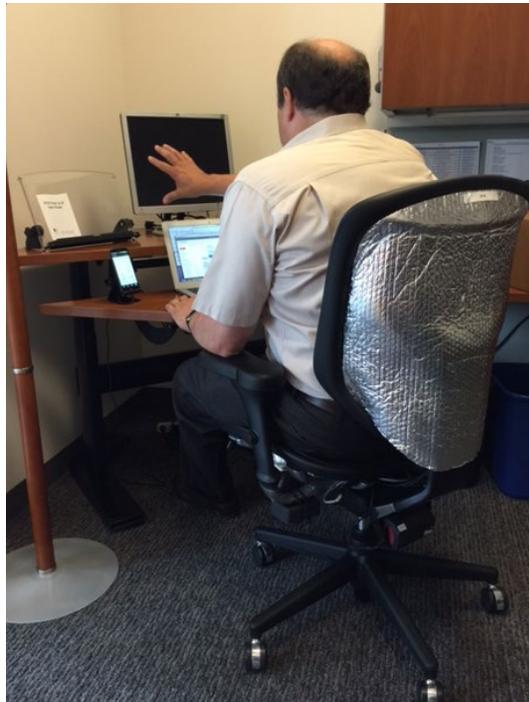
<http://www.washingtonpost.com/blogs/federal-eye/wp/2015/08/07/these-two-men-control-the-thermostat-in-9000-federal-buildings/>

Research Updates

Letting People Call the Shots in Occupant-Controlled Buildings

Giving employees the ability to control their work environment holds great promise for improving workplace effectiveness, well-being and satisfaction. In a previous edition of *Centerline* we introduced an interdisciplinary R&D project to build and test new approaches to expanding the roles of occupants in the control of buildings. The project, titled [Changing the rules: Innovative low-energy occupant-responsive HVAC controls and systems](#), is a collaboration led by CBE researchers, with numerous collaboration partners that include UC Berkeley's Department of Electrical Engineering and Computer Science (EECS), CBE Industry Partner Taylor Engineering, and the California Institute for Energy and Environment. Principal funding comes from the California Energy Commission with match funding from CBE's industry partners. The project is testing personal comfort systems (PCS) combined with new approaches to HVAC control to optimize building for both comfort and energy efficiency.

We are currently finalizing a new version of the "PCS chair" that includes built-in heating and cooling, a key element of the occupant comfort system. The newest version of the chair includes digital controls based on an Android phone app that communicates with the building HVAC system



Study participant at UC Berkeley with the PCS chair and Android controller.

in real-time via sMAP, an [open-source building communication framework](#) created by EECS faculty and students. This communication will allow occupant input to improve HVAC control to increase comfort while also saving energy, optimizing for temperature and airflow at the central air handling unit (AHU). The HVAC control will be based on occupancy and on multiple user preferences when multiple rooms are controlled as a single zone. The system

will also further test [methods for providing minimum ventilation air supply](#) that has previously been demonstrated by CBE as a way to improve warm season comfort while saving energy.

This summer the research team deployed fifteen new PCS chairs in Berkeley's Sutardja Dai Hall, where the system will be debugged and tested for deployment in additional locations. The team also handed out dedicated Android phones to participants to be used to control the chairs and connect with the buildings via sMAP. (In future iterations more intuitive controls will be directly on the chairs, as in previous analog versions.)

Berkeley Ph.D. student Joyce Kim notes that when the chairs were delivered, participants showed a high level of engagement and expressed interest in benefits besides thermal comfort, for example to relieve back pain with warmth, or to use cooling to remain alert. In addition, participants throughout the building (including those without the PCS chairs) can use Building Robotics' [Comfy](#) app to provide feedback on temperature and to directly influence the temperature setpoints.

The research team will monitor several performance metrics, including building energy use, indoor environmental conditions, HVAC control stability, and the comfort of building occupants. Occupants will be asked to respond to the “right-now survey” for thermal comfort, allowing researchers to compare subjective assessment of the indoor environment with thermostat settings and HVAC operations. The research plan provides a baseline period in which current HVAC operations will be maintained, and also subsequent changes to temperature and airflow with the goal of optimizing for both comfort and energy conservation.

