

# centerline

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

Summer 2007



## Mobile Carts for Building Commissioning

Also: New Partners,  
New Projects, and  
Research Updates

# Director's Note

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## Contact Us

Email: [cbe@berkeley.edu](mailto:cbe@berkeley.edu)  
Web: [www.cbe.berkeley.edu](http://www.cbe.berkeley.edu)

Center for the Built Environment (CBE)  
University of California, Berkeley  
390 Wurster Hall #1839  
Berkeley, CA 94720-1839  
510.642.4950 | fax 510.643.5571

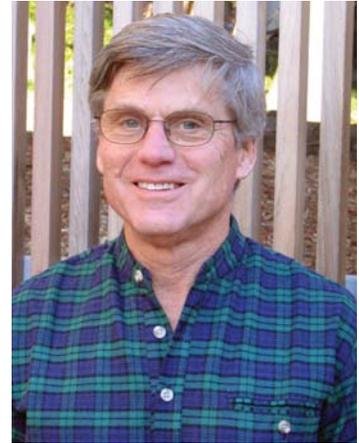
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Dear Industry Partners,

In this edition of *Centerline* we highlight several projects that exemplify our collaboration with industry. Our feature story describes how we are applying our expertise building mobile measurement carts—and incorporating new wireless capabilities—in order to develop a whole new way of commissioning high-performance buildings. We also report on an unusual new project we are doing with Arup's London office, evaluating new methods of cooling the London Underground. This project may lead to cooling approaches that can improve the daily experiences for many thousands of London commuters.

In other partner news, we are happy to report that we will have three new partners at our next meeting on October 18-19, 2007, and we greatly look forward to their participation (details on page 10). Finally, I would like to thank Evelyn Wong, CBE's Program Administrator, for her assistance managing CBE's meetings and accounts over the past year and a half. Evelyn will be taking a new position within the University, and we wish her all the best in her new work.

Sincerely,  
Edward Arens



# Delivering Buildings that Work:

## Commissioning at The New York Times

The newest addition to the New York City skyline is the unique 52-story headquarters for The New York Times Company. Designed by Renzo Piano Building Workshop, with a project team that includes CBE industry partners Flack+Kurtz and Gensler, the building incorporates numerous technological innovations. For

example, the building's glazing is shaded by thousands of externally mounted

white ceramic rods. Inside,

rolling shades with sophisticated controls predict the exact hours when sunlight will strike individual windows, taking into account all the surrounding buildings that throw shadows onto the building's facade. On 22 floors of the building, an underfloor air distribution (UFAD) system will provide a well-controlled thermal environment and enhance the workplace environment for employees.

In order to properly develop and implement these systems, the Times construction team has undertaken a comprehensive series of tests and commissioning procedures. Glenn Hughes, the Times' Managing Director of Construction, sees commissioning as an essential part of the project delivery

process. "We were committed to delivering a working building, and we are installing systems that are new for New York City, and some that have not been used on any building. For example, there are not many UFAD buildings in New York, so this building is a gigantic step forward." Glenn explains that the Times opted for the UFAD system on the floors to be occupied by the media company because of the many benefits offered by the technology. "We believe UFAD systems are more energy efficient, they provide more controlled temperatures in large floor plates, and they create a healthier environment. These three reasons add up to enhancing the way we work."

For assistance with this commissioning effort, Times staff brought in researchers at Lawrence Berkeley National Labs, and the Center for the Built Environment. Early in the design process, LBNL developed and tested the project's integrated shades and lighting controls, using a comprehensive, full-scale mockup constructed in a parking lot of the Times' printing plant in Queens. The team then used these test results to develop specifications for bid and construction documents. Because the results of these tests would

