centerline

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

Winter 2011

WORKPLACE ACOUSTICS

in High-Performance Buildings

Director's Note

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CBE's Industry Partners

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Dear Industry Partners,

This winter we are excited to report on our progress on several fronts in this edition of *Centerline*. First, we describe a research project that is providing valuable insight into solving the acoustical design challenges that we have seen in several high-performing buildings. We also update you on milestones that we have reached with several projects, and describe new funding from the California Air Resources Board that will support our research on promising new design ideas — such as integrating fans into commercial ceilings, and on the potential for using energy feedback to help occupants and building managers to save energy through better building operations.

In addition, we introduce our newest industry partners, San Diego Gas & Electric®, and M.E. GROUP, who will provide additional perspectives to our work, and reinforce our membership base. We are also excited to announce an upcoming event we are planning in April that will precede our advisory board meeting — a symposium on information visualization, energy feedback, and promoting energy conserving behavior in commercial buildings. We have a great lineup of confirmed speakers, including designers, social scientists, and researchers, who will provide a broad range of viewpoints. We expect a strong turnout for this event, and hope to see many of you there.

Sincerely,
Edward Arens

Workplace Acoustics in High-Performance Buildings

At CBE we take a multi-disciplinary approach towards our research, and consider energy performance and human factors as equally important and often closely related issues. This is based on our simple belief that promising building technologies will fail to be widely adopted if they have negative impacts on building occupants. Therefore much of our research takes a two-pronged approach, studying both the design and engineering aspects of building technologies, and also documenting the impacts these technologies have on occupants.

One area in which this dual approach is valuable is with respect to understanding how new building technologies will impact workplace acoustics. Even in conventional buildings, CBE's occupant survey research reveals that office occupants are generally poorly satisfied with acoustics, especially in open plan offices. (Of all the categories included in CBE's occupant survey, acoustics is typically the lowest ranked.) Although the integration of new technologies may provide new challenges to designing for office acoustics, recent research opportunities are allowing CBE staff and research collaborators to better understand potential conflicts, and to provide guidance to design professionals.

Acoustical concerns with radiant ceilings

We are currently conducting several research projects to evaluate the energy saving potential of radiant cooling systems. (See page 8 for more on this research.) One issue raised by practitioners is the conflict between the desire to have an exposed radiant slab (or panels) for space conditioning, and the need to have acoustically absorptive materials that maintain acceptable sound levels and speech privacy. Although there are design guidelines to address acoustical performance in buildings with exposed radiant ceilings, to date there has been only limited experience with this building configuration, and it is certainly an area that needs further study.

A useful case study that will examine this problem in detail is underway at the LEED Platinum-rated David Brower Center in Berkeley. The nonprofit Center is a home for environmental and social action, with educational and arts programs, conference and event facilities, and high-quality office space for nonprofits. With a hybrid system combining radiant slab cooling, underfloor air distribution (UFAD), and natural ventilation, the project displays excellent energy performance, with an Energy Star score of 99. Occupant survey results show that the building is also providing an excellent environment for occupants, and put the building in the top quartile for all categories, with one exception — acoustics. There seem to be multiple causes for this finding: an exposed ceiling slab, inadequate sound absorbing materials, a UFAD system with low ambient sound levels, open floor plans, and operable windows which admit outside noise from traffic and other sources. Charles Salter, who was involved with the acoustical design of the project, notes that both the building and interior architects recommended acoustical features to tenants,

> Integration of advanced building technologies requires creative design approaches to provide quality workplace acoustics.

Center for Ecoliteracy's office at the Brower Center, showing exposed slab for radiant system, daylighting features, and operable windows. Photo: Tim Griffith.

but many opted out due to expense, and took a "wait-and-see" approach.

To better understand this issue, and to learn how to mitigate this type of challenge, CBE researchers are partnering with CBE industry partners Charles Salter Associates (CSA) and Armstrong, along with building management from the Brower Center. This team toured the building in December to discuss appropriate retrofit options that will be cost effective. There are several interesting challenges inherent in this undertaking. For example, current guidelines recommend that no more than one-third of the ceiling may be covered with acoustical sound absorbing material, and fasteners that penetrate the slab, which has embedded radiant tubing, cannot be used. In addition, all adhesives must be able to tolerate temperature variations associated with the radiant slab, and must also must be low-VOC and non-toxic to maintain a healthy indoor environment and to meet building standards.

> Studying occupied buildings can provide valuable lessons learned and guidance for future design.

The Brower Center management's desire to study alternative solutions is promising, and provides a unique research opportunity. As the retrofits are designed, funded, and hopefully completed, we plan to conduct future occupant surveys to evaluate their effectiveness. Because the Brower Center management is interested in using the building as a laboratory and sharing lessons learned, we hope that our findings may provide valuable guidance for designers of radiant systems, and help meet the dual goals of providing excellent performance in terms of both energy and indoor environment.