Following the exploratory and developmental testing in Sutardja Dai Hall, the project will conduct two comprehensive demonstration field studies using the integrated solution of PCS, information connectivity, and advanced VAV controls. The first of these field studies has already begun in [Integral Group's San Jose office](#), an advanced ZNE building featuring a radiant floor slab system that we described in an [earlier edition of Centerline](#) (formerly the office of Integrated Design Associates, or IDeAs). There we provided all the employees with PCS chairs, desk fans, and the Comfy app, and we are testing the effect of raising the thermostat setting from 75°F to as high as 79°F to learn if the personal comfort control is effective. (Laboratory tests conducted by CBE showed that people were comfortable in the chairs when provided with small



Research team member Yongchao Zhai installs monitoring equipment at Integral Group's San Jose office last July.

desk fans at temperatures as high as 84°F.)

The second demonstration field study will take place in the offices of the County of San Mateo, located in Redwood City. This will allow us to test our integrated solution in an office environment with a conventional overhead VAV air distribution system, one that is representative of millions of existing buildings. This building will showcase a full-scale demonstration of these concepts, and will integrate Comfy, new control methods developed by the research team, and

the fully connected PCS chairs.

All combined, these three field study sites will provide testing grounds that we hope will produce robust and reliable results for evaluating the potential for putting occupants in control of their workspaces, thereby improving thermal comfort while conserving energy. Preliminary results to date are documented in an interim report to the California Energy Commission, and will be summarized for CBE's partners at the upcoming Industry Advisory Board Conference in October.

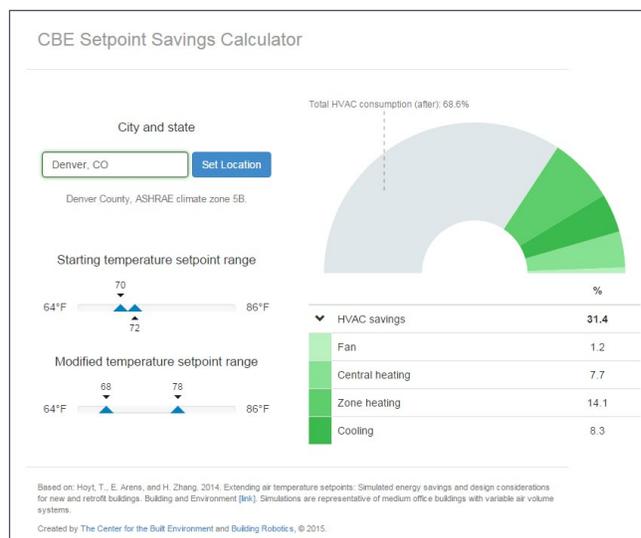
New Interactive Calculator Shows Energy Savings from Temperature Adjustments

Recent media attention has raised concerns of the so called “air-conditioning wars,” apparently pitting male workers against female employees, and perhaps everyone against facility managers, in what may be an impossible attempt to make diverse groups of people comfortable within a narrow range of temperatures.

While comfort for all may be an admirable, even incontestable goal, maintaining a narrow temperature range year-round also has significant energy implications. To understand the relationship between temperature settings and energy use, CBE and Building Robotics have created the first online calculator that provides quick and simple estimations of energy savings that can be achieved by changing thermostat settings by a few degrees or more.

This interactive tool was created by former CBE Research Specialist Tyler Hoyt (now with Building Robotics). It calculates the HVAC energy savings resulting from changing the thermostat “deadband,” the range between heating and cooling setpoints in which neither heating nor cooling are required, and air supply is needed only for ventilation.

To use the calculator, users first select a climate zone by typing a U.S. city and state, then they define a base case, and finally they interactively view energy savings for temperature alternatives that they choose. The results are viewed as a percentage of total HVAC energy saved, and also broken down into four major subcategories.



The setpoint calculator uses a simple single-screen interface.

<http://comfort.cbe.berkeley.edu/energycalc/>

The interactive tool, which [is online on CBE's website](#), was based on exhaustive energy simulation studies that have been [summarized in a paper](#) by Tyler Hoyt with co-authors Edward Arens and Zhang Hui, and published in *Building and Environment* last fall. For the study, the authors used EnergyPlus software, and parametrically varied temperature setpoints for six distinct medium-sized office building prototypes with typical variable air volume (VAV) systems, in seven ASHRAE climate zones. The calculator tool was created using a summary of the simulation results, based on close to 1,700 individual simulations.

