

# INDUSTRY/UNIVERSITY COLLABORATIVE RESEARCH SOLUTIONS

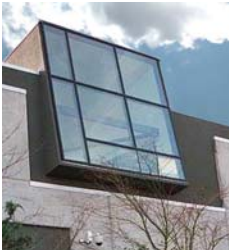
## OUR MISSION

*The Center for the Built Environment (CBE) at the University of California, Berkeley, provides timely, unbiased information on promising new building technologies and design techniques.*

*This work serves CBE's industry partners, a consortium of leading building industry firms and organizations committed to improving the performance of non-residential buildings.*



*Industry Advisory Board meetings combine research presentations, new technology demonstrations, and partner feedback.*



*CBE research projects frequently involve partner projects, staff, or resources.*



*Graduate students from architecture, engineering, computer science, and business contribute to CBE research.*

## CENTER ORGANIZATION

The Center operates under the National Science Foundation (NSF) Industry/University Cooperative Research Center Program. The Center is guided by an Industry Advisory Board that meets semi-annually to discuss research findings and directions, review and approve annual budgets, and discuss ideas for future research. This Advisory Board provides valuable feedback which helps CBE focus its research on issues of relevance and importance to the building industry today.

Advisory Board members evaluate all active CBE projects to assure that the Center is responsive to its membership. Past evaluations have been highly favorable; an independent NSF reviewer reported that the industry evaluations showed “overwhelming support for the direction of CBE’s research,” and that the Center is “especially good at responding to industry partners’ needs.”

## PRIMARY OBJECTIVES

Our research has two broad purposes. First, our research team and industry partners are developing ways to “take the pulse” of occupied buildings, asking occupants what they like and don’t like about the interior environment, and linking these responses to physical measurements of indoor environmental quality.

Secondly, we are studying new building technologies, applications, and design strategies that hold promise for making buildings more environmentally friendly, more productive workplaces, and more economical to operate.

## FACULTY, STAFF, AND RESOURCES

CBE is an interdisciplinary group comprised of UC Berkeley faculty, researchers, and staff. The core research team currently includes nine faculty and research staff members, with research affiliates and graduate students from numerous UC departments including Architecture, Building Science, Electrical Engineering, Mechanical Engineering, Business, and Computer Science.

Research facilities at CBE include a controlled environment test chamber, a full-scale underfloor air facility, a boundary-layer wind tunnel, and a sky simulator. Additional facilities include instrumented “thermal mannequins,” and an extensive set of mobile and wireless instruments for measuring the performance of buildings.

## REPORTS AND PUBLICATIONS

The Center publishes research findings in summary reports that may be made available to the building industry at large. At least 60 days prior to public release of reports, CBE distributes drafts for review to industry partners. In addition, articles and papers by CBE regularly appear in journals, trade magazines, and conference proceedings.

CBE may also distribute to partners internal reports—technical summaries produced at interim points in a project, or in lieu of a summary report. Internal reports are confidential and are intended to provide our industry partners with valuable details on research findings and methodologies.

# OUR RESEARCH PORTFOLIO

*New technologies allow today's buildings to be more efficient and responsive to occupant needs than ever before. A challenge to the building industry is to understand the opportunities offered by these new technologies, and learning how best to apply them.*

*The Center's portfolio of research projects has been developed based on industry partner needs, and represents relevant and timely topics in building science research.*

## BUILDING INFORMATION TECHNOLOGY

New information technologies provide ways to optimize the performance of building systems. We are investigating applications for sensing and control of buildings using wireless communications technology, micro-electromechanical systems (MEMS), and Web-enabled software. The cost of installing wiring for controls and sensors in buildings may represent 50%-90% of the installed cost. With wireless and MEMS technologies we can greatly reduce this cost, enable energy savings, and improve the control of the indoor environment. Building IT research areas include:

- Wireless sensing and control strategies
- Wireless lighting control systems
- Demand-response technology development
- Using tenant interface systems to improve building operations

## BUILDING HVAC SYSTEMS

Mixed mode and underfloor air distribution (UFAD) systems provide opportunities for energy savings and benefits to occupants. UFAD technology has experienced rapid adoption due to the number of potential benefits it offers over conventional ceiling-based air distribution. CBE has become the leader in UFAD research, and is conducting a number of projects including:

- Case studies of mixed-mode buildings
- Radiant cooling tools and applications
- UFAD simulations and laboratory testing
- UFAD case study research
- UFAD cost analysis tools
- UFAD model development for EnergyPlus whole-building energy simulation
- UFAD design resources development