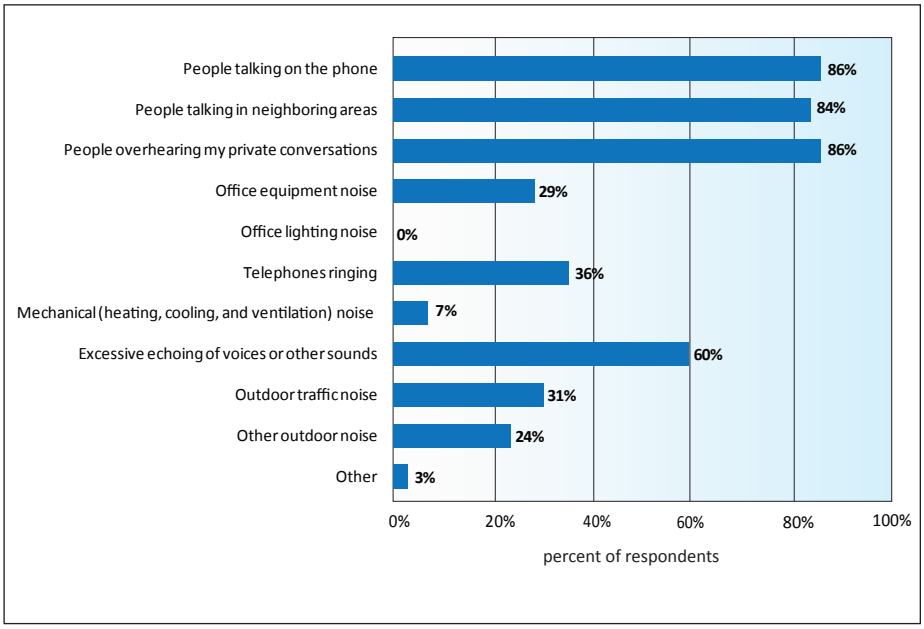
Related acoustical research at CBE

This research builds on previous acoustics research conducted at CBE in buildings with other non-conventional systems, for example in buildings with UFAD systems. Because UFAD buildings have air distribution openings in the floor, there was concern that sound transfer between adjacent spaces through the floor plenum could lead to unacceptable levels of speech privacy and other acoustical problems. Low ambient sound levels typical of UFAD buildings added to this concern.

Working in collaboration with Charles Salter Associates, we

completed field tests in a UFAD building to test the acoustical separation of a variety of wall assemblies with differing acoustical requirements. Standard offices had walls built on top of the raised floor, with the floor plenum left open, while executive offices and conference rooms had an acoustical "septum" added in the floor plenum below the wall. Spaces requiring the highest level of noise reduction had full-height walls that extended to the slab below. The tests found that the overall level of speech privacy between the various tested spaces met normal privacy standards, and that the acoustical septum was effective for spaces requiring high levels of speech privacy. CBE and CSA published these findings to provide design guidance that would help designers of UFAD buildings to provide adequate acoustical performance.

We are now continuing our collaborations with CSA on the development of acoustical testing protocols for green buildings. We are using the new USGBC/ASHRAE Performance Measurement Protocol (PMP) as a starting point for this research. Last year, staff from CSA and CBE conducted a series of acoustical field tests based on the PMP protocol, and our experience with this system will lead to a series of recommendations for measuring and benchmarking workplace acoustics. In our Advisory Board conference this April, Charles Salter will present an update on this research, and a summary report will be published later in the year.



Occupants' survey responses show specific reasons for acoustical concerns at the Brower Center. This data will aid the project team in addressing acoustic improvements.

Links and References

Radiant Cooling Research at CBE

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

Designing Acoustically Successful Work Places: A Case Study Assessment of the Speech Privacy and Sound Isolation of Spaces Having Underfloor Air Distribution Systems. C. Salter and R. Waldeck, CBE Summary Report, 2006.

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

Acoustic Quality in Office Workstations as Assessed by Occupant Surveys. Proceedings of Indoor Air 2005, K. Jensen and E. Arens, 2004.

http://www.cbe.berkeley.edu/research/pdf_files/Jensen2005_IndoorAir.pdf

Information about the David Brower Center Building

http://www.browercenter.org/building

Livable Buildings 2010

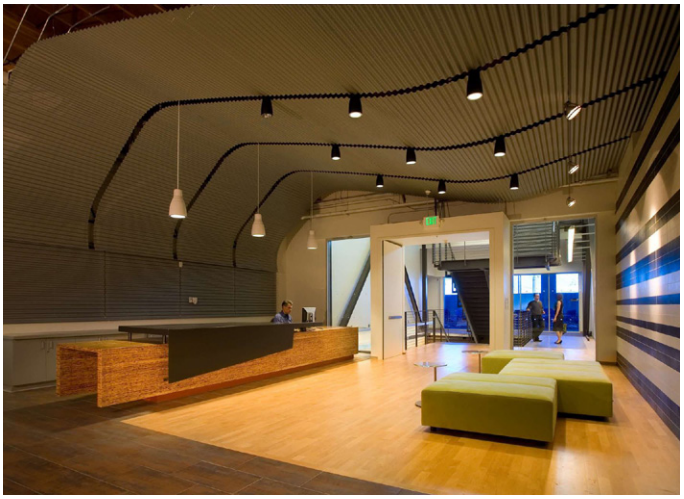
Livable Building Awards Recognize Sustainability and Excellent Workplace Design

A converted industrial building in San Francisco's SoMa neighborhood was designated the winner of the 2010 Livable Buildings Award last December. The award program jury, made up of CBE industry partners, also recognized the Kavli Institute for Particle Astrophysics and Cosmology with an honorable mention. These buildings were among a select group of buildings that qualified to compete for the award by having exceptional indoor environmental quality as determined by occupant feedback through CBE's occupant IEQ survey.