**Mobile measurement carts originally developed for field research are being adapted for building commissioning.**

# Commissioning at The New York Times

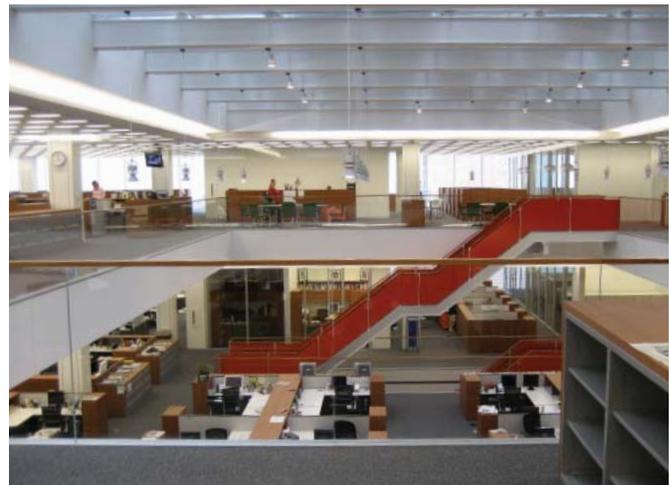
contribute new knowledge to the building industry at large, the team was able to obtain funding support from the New York State Energy Research and Development Authority, the U.S. Department of Energy, and the California Energy Commission.

Larry Dumpert, Director of Facilities Technology for the Times, explains that his group is actively involved in the commissioning process. “Our approach is very intense, we have pre-installation meetings with contractors, post-installation checklists, and global system checks. We have taken a very active role, and I don’t know of any other owner that has gone to this extent with commissioning.”

## UFAD System Commissioning

To verify that the UFAD system is operating as intended, numerous physical measurements are required during the building’s commissioning sequence. Air temperature profiles from the floor level up to the ceiling must be checked, and air temperatures throughout the underfloor supply plenums must be verified. Considering the building’s size, this adds up to literally thousands of physical measurements. To conduct the work in an efficient manner, the Times staff collaborated with CBE to develop a mobile building commissioning cart with special capabilities for the new UFAD building. CBE researchers have many years of experience with the design, fabrication, and instrumentation of mobile measurement carts, as the group has developed several of these innovative devices in the past for its field research.

Led by Research Specialists Tom Webster and Fred Bauman, and



Photos: Glenn Hughes

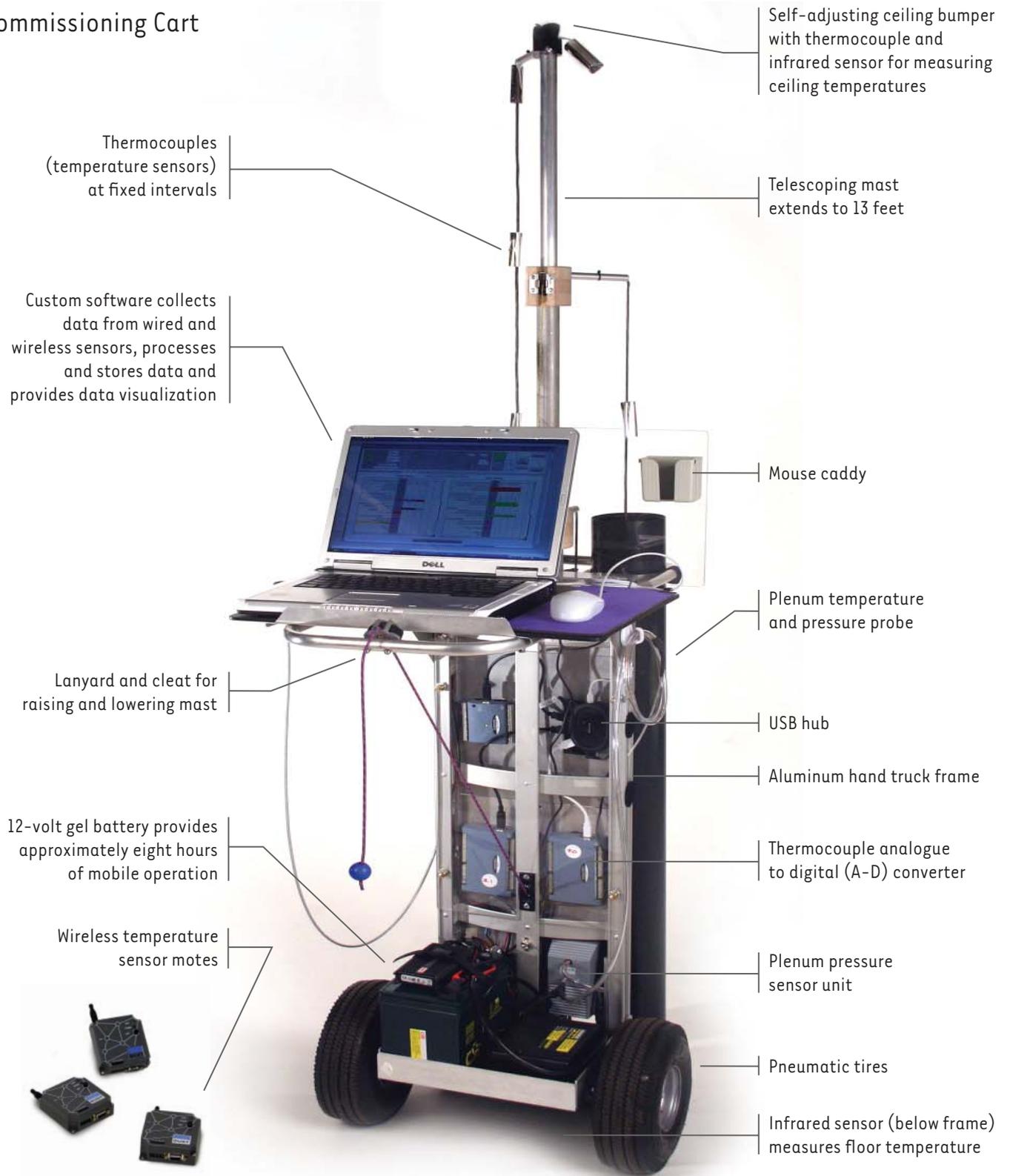
CBE Director Ed Arens, the CBE team developed the cart and its software with input from the Times project team, starting in February of 2006. The team developed a stratification profile “tree” consisting of a telescoping pole with a series of temperature sensors that extend from the floor to the ceiling. The team also included sensors for measuring the plenum air pressure, and the radiant temperature of the ceiling and floor surfaces.

