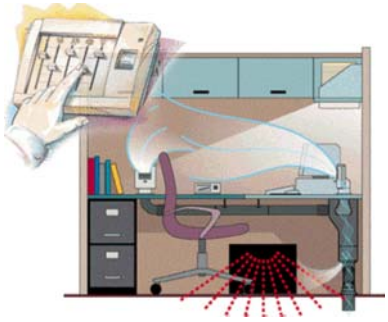
Center for Building Performance and Diagnostics (CBPD)

Carnegie Mellon University
Dr. Volker Hartkopf, Director
Phone: 412-268-2350
E-mail: hartkopf@cmu.edu

Building operations (heating, cooling, lighting, and ventilation) consume almost 40% of the U.S. primary energy, and 67% of electricity. The Center for Building Performance and Diagnostics (CBP&D) is dedicated to research, develop, design, engineer, demonstrate, and test, as well as apply systems, components, and materials and their integration to create built environments which simultaneously increase: occupant comfort and productivity, organizational flexibility and effectiveness technological adaptability, as well as energy and environmental effectiveness; thereby creating a pathway towards sustainability in the built environment. The built environment is a key factor for human health. For instance, materials, component and systems choices, as well as building operations, can lead to sick building syndrome (SBS) and building related illness (BRI). The EPA estimates the annual cost to the U.S. economy to be in excess of $60 billion. In contrast, best practices can significantly enhance human health and result in increased productivity through reduced absenteeism and health costs as well as enhanced motivation, compared to standard practices. The CBPD has established the technical and economic feasibility, as well as environmental and social desirability to create win-win solutions that prove false the widely held belief that the higher the non-renewable energy consumption, the higher the quality of life. For the built environment, the opposite is largely true.

The Robert L. Preger Intelligent Workplace (IW)



Since December 1997, the IW, designed and engineered by the Center, in close cooperation with architects and engineers and the Advanced Buildings Systems Integration Consortium, functions as a living (frequently adapted and updated to incorporate new materials, components, and systems) and lived-in (occupied by Center faculty, staff, and students) laboratory. The integration of innovative systems (envelope, lighting, HVAC, structure and interior) demonstrates the advantages of and opportunities for integrating daylighting with artificial lighting, natural with artificial ventilation, passive and active heating and cooling strategies. These integrations resulted in high levels of energy conservation. The IW pioneered the concept of integrated horizontal load bearing structure, HVAC ducting, cabling (power, controls, communication) and excess floor technologies for floor-based infrastructures. This resulted in unprecedented levels of user accessibility, organizational flexibility, and technological adaptability, while eliminating the concept of obsolescence and material waste. The research, development, and demonstration work has resulted in numerous applications of technologies and concepts pioneered in the IW. For instance, floor based infrastructures, and flexible interiors introduced into the Owens Corning Headquarters project, Toledo, Ohio, resulted in 500 to 600 thousand dollars per year in savings in worker relocation costs within the building. The Beijing energy Efficient Office Building of the Ministry of Science and Technology, China, has a 60 percent reduced peak cooling load due to the design and engineering involvement of the Center. For more information, contact Dr. Ing. Volker Hartkopf; e-mail: hartkopf@cmu.edu.

Personal Environmental Module

The work of the Center has established the importance of personal control in reaching highest levels of occupant satisfaction in thermal, visual, acoustic, air quality, and spatial ergonomic quality. The research and evaluations establish and document effect that users with personal control, for instance in thermal quality, express satisfaction far beyond the 50 to 60 percent reached by standard practices and technology. Satisfaction rates reaching up to 95 percent can be achieved. An example of a breakthrough product developed by Johnson Controls in close cooperation with the Center, is the Personal Environmental Module (PEM) which allows users to control at their workspace air speed, and direction, air and radiant temperature, as well as task lighting and background noise levels. Thousands of PEMs have been installed in major building projects.
For more information, contact Dr. Ing. Volker Hartkopf; e-mail: hartkopf@cmu.edu.

Building Investment Decision Support Tool BIDS

A key reason for lower standard building performance is the absence of convincing economic arguments for enhanced performance. First-cost and past practices rule. The web-based interactive Building Investment Decision Support Tool, supports sound economic decision making, by providing life-cycle and return on investment based frameworks which take into account energy conservation, productivity, human health, and organizational effectiveness results of best practices. The team led by Professor Vivian Loftness, in close cooperation with researchers in industry and government has examined over 8,000 articles and distilled over 150 datasets which are now incorporated in the BIDS tool. The tool is aimed at highest-level decision-makers and resulted in providing the economic justifications for enhanced design and engineering practices, as well as advanced system choices in a number of governmental projects. Currently, a large user group, consisting of utilities, local governments, building owners, developers, architects, and engineers is examining the usefulness of this tool in their own ongoing operations. For more information, contact Dr. Ing. Volker Hartkopf; e-mail: hartkopf@cmu.edu.