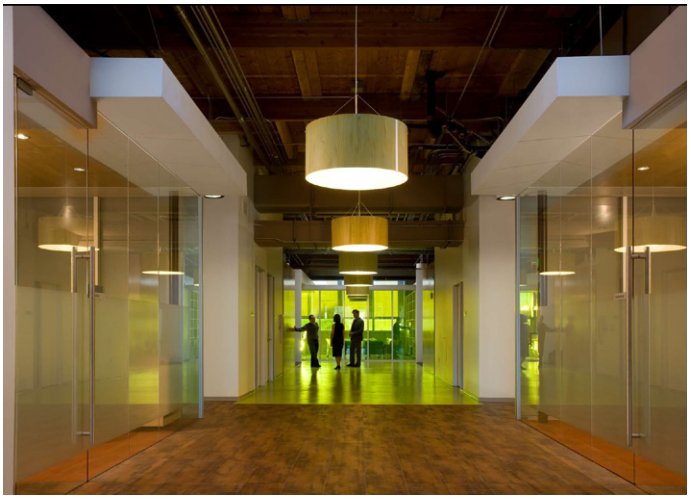
The winning project, UC San Francisco's 654 Minnesota Street project, designed by STUDIOS Architecture and Taylor Engineering, houses the campus' Capital Programs & Facilities Management Department. The existing three-story building offered opportunities with its massive timber framing, but also created challenges inherent in working with a large floor area. The renovation included replacement of old windows with high-performance glazing, and operable windows to provide occupant control. Sustainable finish materials, reduced water usage, and efficient mechanical and lighting systems earned the project a LEED CI 2.0 certification.

The project was designed to demonstrate sustainability, collegiality, and innovation, and to put forward a non-institutional and a welcoming look for the public. Managers have reported that the new workspace allows for improved staff collaboration, increased employee satisfaction, and serves as a "working prototype for progressive workplace and environmental strategies."

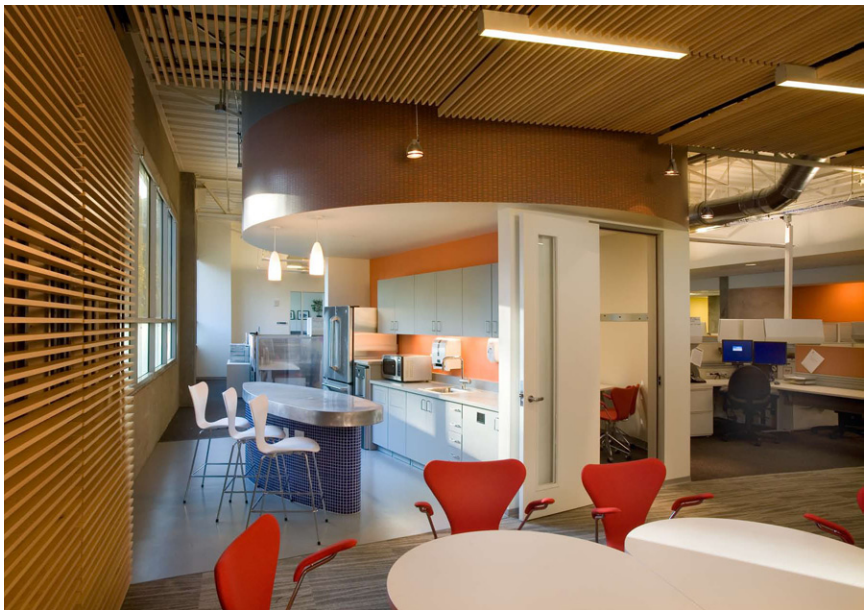
As one award jury member commented, "In terms of energy use and workplace design, this project is compelling. As a rehabilitation project, it's also a good example of



Entryway to UC San Francisco's redesigned office space at 645 Minnesota Street. UCSF photos: Michael O'Callahan.



Central "boulevard" at 645 Minnesota Street.



Kitchen and informal meeting space at the new UCSF building.

Kavli Institute for Particle Astrophysics and Cosmology. Photo: Patrik Argast.

what we need to do in the building industry."

The jury awarded an honorable mention to the Kavli Institute for Particle Astrophysics and Cosmology building, located at the Stanford Linear Accelerator Center, in Menlo Park, Calif. Designed by EHDD Architecture, this 25,000-ft^2 building houses offices, labs, meeting rooms, and a state-of-the-art auditorium. The design focuses on the principles of sustainability and resource efficiency through solar orientation and shading, mixed-mode ventilation, and operable windows. With large east-facing windows, the building takes advantage of the site's natural beauty overlooking the San Francisco Bay and the Stanford campus. Also noteworthy is the building's flexibility to meet ever-changing research needs, due to the plan organization and raised-access floor system.