As with previous measurement carts developed at CBE, the initial

Above, top: Night view of the Times’ offices before move-in.

Above: Daylighting in two-story space viewed from the fourth floor.

## CBE's Mobile Commissioning Cart



# Commissioning at The New York Times

design concept was to have all sensors mounted on the mobile cart. But new wireless sensor devices, referred to as “motes,” gave the team the ability to remotely measure temperatures throughout the underfloor supply plenum of an entire floor of the building. As Tom Webster recalls, “we told the Times that we could use motes to map the air temperatures throughout the plenum, and they loved the idea.” The system was designed with 70 wireless sensors that are placed in UFAD floor diffusers on a given floor. Temperature data from the sensors is transmitted by a mesh radio network, recorded on a laptop computer on the cart, and used with other measurements to evaluate the performance of the system. Transforming this data to usable information for the commissioning agents is made possible with sophisticated software based on LabView developed by Integrated Motions Inc.

Staff from the Times were involved in the development of the cart throughout its development. “The system was designed around the commissioning workflow, and had to allow the commissioning agent to conduct the tests in an efficient way,” notes Tom Webster. Glenn Hughes and Larry Dumpert worked closely with the CBE team, to insure that the cart would meet the needs of the project.

With the fabrication of cart complete, the system was ready for testing in November of 2006. The team conducted measurements at an office building in Sacramento, California, as a test drive of the cart’s instruments and software. After a

final round of enhancements to the software, CBE shipped the cart to New York in December of 2006.

Once the system was operational in the Times building, Larry Dumpert trained the commissioning agent, Horizon Engineering, on the operation of the cart and software.

## Future Benefits

In addition to supporting the commissioning of the Times building, researchers at CBE view this project as a great benefit to the Center’s UFAD research program. As Tom Webster explains, “most of our room air stratification data is from lab studies. This will provide us with a large body of data from an occupied building that will help us better understand how UFAD systems work in practice.” CBE’s project team also built a duplicate cart which will be available for use in CBE’s ongoing field study research.

This knowledge will also be useful in an upcoming CBE research project, the development of UFAD commissioning guidelines. “The data from the Times building is a good proving ground for our draft of the guidelines,” explains Webster.

The move-in to the building was completed at the end of June 2007, and Glenn Hughes says that the feedback from most of the occupants has been positive. “The new space is very open and airy, and the natural lighting is pleasing.” He also mentions that the commissioning process in general has been very successful. “Hiring a commissioning agent has paid off well, we were correct in assuming one would be needed,” he explains.