The simulations demonstrate that reduced airflow minimums are effective in reducing energy use. In addition, field studies [found that reduced minimums improved thermal comfort during warm seasons](#).

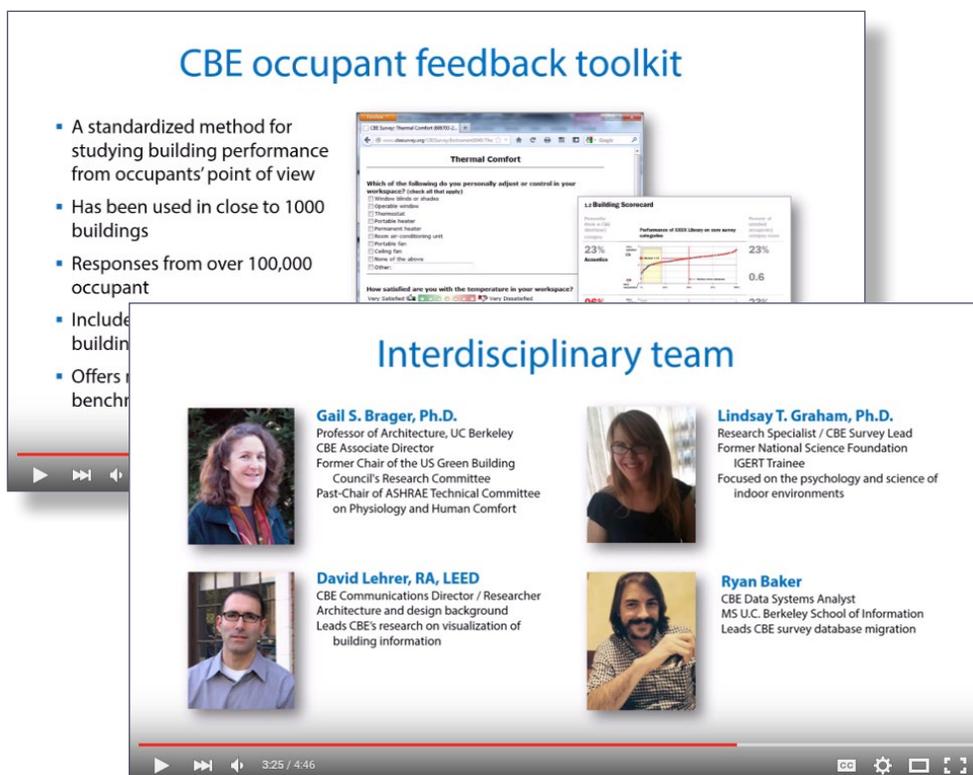
Previous studies show that over-cooling in office buildings in summer is a persistent problem, and also that people are generally comfortable over a wider range of temperatures than those commonly enforced in workplaces. In fact, detailed examination of an extensive ASHRAE database of field studies shows that maintaining narrow temperature ranges does not result in higher occupant satisfaction than wider ranges, such as 4–6°C (7–10°F). This tool provides one additional resource for building operators and design professionals to explore and demonstrate the energy saving benefits of relaxed temperature deadbands.

Additional background on the tool is on CBE's website here: <http://cbe.berkeley.edu/research/setpoint-savings-calculator.htm>

CBE Survey Team Receives DOE Catalyst Business Innovations Award

To advance rapid innovation in solar energy technologies, the U.S. Department of Energy (DOE) created the [SunShot Initiative](#), with a series of competitive, open innovation challenges. These challenges include a building technology contest directed by DOE's Building Technologies Office (BTO). To participate, teams submitted five-minute pitches to compete for support in terms of funding and mentoring.

In September, CBE's survey research team was awarded one of the Catalyst Business Innovations Prizes, and will receive \$25,000 in professional computer programming services via the Topcoder platform (a professional platform designed to connect computer professionals with companies seeking services) and professional advising. We were one of only five teams selected for the BTO award, and the selection was based on a five-minute pitch, produced with assistance from talented CBE Ph.D. student Soazig Kaam, and uploaded to the Catalyst website. CBE's "Livable Analytics" [video pitch can be seen online](#). The pitch demonstrated the value of CBE's occupant survey resources, and how it has become widely adopted by manufacturers, building owners and design professionals to evaluate energy-efficient systems and technologies, and to understand how buildings and workplaces support building occupants in terms of productivity and well-being.