These projects were among a select group which qualified for consideration for CBE's fourth annual Livable Buildings Award by demonstrating livability, which we define as exceptional performance in terms of occupant satisfaction, resource efficiency, sustainability, and overall design. To qualify, a building has to score in the top 50 percent in occupant satisfaction in all areas including air quality, lighting, acoustics, and thermal comfort, and must place in the top 25 percent of survey responses for overall building satisfaction. Only ten projects out of a total of 85 buildings that implemented the survey in 2009 qualified for consideration. This year's finalists represented a diversity of project types including governmental buildings, offices, schools, and a grocery store; and they represented both new buildings as well as renovations.

Additional details about this year's award-winning projects as well as past winners can be found online at www.cbe.berkeley.edu/livablebuildings.

Project Updates

CBE Radiant Cooling Research Expands to Focus on Hybrid Solutions

The input that CBE receives from its industry partners helps to keep our research agenda focused on topics highly relevant to current design practices. A good example of this synergy is seen in the growth of our radiant cooling research. Several years ago, industry partners attending CBE's Industry Advisory Board meeting encouraged CBE staff to study design applications for radiant cooling systems, as a growing number of projects were being designed using this approach. Led by Fred Bauman, Tom Webster, Charlie Huizenga, and with a great effort by then graduate student Timothy Moore, we followed this advice, first completing a research scoping study, then a report on tools available for energy simulation of radiant systems, and also a series of detailed simulations that revealed the system's potential for creating highly energy-efficient buildings.

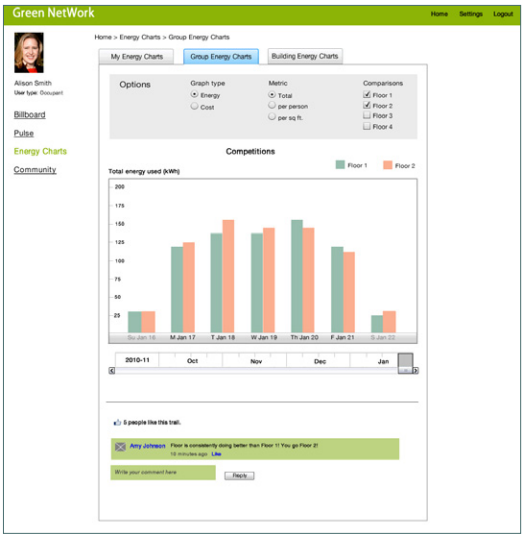
At over one-million square feet, the Bangkok Airport is the largest installation of in-slab, radiant cooling. Image: Harold Hoyer.

Since then, our research on radiant cooling has expanded and can now be described by three related research efforts: (1) simulation studies; (2) laboratory studies; and (3) field studies of advanced buildings with radiant cooling systems. Because radiant systems have less cooling capacity than conventional VAV systems, we are especially interested in approaches that combine radiant cooling with other systems, such as underfloor air distribution (UFAD), displacement ventilation (DV), and/or natural ventilation. So far, these hybrid approaches look very promising in terms of energy savings potential. We are currently conducting a detailed field study of the David Brower Center, a radiant/UFAD/natural ventilation hybrid that has achieved an Energy Star rating of 99. (See page 3 for more on this project.)

In addition, we are contributing to the development of new design resources for radiant systems. For example, we used the CBE Comfort Model to provide guidance to designers so that they can directly establish the range of floor and ceiling temperatures as a function of air temperatures, that will provide acceptable (or optimal) comfort. The results of the above-mentioned lab studies of radiant chilled ceiling/DV systems will contribute to the development of previously unavailable algorithms to predict room air stratification for these hybrid systems. These algorithms will be implemented in EnergyPlus. We are also working in collaboration with Lawrence Berkeley National Laboratory on the development of improved EnergyPlus capabilities to accurately auto-size and design radiant systems. We hope that these tools will provide system designers and operators with greater flexibility for optimizing energy performance, while improving comfort for occupants. We are collaborating with many of our industry partners in this work, including Price Industries, Integral Group, and others. An overview of our radiant cooling research, including links to publications, is on our website at: www.cbe.berkeley.edu/research/radiant_cooling.htm.