## Additional Information

For more information on this project please visit the following websites:

CBE’s commissioning cart webpage: <http://www.cbe.berkeley.edu/research/commissioning.htm>

LBNL’s daylighting and shade control studies: [http://windows.lbl.gov/comm\\_perf/newyorktimes.htm](http://windows.lbl.gov/comm_perf/newyorktimes.htm)

# Research News

## USGBC Pledges \$1 Million to Stimulate Growth in Green Building Research

This past June, the U.S. Green Building Council announced that it will provide seed funding to spur more investment in research in green and high-performance buildings. “Our pledge to invest \$1 million in research is a reflection of USGBC’s commitment to its vision of a sustainable built environment within a generation,” said Rick Fedrizzi, President, CEO and Founding Chair of USGBC. This announcement comes only two months after the release of a study published by the USGBC which found that research related to green building practices and technologies amounts to only 0.2% of all federally funded research, while buildings consume 40% of all energy consumed.

Gail Brager, CBE Associate Director, and Chair of the USGBC Research Committee, says that “the Committee was delighted to see how quickly the

USGBC Board went beyond our initial goals of merely identifying critical needs for funding, to commit their own money to directly support green building research. The intention is for those funds to serve as matching dollars, to leverage greater funding from other sources within the building community.”

The USGBC-published study, *Green Building Research Funding: An Assessment of Current Activity in the United States*, provides a detailed account of the surprisingly low levels of funding for energy efficiency in buildings. For example, the study shows that only 2.5% of the Department of Energy’s R&D budget is allocated for building-related studies, and only 3.2% of the EPA’s direct research grants are allocated for green building research, yet buildings create

38% of the nation’s CO<sub>2</sub> emissions. The study was produced by Mara Baum, a graduate of UC Berkeley’s Building Science program, and a recipient of USGBC’s Mark Ginsberg Sustainability Fellowship.

“We are now working on a report that will identify and prioritize critical research needs, and hope that this, along with the USGBC’s own investment in research, will be a catalyst for increasing funding commitments from other sources such as government agencies, foundations, and corporate entities,” said Brager. Details about the structure of the fund and how organizations may apply for research grants will be released by the USGBC Research Committee later in the summer.

# People

## Our work informs the building industry

Research Specialist **Charlie Huizenga** is the recipient of ASHRAE's 2007 Ralph G. Nevins Physiology and Human Environment Award. This award is given annually to a researcher under the age of 40 for significant accomplishment in the study of bio-environmental engineering and its effect on human comfort and health. His nominators accurately described Charlie as "an extremely creative and pioneering researcher."

Charlie has been one of the driving forces behind the development of CBE's Advanced Human Thermal Comfort Model (TCM) for over 15 years. Most recently, Charlie is busy integrating the model into the energy modeling software COMFEN, with support of the California Energy Commission's PIER Program. Charlie joins past Nevins Award winners from CBE, including Associate Director Gail Brager, Research Specialist Zhang Hui, and former Research Specialist, Cliff Federspiel.

The Switzer Environmental Fellowship Program has named UCB graduate student **Timothy Moore** as one of its Fellows for 2007. The Switzer Foundation provides grants

each year to graduate students in New England and California whose studies are directed toward improving environmental quality, and who demonstrate leadership in their field. Timothy will use the fellowship to continue his current research on radiant cooling systems. The initial phase of his research was summarized in CBE's Internal Report, "Radiant Cooling Research Scoping Study," released in April 2006. Timothy joins Mara Baum, another alumnus of UC Berkeley's Architecture Program, who became a Switzer Fellow in 2004.

UC Berkeley Chancellor Robert Birgeneau presented CBE Director **Edward Arens** with a Campus Sustainability Leadership Award. In his presentation of the award, Chancellor Birgeneau cited Ed's leadership in sustainable design and development. The award was given at the UC Berkeley Sustainability Summit in April 2007, an annual event to recognize sustainability efforts taking place on campus. In conjunction with the summit, Chancellor Birgeneau announced that UCB would adopt a goal of reducing its greenhouse-gas emissions to 1990 levels by 2014.