Screens from CBE's winning five-minute video pitch to the BTO Catalyst Challenge.

This award enters CBE into a 60-day development challenge, and in December our team will compete in a demo day to advance to the next phase of the project that can provide up to \$100K in additional support.

The project team includes Lindsay Graham, David Lehrer, Ryan Baker, and Gail Brager. Our team will focus on creating new analytics and visu-

alization tools to allow users of our survey to engage more deeply with our unique survey data and benchmarking statistics. We are excited for this new challenge and know the new tools that come out of this competition will help to enhance our survey tool and make our survey even more useful for our partners and clients.

Partner News

CBE's Newest Industry Partners Represent Sustainable Design and Innovation



Previously a CBE industry partner, Trane continues to be a partner through Ingersoll Rand.

This spring we welcomed three new members to CBE's industry consortium. These firms are leaders in manufacturing and design of sustainable buildings, and we have been involved with key members of each firm for some time:

Ingersoll Rand advances the quality of life by creating comfortable, sustainable and efficient environments. Through its family of brands – including Club Car, Ingersoll Rand, Thermo King and Trane – the company enhances air quality and comfort in homes and buildings; transports and protects food and perishables; and increases industrial productivity and efficiency. Its operations reflect a long-standing commitment to innovation, sustainability and energy efficiency.

In 2014, Ingersoll Rand made a

commitment to significantly increase energy efficiency and reduce environmental impacts by 2030. Milestones for 2020 include a 50 percent reduction in the greenhouse gas (GHG) refrigerant footprint of its products; a \$500 million investment in research and development to fund the long-term reduction of GHG emissions; and a 35 percent reduction in the GHG footprint of operations.

Ingersoll Rand was selected for two 2015 Dow Jones Sustainability Indices, marking five consecutive years on the index series. The company has been recognized on the FTSE4Good Index Series, the CDP S&P 500 Climate Change Report and the MSCI Global Sustainability Index. It was also named the No. 1 Industrial Machinery company on FORTUNE Magazine's

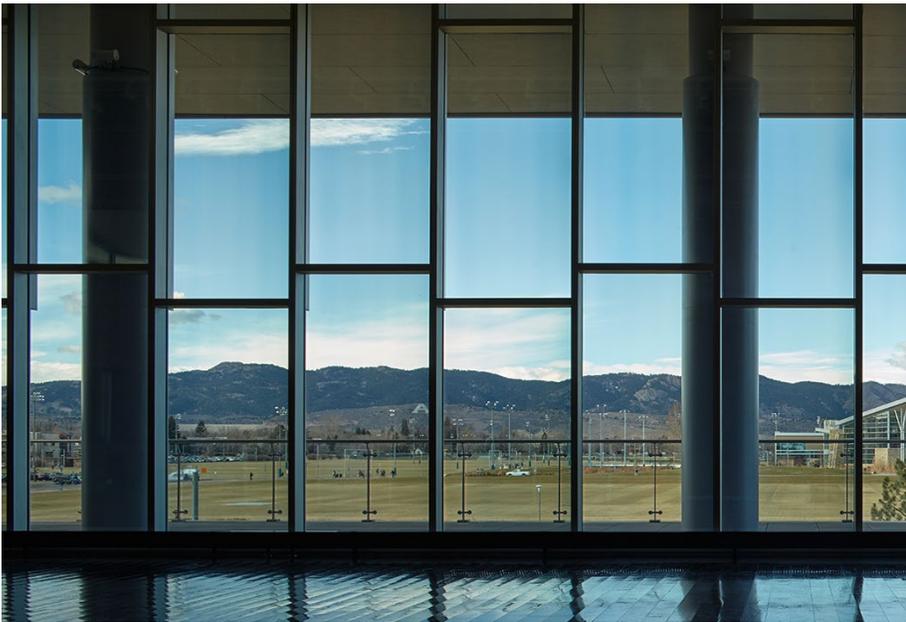
2015 World's Most Admired Companies list. CBE presented research findings to Ingersoll Rand's senior management at two innovation seminars held in 2014 at its North American Headquarters in Davidson, North Carolina. We look forward to future engagements with them.