New Funding Expands CBE's Research on Occupant Feedback in Commercial Buildings

One of CBE's newest research areas is our ongoing research on the potential for using energy information and feedback to engage occupants and to improve commercial building performance. Last year we completed a research study in which we asked expert uses — architects, engineers, building operators, and others — about the tools they use, and their practices and preferences with respect to viewing energy information. An interesting finding from this study was that 90 percent of the expert users we surveyed would like a more systematic way to interact with the occupants in their buildings. This finding led to our current scope of work, the design and evaluation of a social network on the scale of a single building or campus, that would promote energy efficient behavior, and enable effective communications between occupants and managers. Our working hypothesis is that a social network integrated into the workplace environment — allowing people to track their own energy-related activities, to share this information, and to view and react to peers' activities—can take advantage of social influence to positively affect behavior. We are currently developing a prototype of such an application, which we plan to test with a number of subjects this spring. This project was recently accepted as a "work-in-progress" for the CHI 2011 conference, a recognized venue for researchers and practitioners involved in the area of computer-human interaction. We will present an update of this project, which is funded by CBE industry partners and the California Energy Commission PIER program, at our April 2011 Advisory Board meeting. Information on this research is on CBE's website at: www.cbe.berkeley.edu/research/visualizing-info.htm.

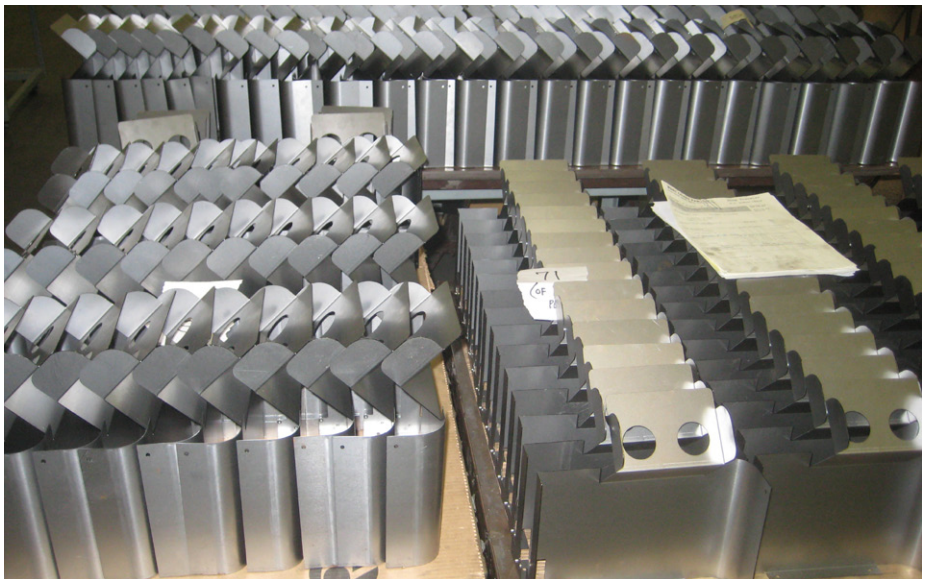


Prototype of social media application showing energy feedback page.

This summer we will start new research that will build on this work, with new funding from the California Air Resources Board. The project team will be led by John Goins, and will study the use of feedback from commercial buildings to support energy-conserving behavior at work and beyond. The project is planned as a 20-month effort in which we plan to deploy a building information and feedback system to both aid energy-efficient operations in commercial buildings while encouraging energy-efficient use by building occupants. The project will include several research tasks. First, we will identify the kinds of energy conservation-related information most likely to motivate occupants and assist operators. The second and primary task of this work is the design and prototyping of an information feedback system for application in commercial buildings. We will implement a pilot study in a small building to test the system, and then conduct our experiment in two large buildings (each with over 600 occupants) for a period of approximately five months. In our eventual analysis of the study results, we hope to quantify the degree to which the system's information feedback affects the energy-conservation beliefs and actions of the occupants, and the related energy and GHG reduction potential associated with these behaviors. This ambitious project is scheduled to begin this summer and extend through 2012, during which time we will periodically report to our industry partners.

Comfort Research Reaches Milestones and Branches in New Directions

Research conducted at CBE has shown that some of the most effective ways to make people comfortable in buildings is by providing them with individual control of their environment, and allowing them to have more air movement to keep cool and to prevent the common feeling of "stuffiness" or "stale air." This research has led to changing the standards used for HVAC and building design (ASHRAE Standard 55) to give designers more flexibility in designing low-energy efficient systems, especially in naturally ventilated buildings, and/or when using air movement for comfort during warm months. (For more background see the feature article in the winter 2010 *Centerline*, at: www.cbe.berkeley.edu/centerline/winter2010.pdf.)