## BUILDING ENVELOPE SYSTEMS

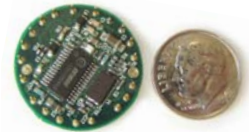
Building occupants in perimeter zones are affected by outdoor influences such as noise, temperature, and solar radiation, and by their ability to control these influences. CBE is developing tools and criteria for evaluating facade performance in terms of occupant comfort and energy efficiency. We have also conducted extensive field studies to determine how operable windows and control of building features affect occupant comfort. Research areas include:

- Evaluation methods for facades and perimeter zones
- Impacts of facades on occupant comfort
- Operable windows and thermal comfort
- Operable windows and natural ventilation case studies

## INDOOR ENVIRONMENTAL QUALITY (IEQ)

CBE has developed methods to measure the performance of occupied buildings in terms of occupant comfort and productivity, energy efficiency, and operations. For example, CBE's Web-based Occupant IEQ Survey quantifies how a building is performing from the perspective of its occupants. This provides immediate feedback for building owners and operators, and assists architects, engineers and builders in the development of future buildings. Project areas include:

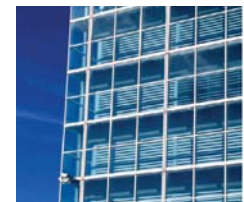
- UCB advanced thermal comfort model
- Occupant IEQ survey and building benchmarking database
- Occupant satisfaction in green buildings
- Team space and collaboration
- Ventilation and productivity field study
- Speech privacy in the workplace



*CBE utilizes new wireless and MEMS technologies to improve sensing and control in buildings.*



*CBE's full-scale test facility is utilized for advanced research on underfloor air distribution technology.*



*CBE is developing methods for evaluating facade and perimeter zone performance.*



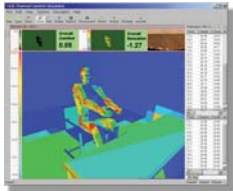
*CBE's Occupant IEQ Survey evaluates building performance and facilitates benchmarking comparisons between buildings.*

## OUR INDUSTRY PARTNERS

*CBE's partners are leading organizations across the spectrum of the building industry, including design firms, manufacturers, builders, and governmental organizations. Member involvement frequently goes beyond participation in regular meetings, and many CBE projects directly involve member representatives, buildings, and resources.*



*CBE's Industry Partners represent a broad cross section of building industry leaders.*



*Membership in CBE's consortium provides multiple benefits such as access to design tools including the UC Berkeley Thermal Comfort Model.*



*CBE Industry Partners receive recognition on all CBE publications, publicity materials, and web sites.*

### BENEFITS OF MEMBERSHIP

CBE welcomes firms and organizations to become involved through membership in its industry consortium. The consortium is a rare opportunity for partners to identify information needs and to advance research in directions that maximize benefits to their organizations, while avoiding the high costs of in-house research.

Partner benefits include:

- Participation in semi-annual Industry Advisory Board meetings (up to 7 individuals per firm).
- Quarterly updates on all active CBE projects, and presentations on related research.
- Advance review of research findings and summary reports.
- Free implementations (4 per year) of CBE's Occupant IEQ Survey, with access to CBE's building benchmarking database.
- Priority access to specialized research tools, facilities, and staff.
- Acknowledgement in CBE reports, web sites, and publicity materials.

Affiliation with UC Berkeley and the National Science Foundation give's CBE's research a high level of credibility within the industry. Industry partners benefit from this research, by using empirical results to influence clients and regulators, and also through recognition of their commitment to promoting sustainability and improving our built environment.



### CBE'S INDUSTRY PARTNERS

Our partners include: (as of October 2008):

Armstrong World Industries  
Arup\*  
California Energy Commission  
Charles M. Salter Associates  
Coherent Structures  
Cohos Evamy  
EHDD Architecture  
Engineered Interiors Group  
Environmental Systems Design  
Glumac  
Haworth  
HOK  
Johnson Controls\*  
KlingStubbins  
Larson Binkley  
Pacific Gas & Electric Company  
Price Industries  
RTKL Associates  
Rumsey Team: Rumsey Engineers, CPP,  
Mahlum Architects, Mithun  
Skidmore Owings and Merrill  
Stantec  
Steelcase  
Syska Hennessy Group  
Tate Access Floors\*  
Taylor Team: Taylor Engineering,  
CTG Energetics, Guttman & Blaevot,  
Southland Industries, Swinerton Builders  
Trane  
Uponor  
U.S. Department of Energy (DOE)\*  
U.S. General Services Administration (GSA)\*  
Webcor Builders\*  
WSP Flack + Kurtz  
Zimmer Gunsul Frasca Architects  
*\*founding members*

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