Based in Portland, Oregon, **SERA** is a 120-person architecture, urban design and planning, and interior design firm. The firm specializes in sustainable place making at all scales through high-performance design and planning for hospitality, workplace, mixed-use housing, higher education and civic projects. This year, the firm opened its first new branch in Silicon Valley.

Serving diverse clients such as Marriott Hotels, Google and the U.S. General Services Administration, SERA's multi-award winning project portfolio includes the Edith Green – Wendell Wyatt Federal Building modernization; The Collaborative Life Sciences Building and Skourtes Tower; and the Pearl District Residence Inn.

Over the past several years, SERA has collaborated with CBE through a number of efforts, including the application of Indoor Environmental Quality (IEQ) research and post-occupancy evaluations. The staff at SERA tell us they are excited to join CBE as an Industry Partner, and that they look forward to collaborating on ideas and tools that will make their projects healthier and more sustainable.

[View Dynamic Glass](#) is a pioneer



top: **The Collaborative Life Sciences Building and Skourtes Tower, a 2015 AIA COTE Top Ten award winner in Portland, Oregon, by SERA Architects and CO Architects.**

Image: Jeremy Bittermann.

above: **View Dynamic Glass is featured in Colorado State University's Lory Student Center, Fort Collins, Colorado.** Image: Courtesy of View Dynamic Glass.

in large-scale architectural dynamic glass, a new generation of glass that intelligently changes tint levels in response to external and internal conditions, providing enhanced comfort, control, and energy efficiency. View's glass changes tint over the course of a day based upon latitude/longitude, sun angle, cloud cover, and where people sit. Windows are commonly regarded as one of the least energy efficient building components, responsible for up to 40 percent of the total HVAC and lighting consumption. However, View reduces these costs and offers energy savings of up to 20 percent.

In addition to the benefits of sustainable building, View Dynamic Glass improves the occupant experience by eliminating the need for blinds or shades, allowing people to enjoy unobstructed views. Earlier this year, View unveiled the next generation of the predictive intelligence engine behind View's self-tinting dynamic windows. By integrating with third-party data providers, View can react to clouds and weather conditions beyond the immediate vicinity, advancing the role of sustainability in connected buildings.

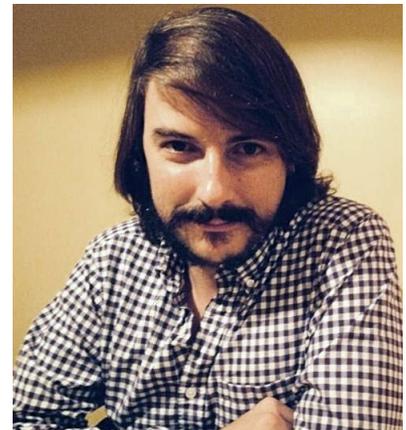
View's clients includes Overstock.com, CenturyLink, Colorado State University, Kaiser Permanente, Hilton Hotels, and the Department of Defense among many others. With over 250 projects and counting, View is a leader in glass technology and is fueling a dramatic shift in building design. View shares CBE's belief that sustainable, people-focused building design is the future, and we are looking forward to their contribution and participation.

People

New Research Team Members Expand CBE's Expertise in Psychology, Information Science and Programming

Our research team is pleased to announce the hiring of CBE's new survey research lead, **Lindsay Graham, Ph.D.**, who joined us this summer after an extensive recruitment process. Lindsay joins us from UT Austin, where she completed her undergraduate studies and a doctorate in Personality and Social Psychology, focusing on how people express themselves and interact with their physical spaces both at work and at home. She is excited to join CBE for its interdisciplinary nature, where she plans to bring her knowledge of how people think and behave in space, and her experience in psychometrics, to enhance the suite of survey tools and data that CBE has collected over many years. Lindsay says she is "looking forward to collaborating with CBE's industry partners to impact real world situations," beyond the sphere of academia. During her time at UT, Lindsay received an award from the National Science Foundation to participate in an engineering traineeship (in which she was the sole social scientist) and she published her work widely on topics that include both physical and virtual environments.