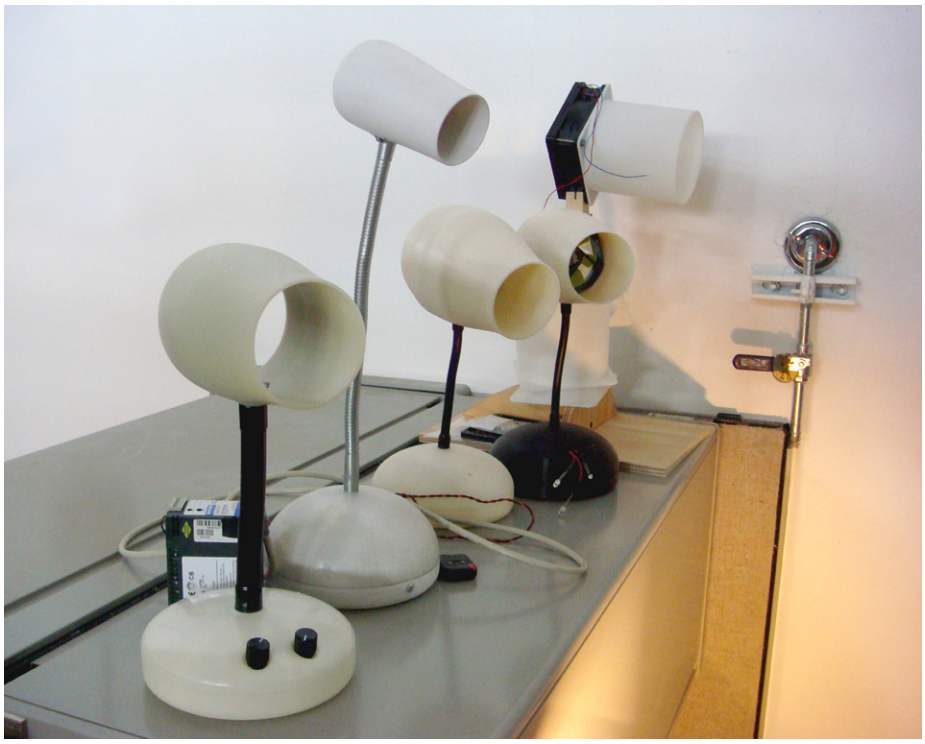
Components for foot warmer prototypes in fabrication.

Several of our projects will study these comfort concepts in more detail, using both laboratory studies, and field studies in occupied buildings, which we hope will provide new insights and understanding with respect to these concepts.

Personal environmental control prototyping

In previous laboratory studies we learned that thermal discomfort is most commonly due to cold hands and feet (in cold conditions), or a feeling of warmth or stuffiness around the head and "breathing zone" (in warm conditions). Our theory is that by providing low-energy foot warmers and desktop fans, we can both improve comfort and save overall building energy (in conjunction with an allowance for a wider range of acceptable indoor temperatures). To test this theory, we have developed prototype foot warmers and desk fans that we intend to deploy in occupied buildings. The devices are low energy users. The foot warmer uses a maximum of 160 watts and less than a quarter of that at steady state. The fan uses only three watts — and both devices have occupancy sensors to further reduce their energy use. The prototypes include Arduino-based data collection devices that will allow us to record how our test subjects use these devices at different ambient temperatures. Funding for the project has been provided by the California Energy Commission PIER program, and by the CBE industry consortium.

After months of mockups, design drawings, and sourcing materials, last December we placed fabrication orders for the main device components that will enable us to make a total of 125 sets of these "PEC" devices. The foot warmer cases were fabricated in Richmond, Calif. and delivered to our lab in February. The plastic compo-



View of some of the many design iterations of the PEC desk fan prototypes. The final design integrates occupancy sensors, and controls for the foot warmer devices.

nents for the fans are currently being injection molded in Atlanta. Our lab is filling up with the parts which we will put together in assembly-line fashion in the coming months.

For the next phase of this work, we will finalize the locations in which to deploy the devices. We intend to cover a range of buildings including those with conventional VAV systems, buildings with radiant systems, and those with natural ventilation/mixed mode approaches. CBE's industry partners at **LPA Inc.** have already expressed interest in testing the devices in their offices.

Funding approved for new integrated fan study

Our work developing PEC prototypes will be helpful in a new study to begin later this year. We received funding from the California Air Resources Board (CARB) to support the development and testing of occupant-controlled fans integrated into ceilings, office furniture, and partitions. The devices should be suitable for a range of positions, and able to produce fast-acting personal environmental control for all of the occupants.

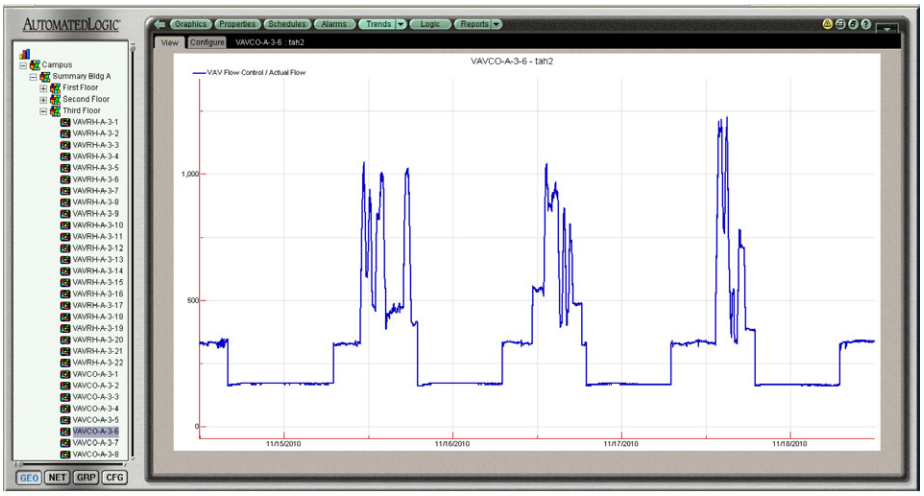
This research has several steps. First we will identify configurations for integrating fans into acoustical clouds or suspended ceilings. Our industry partners from Armstrong have shown great interest in collaborating with us on this work, and have started diagramming potential design ideas. We will mock up prototypes of these devices and install them in our environmental test chamber to measure the airflow patterns they produce. They will also be supplemented by a small number of horizontal air flow fans to fill in areas not in the airstream of the ceiling devices.