Charlie Huizenga



Timothy Moore



Ed Arens with Chancellor Robert Birgeneau and other Sustainability Award recipients

Photo: Deborah Starford

## CBE Alumni Interview

### Anna LaRue

Architectural Technical Consultant

Pacific Gas & Electric Company  
Pacific Energy Center



#### **How do you work with designers to improve the performance of their projects?**

I help building designers use the heliodon to study direct sun and shading, and the overcast sky simulator to evaluate daylighting strategies. By reducing solar heat gain and effectively daylighting a space, we can potentially reduce the amount of energy needed to cool and light the building. There are a number of architects that come in regularly, especially to study elementary schools. To comply with requirements of CHPS (Collaborative for High Performance Schools) incentives, they cannot have direct sun on the teaching wall, or on students' desks. Also, this fall I will be teaching a class at the Energy Center with Cris Benton on the fundamentals of solar geometry, shading, and solar site analysis.

#### **This is a valuable service to designers. Are you developing any new resources?**

I'm developing an online searchable glazing library, collaborating with Charlie Huizenga at CBE and Robin Mitchell at LBNL. This database will enable designers to input their design values and view products that meet their requirements. We also expect to have manufacturers update their own product data. We intend to have this completed next year.

#### **We have seen a great increase in the awareness of global warming. How is this affecting your work at the Center?**

Energy efficiency is one of the best ways to address global warming, by

using fewer resources, but there is now also a focus on being carbon neutral. For example, people are thinking about how to use concrete, how to recycle it, or add fly-ash to make it have a lower carbon footprint over its lifetime. In addition to energy points, LEED also includes Indoor Environmental Quality, things like occupant controls, and access to windows. This gives us more freedom to talk about these things.

#### **Being carbon neutral sounds more complicated than just being energy efficient.**

It's a broader issue, people are thinking about how they get to work, transportation, commuting, and even the location of projects.

#### **What resources are people using to calculate carbon emissions?**

It's a learning curve for many people. Some people are adapting life-cycle analysis tools. EHDD Architecture has actually developed a carbon calculator that they can use to look at a project and determine the carbon impacts of the steel, concrete, and other materials used.

#### **There are lots of graduates from the UC Berkeley Building Science Program at the Energy Center.**

We are all interested in different things, but it's helpful that we all share a research background that we can apply. We have a common culture, and we still hang out together. It's a useful network that continues.

# Project Updates

## Insights on our latest research

### Project: **New Arup Collaboration Will Study Subway Comfort**

Researchers at CBE may soon be helping subway riders in cities around the world to keep cool in summer. In recent years, heat from trains, equipment and people—combined with the effects of record hot temperatures—have been gradually increasing air temperatures inside major subway systems, such as those in New York, London, Hong Kong, and Beijing.

During the heat wave that affected Europe in 2006, for example, temperatures of up to 116°F (47°C) were recorded in subway tunnels in the historic London Underground. The problem became so acute that during the hot summer of 2003, London's mayor offered a prize of £100,000 for a solution to the problem. (Unfortunately the competition ended two years later without a winner being selected.)

Traditional climate control systems condition entire volumes of subway stations, resulting in high energy consumption but still not providing comfortable conditions for many occupants. To address this problem,

CBE is teaming up with staff from Arup in London and New York to investigate possible solutions. The group will use CBE's Thermal Comfort Model (TCM) to evaluate comfort under the “transient” thermal conditions commonly experienced in subways. They will use the TCM results to develop indices or standard scenarios for quantifying comfort in such conditions.

Don Guan, a project manager in Arup's New York Office, explains that the goal of this effort is to create a “new generation of the thermal comfort model tool” that will enable the design of more energy efficient and effective conditioning systems in subways. The team plans to develop design and evaluation techniques for subway station air conditioning or tempering systems, and evaluate a number of design options including a combination of radiant cooling/heating and air distribution systems. After its completion, the Arup London team plans to apply the new model on projects for London Underground.



High temperatures in major subway systems are prompting research into creative new cooling strategies.

**Project: New Installations for Wireless Lighting Control**

Facility managers at UC Berkeley are reducing lighting energy consumption in two campus libraries, with the help of wireless controls developed at CBE and commercialized by Acura Technologies. Together the projects will save a combined 90 MWh per year and will have a simple payback of less than one year.