Last semester we also welcomed a new CBE Survey Coordinator, **Hudson Attar**, who is working towards a double major in business and computer science at UC Berkeley. Hudson quickly became adept at using CBE's software, and over the past few months has



been supporting CBE's partners and other survey users to implement surveys, create reports, and utilize the survey data. CBE was also joined last winter by **Ryan Baker**, a recent graduate from the UC Berkeley School of Information. Ryan has been working on migrating the CBE survey database to a more current database structure that will enable the use of the Python Django software framework for the web applications, which will provide flexibility and allow us to improve the look and feel of the survey tools. We are happy to have such great new talent supporting CBE's survey work and expanding our capabilities, and we look forward to the next phases of this important part of CBE's research portfolio.

clockwise from top left:
**Lindsay Graham, Hudson Attar
and Ryan Baker.**

Livable Buildings 2015

Student center designed for diversity provides welcoming campus nexus

The winner of this year's Livable Buildings Award is the [Student Community Center \(SCC\)](#) at the University of California, Davis. The original project goals included the creation of a learning environment that would value diversity, and providing a hospitable and non-institutional place for socializing and study. The project has also performed well on CBE's Occupant Survey, meeting high criteria in terms of overall occupant satisfaction that qualified the building for this award.

Sheri Atkinson, SCC Director, notes that the "building is a labor of

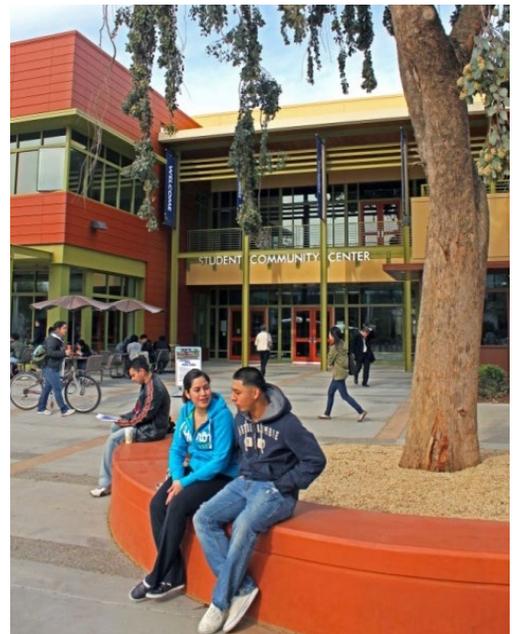
love for many students, staff, and administrators," and that, "receiving CBE's Livable Buildings Award is such an honor and acknowledgment of all the hard work that went into creating a home away from home for our students."

The 43,000 square foot building, designed by BAR Architects, functions as a major hub for the campus. It houses student organizations, a computer lab, classrooms, study lounges, undergraduate research and graduate school programs, as well as a student-run cafe. Together these groups provides support for students

from application through graduation, an organizational approach that is unique in higher education.

The project was funded by student-approved fees, and three student members participated on the project advisory committee from the very beginning of the project. Previous student services were difficult to locate, hidden away in basements, back annexes, or temporary structures. The SCC replaced a set of buildings in the central campus area, and was the first step in implementing a master plan to revitalize the campus.

Learning from previous projects



The UC Davis Student Community Center links inside and outside spaces to create a usable and climate-responsive plan. Images: Bo Botelli (UC Davis) and Doug Dun.



SCC's central lobby features ample daylight to provide a space for study and socializing.

that utilized occupant surveys, the project team were aware of common problems with acoustics, natural lighting, and ventilation as they started the design process. To mitigate potential dissatisfaction, they included operable and accessible windows, high quality acoustic ceiling tiles and extra insulation to address noise issues. The two-story layout is organized around an open lobby, with large skylights to provide a warm and inviting space for meeting and collaboration.

The location of this new building allowed for the creation of a plaza along a campus promenade, creating a lively public place where students and faculty can meet and gather. By taking advantage of the mild climate and existing landscape, outdoor and indoor spaces are interconnected and allow for a usable site plan. A “reflection room” with an outdoor garden and fountain was provided on the north

side of the building for meditation, and thoughtful quieter activities.

The building is LEED-Platinum certified, and was designed to use 33% less energy than the state’s Title-24 energy code “compliant” building. Water use in the building is reduced by 43%, with hydration stations on each floor to reduce use of bottled water. The building demonstrates many sustainable processes and products, including programmable LED exterior lighting, and diversion of 96% of construction debris.