We will then conduct human subject tests to evaluate the comfort and perceived air quality effects of the devices, and conduct energy simulations to estimate their energy savings when integrated in a typical office building. From these, we intend to devise metrics characterizing the quality and quantity of comfort in rooms served by such devices. The metrics should be suitable for eventual inclusion in the ASHRAE Comfort Standard, applicable to many types of indoor airflow. Finally, we will work with CBE's industry partners to develop an initial set of design specifications for integrating fans into building components.

We will share the development of these projects, including our design iterations and preliminary findings, during our CBE member events, and we invite our consortium members to provide feedback on our direction and progress.

Recent Progress in CBE Study of Alternative VAV Operation

To meet rapidly approaching climate change goals, there is a growing appreciation of the importance of reducing energy use in both new and existing commercial buildings. One potentially low-cost method now being evaluated by CBE and its industry members is through reducing VAV box minimum airflow rates below current standard practice. As we reported in a previous version of *Centerline* (winter 2010), simulations done by **Taylor Engineering** show that reducing the minimum airflow from 30 to 20 percent can reduce total building energy use by 10 percent. We are currently collaborating with Taylor and **Price Industries** on field study research that will provide detailed information on how minimum flow reductions improve energy use in real buildings, and what impacts, if any, these changes will have on occupants.



Screen from the project's building automation system, showing the airflow rate in a typical zone. The image shows that the system operates in minimum mode frequently.

The study, currently underway at a corporate campus in San Jose, has two closely related parts: (1) an energy study funded by the California Energy Commission PIER program; and (2) an occupant comfort study funded by a research grant from the ASHRAE Technical Committee on Physiology and Human Environment. Together these projects will provide detailed information about both energy and occupant comfort implications of this promising HVAC operational strategy.

We have made some significant progress with the project over the past few months. In March, we conducted a "background" survey at the study site, and received responses from about 1200 occupants, representing approximately 30 percent of the population. During the winter test phase this past December and January, the airflow rate was "toggled" between two test conditions for periods of approximately three weeks — the standard practice minimum airflow rate of 30 percent of the maximum, and the low-flow minimum rate of around 10 percent. During this phase, permanent energy meters collected heating, cooling, and fan energy use separately. We also implemented a series of "right now" surveys asking the workplace occupants to give us instant feedback on their comfort perceptions in terms of perceived air quality, thermal comfort, and acoustics. The responses to the survey will provide a robust data set, with a total of 7500 individual responses, and about 15 percent of the building occupants participating.

We are continuing to collect energy data, and will document the energy performance for spring and summer conditions, and also do another set of occupant surveys. By the end of February, we will provide a report for our funding partners at CEC-PIER (and the California Institute of Energy and Environment) to describe the control work, the energy monitoring data, and the occupant survey results to date. For the final phase of this project, scheduled to take place in spring of 2012, we will work with CBE industry partner Price Industries to conduct a laboratory study to characterize the room air distribution performance of diffusers at low flow for a number of diffuser types and test configurations.

Occupant Survey Research Team Focuses on Outreach

Led by Research Specialist John Goins, CBE's occupant indoor environmental quality (IEQ) survey research team has been busy publishing research results and presenting at industry events. Last November, John and his frequent coauthor Mithra Moezzi, of Portland State University, gave a talk at the Behavior, Energy, and Climate Change Conference, in Sacramento, Calif. Their talk, *Turn off the AC: What Occupants Really Think about Comfort in the Buildings They Work In, and Why it Matters,* brought together recent findings about over-cooling in office buildings, with results from our occupant survey program, and posed future directions for occupant behavior research. It described how conflicting operational and business objectives can complicate the issue in addition to describing occupants' take. Most often, workers suffer through over-conditioning because they have limited temperature control or because they must attend to higher priority activities. The panel also included Brad Jacobson of **EHDD** and Judith Heerwagen of the **U.S. General Services Administration**.

On the same day, John also presented at the Healthcare Design Conference in Las Vegas, with Whitney Austin Gray, a research collaborator from the Johns Hopkins School of Public Health. (Luckily the flight from Sacramento to Las Vegas is a short one.) They presented *Data as Proof: Links between Healthcare Design Strategies and Staff Stress and Productivity*, which compared occupant study findings in office buildings and hospitals and gave an overview of various study protocols used in healthcare settings. The presentation was designed to showcase the ways the occupant survey can support causal analyses and supplement the robust evidence-based design methodology.

This "wordle" image provides a visual summary based on the frequency of keywords found in text responses in CBE's occupant survey.