Eighty-eight of Acura’s “LightPoint” fixture controllers were installed over a two-day period in July in UCB’s Moffitt Library, enabling over 15 kW of lighting on the 5th floor to be turned off after hours. Before the retrofit, these lights could only be controlled by circuit breakers inside

a locked closet accessible only by electricians. The retrofit allows facility managers to control the lights with a schedule they can update via a web page. It also provides a local override switch for the cleaning crew.

Later this summer, 45 controllers will be installed in the Doe Library Reference Room. In this case, high-output fluorescent lights currently burn 24 hours a day above skylights in the two-story space. During daylight hours when there is plenty of natural light entering through the skylights, the Acura system will turn off these lights, reducing lighting use by 7.5kW.



Wireless controls from Acura will control lighting in Doe Library’s main reading room.

**Project: Occupant Indoor Environmental Quality Survey**

In conjunction with HOK, PG&E, and the University of California, San Francisco (UCSF), CBE is developing a class about conducting Post Occupancy Evaluations (POEs) in high performance buildings. Through a combination of case studies and hands-on demonstrations, this half-day class will show participants how to use POEs to learn what’s working in green and high performance buildings. The class will take place on the morning of Tuesday, November 13th, 2007. For more information contact [cbe@berkeley.edu](mailto:cbe@berkeley.edu).

To encourage wider adoption of the survey, PG&E in collaboration

with CBE is offering to implement the survey at a 50% discount for California-based projects. Twenty such discounted surveys exist, and include the core survey and automated reporting that meets the intent of the LEED-NC 2.2 thermal comfort verification credit.

CBE, Stantec, and the EcoSmart Foundation will present “Learning from Our Buildings: A New Protocol for Performance Evaluation of Occupied Buildings,” at Greenbuild in November. You can find more information about this presentation at: <http://www.greenbuildexpo.org/Program/sessions.html>.



Survey team, clockwise from far left: Tamsen Drew, Wesly Hinkle, Charlie Huizenga, John Goins, Jennifer Hsiaw, and Wally Ye.

## Project: **New Grants to Study Energy Use in Mixed-Mode and UFAD Buildings**

Cooling and ventilation together accounting for approximately 27% of California commercial building electricity consumption, and 54% of peak demand. Although natural ventilation (NV) and mixed-mode (MM) strategies may reduce consumption, questions remain about the feasibility of these strategies in various climatic zones, about operational strategies, and about the limits of simulation tools to assess energy savings.

With the recent award of a \$150,000 grant from the California Energy Commission's PIER BERG program, Gail Brager will be working in

collaboration with Phil Haves and Fred Buhl of LBNL to address these questions. CBE will conduct energy simulations to quantify the energy savings potential of NV and MM strategies across California's 16 climate zones. The project will examine both new construction and retrofits, giving special attention to the combination of natural ventilation and radiant slab cooling. We will also recommend changes for Title 24 and LEED to better accommodate these systems.

In addition, CBE researchers received a second BERG research grant to conduct research on the energy efficiency of UFAD systems relative

to conventional overhead systems. This project will include energy simulation, using the new version of EnergyPlus/UFAD developed by CBE and UC San Diego. Simulations will compare the energy performance of a prototype building (very similar to the DOE large commercial office building prototype) with UFAD and overhead systems. Results from the study will also provide support for the development of improved UFAD modeling guidelines for the 2008 revisions of the California Title-24 Alternative Calculation Method (ACM) Manual.

## Project: **Revision Planned for UFAD Design Guide**

When released by ASHRAE in 2003, the *Underfloor Air Distribution (UFAD) Design Guide* provided a comprehensive overview of research knowledge and design practice pertaining to UFAD systems. At that time and continuing today, UFAD is being widely adopted in North America, with an estimated 500 UFAD projects completed. With this continued adoption, CBE researchers have come across numerous lessons learned from practitioners. In addition, CBE has completed or is nearing completion of several major research efforts since the guide was published in

2003, for example, a whole-building energy modeling program, a cooling airflow design tool, and a first cost and lifecycle cost analysis of UFAD buildings.

Considering this new body of information that has become available, and the rapid creation of new case studies, the original guide, while still containing valuable background material and design guidance, needs to be updated.