UC Davis conducts rigorous commissioning, and monthly post-occupancy meetings are held to resolve any issues that arise. The project utilized enhanced commissioning from the university’s in-house commissioning agent, who also coordinated training of facility staff.

From the first day the it opened, the SCC has been embraced by the

student community. Interest in volunteering at the center tripled in the quarter after it opened, and use of the computer lab and classrooms have also increased.

We also recognize the other finalist of this year’s award program, the **Parharpur Business Centre** in New Delhi, India. Despite being located in a city with **high levels of air pollution** (frequently worse than Beijing), occupants of the building had high satisfaction with indoor air quality, and other buildings characteristics overall.

This award program is unique in its inclusion of building occupant satisfaction in its selection criteria. To be considered for the award, now in its ninth year, buildings must rank among the top scorers in **CBE’s Occupant Indoor Environmental Quality Survey**, which has been implemented in close to 1000 buildings around the world.

Events

Seminar on Sustainable Urban Housing

Multi-unit residential construction is growing both in California and nationwide, with the number of units to be delivered in 2015 expected to surpass pre-recession averages. With such growth, improving the environmental performance of this building type is essential to meet California's energy goals for zero net energy buildings while addressing other issues such as land use, water, transportation and human health.

What are the key issues affecting design, construction, liability, and operation of multi-family buildings in an urban context? A panel of experts will explore the issues related to sustainable urban housing in multi-unit buildings, in ways that further sustainable design at the neighborhood level as well.

This event is free and open to the public, presented by the ASHRAE Golden Gate Chapter, and is co-sponsored by the Center for the Built Environment (CBE), at the University of California, Berkeley, and PG&E.

The in-person program qualifies for six AIA Continuing Education learning units/HSW.

October 7, 2015
8:30 AM – 4:00 PM

Pacific Energy Center
851 Howard Street,
San Francisco, CA 94103

Also available by live webcast.

[See event brochure for details.](#)

Speakers

Development Issues:

Paul Zeger, Polaris Pacific

Transportation:

John Holtzclaw, Consultant

Sustainability and Land Use:

Joe DiStefano, Calthorpe Analytics

Quality Assurance:

Bruce Furakawa, Long & Levit LLP

Architecture & Design:

Sylvia Kwan, FAIA,
Kwan Henmi Architecture

Technical Design Issues:

Keith Boswell, FAIA, SOM

HVAC System Design:

Steve Taylor, PE, Taylor Engineering

Automation & Smart Homes:

Joshua Mooney, Nest Thermostats

Renewable Energy:

Cole Roberts, Arup



Register for the
San Francisco class:
www.goo.gl/w6L5Bi

Register for the
live webcast:
www.goo.gl/f4NR4s



Photos courtesy of:
©Skidmore, Owings & Merrill LLP/
steelblue, 2015. All rights reserved (top);
Kwan Henmi (middle); ZGF Architects
LLP, ©Timothy Hursley (bottom).

Seminars on Radiant Slab Systems Coming to New York City and San Francisco

Fred Bauman will continue to lead seminars to inform design professionals of current practices and summarize research on slab-integrated radiant systems. The next sessions are scheduled in New York City on October 13th, and in San Francisco on November 3rd. CBE's Paul Rafferty and Stefano Schiavon will also participate in the San Francisco course.

The seminars will cover the key advantages and differences between radiant and air systems, including fundamentals, energy use and practical considerations. This seminar series is sponsored by CBE Industry Partner [Viega](#). For more information please [email Fred Bauman](#).



Project Scientist Fred Bauman presenting at one of two radiant system seminars held last year. Image: Candace Roulo

Visit CBE at Greenbuild in the Nation's Capital

We hope to see many of you at Greenbuild this year, please stop by our **booth 3565** in the non-profit section of the exhibit hall. Organized by the USGBC, Greenbuild is the premier event for sustainable building, and CBE has exhibited in each one since the first in Austin, Texas, in 2002.

Greenbuild provides us with an excellent opportunity to meet with our current partners and to learn about their activities, to recruit new companies, and to keep up with new trends and technologies.



The 2015 Greenbuild Conference and Expo will be held at the Walter E. Washington Convention Center. Image: US News.

Industry Partners at the Center for the Built Environment

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