John and Mithra also collaborated on research to mine the extensive data collected by CBE's survey tool, by using text analysis software to analyze occupants' responses to open-ended survey questions. Using a subset of 192 U.S. office buildings, the research provides insight on occupants' perspectives on their overall workplace and building perceptions, with a focus on temperature and acoustics findings. These occupant texts detail interactions between occupants and their physical environment, and reveal a "user-centered perspective that points to issues...such as over air-conditioning, worker stress and frustration, workplace usability, and relationships between physical and other aspects of the workplace." They also suggest new control and operational solutions that work for occupants. This paper is slated for publication as "Text mining for occupant perspectives," in *Building Research Information* this spring, and will be posted to the UC eScholarship website. For more information on CBE's survey research or email us at: cbe-survey@berkeley.edu, or visit: www.cbe.berkeley.edu/research/survey.htm.

Industry Partners and Events

New Partners Expand CBE's Consortium

We are excited to welcome two new partners who recently joined CBE's consortium. Last summer we were joined by **San Diego Gas & Electric®** (SDG&E®). SDG&E provides safe and reliable energy service to 3.4 million consumers through 1.4 million electric meters and more than 845,000 natural gas meters in San Diego and southern Orange counties. The utility is a leader in promoting energy efficiency and emerging technologies, and recently announced the development of a new Energy Innovation Center, which will be a hub for education on green technologies and energy efficiency. According to company literature, the center will be a "great forum for showing off some of the innovative products and solutions coming out of San Diego-based companies." SDG&E's primary representative to CBE is John Holmes, Senior Technology Development Advisor for the Customer Innovations RD&D group. John has been an active participant at recent CBE events, and we look forward to collaborating with him and his colleagues. With the addition of SDG&E, CBE's membership now includes three of the largest investor-owned utilities in California, along with PG&E and Southern California Edison.

Rendering of the Energy Innovation Center. Image: Arch. Hanna Gabriel Wells.

Above and below: M.E. GROUP provided a range of engineering and green design services for the Evie Garrett Dennis Campus. Photos: M.E. GROUP.

At our April conference we will also be joined by new industry partners from **M.E. GROUP**, a 75 member high performance consulting engineering firm. Their centrally based offices — Denver, Kansas City, Lincoln, Omaha, and Chicago — currently serve clients in 43 states and five countries. The group provides high performance

(continued from page 14)

building engineering, building commissioning, green building consulting, and human inquiry services. Their team includes engineers, scientists, building analysts, building envelope specialists, business analysts, and an anthropologist, who together provide clients with a holistic understanding of the built environment. Their advocacy and contribution to the green movement goes beyond their projects, as they are dedicated to educating partners and clients about the global benefits of best practices.

We first connected with people from M.E. GROUP at Greenbuild, where we discovered our shared interest in practice and research related to human factors. The firm has a division entitled "Human Inquiry," a specialty that seeks to evaluate and optimize the interaction of building performance and occupant engagement. To jump-start our collaborative relationship, M.E. GROUP has generously invited CBE to participate in its annual meeting in March, and Research Specialist Zhang Hui will give a presentation on CBE's recent human comfort research. We look forward to this event and to meeting M.E. GROUP in person at our April conference.

April Symposium: **Information Visualization in Commercial Buildings: Design, Technology, and Human Behavior**

As buildings become more energy efficient, the energy impacts of occupants make up an increasing percentage of overall energy use. In the past, many design practitioners considered these "unregulated" loads to be outside of their scope, however design teams are gradually taking responsibility for all energy uses within buildings — a tend that is reinforced by new net-zero energy goals.

Luckily many new tools are available — through energy feedback, information visualization, and occupant engagement — to positively affect energy-related behavior. How these new tools are being applied, and the underlying principals of affecting behavior change, will be the focus of a symposium that CBE is hosting this spring.

The event will be in collaboration with the **PG&E Pacific Energy Center** on Wednesday, April 13th (the day before CBE's Advisory Board plenary session). The event will take place at the Energy Center in San Francisco, and will also be webcast live.

We are excited about the speakers, which include designers, software developers, researchers, business strategists, and usability specialists. We have confirmed speakers from **IDEO, Usability.org, HOK, Lucid Design Group, Pulse Energy,** and **Lawrence Berkeley National Laboratory.** The morning session will provide several perspectives on occupant engagement and influencing behavior change, with examples of programs that have been successful in changing attitudes and behavior. The afternoon session will focus in on building-specific applications, such as new tools for energy competitions, building management, and energy benchmarking.

Kath Straub, who will discuss behavioral change in the context of energy efficiency, points out that "Nobody wakes up in the morning and thinks, 'I want to use more energy than my neighbor today.' But, inducing people to actually reduce their energy consumption still seems difficult."

Details about this event are on CBE's conference logistics web page at: http://www.cbe.berkeley.edu/membership/meeting_logistics.htm.

Registration for the event is available via the PG&E Energy Center website at the URLs listed below:

Symposium in San Francisco:
www.pge.com/pec/classes/4669.htm

Online live webcast:
www.pge.com/pec/classes/4775.htm

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