To address this need, a group of UFAD stakeholders has teamed up for the purpose of reviewing and revising the guide. The work will be a

collaborative effort among members of the newly formed ASHRAE Technical Resource Group TRG7-UFAD, chaired by Jim Woods, and vice-chaired by Dan In-Hout. The group is currently considering how to produce the new edition, whether by volunteer efforts, ASHRAE funding for a "special publication," or some combination thereof. The group will have its next meeting on August 17-18, 2007, at the Chicago O'Hare Garden Hotel.

If you are interested in being involved please email Fred Bauman at [fbauman@berkeley.edu](mailto:fbauman@berkeley.edu).

# Partner News

## New CBE partners are leaders in sustainable design



Photo: Roy Steinke Photography

PCL Centennial Learning Centre,  
**Cohos Evamy integrated design™**



Photo © Eckert & Eckert

Portland State University Northwest Center for Engineering, Science and Technology,  
**Zimmer Gunsul Frasca Architects**



Photo: Paul Stenbentz

The Carnegie Institute for Global Ecology,  
**EHDD Architecture**

We are happy to announce that three firms will be joining CBE's industry consortium in time for our October Advisory Board meeting. With this addition, CBE's membership now includes 31 member organizations, the largest number of members CBE has had to date. (When started in 1997, CBE counted only ten members in its consortium.) The three firms joining our group are experts in LEED implementation and sustainable design, and we look forward to their participation.

In June we were joined by **Cohos Evamy**, a multi-disciplinary practice with over 300 people in its three offices in Toronto, Calgary and Edmonton. Founded in 1960, the firm offers multiple services including architectural and interior design; planning; structural, mechanical, and electrical engineering. Cohos Evamy's portfolio covers numerous project types including restoration, educational, health care, research facilities, office buildings manufacturing plants, and also retail, cultural and recreational complexes.

**Zimmer Gunsul Frasca Architects** joined the CBE membership this July. ZGF is a national practice with nearly 500 professionals offering services in

architecture, planning, urban design, and interior design. The firm started in Portland, Oregon, and has grown to include offices in Los Angeles, Seattle, Washington D.C., and New York. ZGF's work includes higher education facilities, healthcare and research institutions, transit systems, office buildings, and mixed-use developments. The firm has received more than 300 local, regional, and national design awards, including the AIA Architecture Firm Award.

Beginning in October, **EHDD Architecture** will again be part of CBE's consortium. The San Francisco-based firm, which was previously a CBE member from 2002 to 2003, has expertise in museums, aquariums, libraries, labs, and academic facilities of all types. In the firm's sixty-year history, EHDD has won many honors including the AIA Firm of the Year Award, the AIA Gold Medal (conferred upon founder Joseph Esherick), and the Architectural Firm Award from the AIA California Council. One of EHDD's recent projects, the Carnegie Institute for Global Ecology, scored high marks in CBE's Occupant Survey, and was the focus of a CBE building case study.

# Industry Partners at the Center for the Built Environment

CBE's research is supported and guided by CBE's consortium of industry partners, a diverse group of leaders in the building industry. The Center's membership includes the following firms and organizations (as of Oct. 2007):

Armstrong World Industries	Skidmore, Owings & Merrill LLP
Arup*	Stantec
California Energy Commission	Steelcase
Charles M. Salter Associates	Syska Hennessy Group
Cohos Evamy	Tate Access Floors*
CPP	Taylor Team:
EHDD Architecture	Taylor Engineering
Engineered Interiors Group (EIG)	CTG Energetics
Flack + Kurtz	Guttman & Blaevoet
Gensler	Southland Industries
Haworth	Swinerton Builders
HOK	Trane
Johnson Controls*	U.S. Department of Energy*
Pacific Gas & Electric Company	U.S. General Services Administration*
Price Industries	Webcor Builders*
RTKL Associates	Zimmer Gunsul Frasca Architects

\* founding partner



## Contact Us

Email: [cbe@berkeley.edu](mailto:cbe@berkeley.edu)

Web: [www.cbe.berkeley.edu](http://www.cbe.berkeley.edu)

Center for the Built Environment (CBE)  
University of California, Berkeley  
390 Wurster Hall #1839  
Berkeley, CA 94720-1839  
510.642.4950 | fax 510.643.5571