FLEXLAB

FACILITY FOR LOW ENERGY EXPERIMENTS IN BUILDINGS

FLEXLAB: Lighting and Plug Loads Testbed

The lighting and plug loads testbed has the most densely instrumented and controllable office space anywhere in the United States.

- 4,000 square foot floor area
- 17 interior office cubicles
- Ten perimeter offices
- Capability for two zones for comparative study
- Easily replaceable plug-in lighting fixtures
- All lighting and plug outlets individually circuited, metered, and programmable
- 25 photosensors for lighting measurement
- Lighting occupancy sensing by fixture or zone
- Individual workstation occupancy sensing
- Infrastructure to support additional sensing and instrumentation
- Robust, secure data acquisition and data storage

Lawrence Berkeley National Laboratory (Berkeley Lab) and its research partners are using the testbed to develop, demonstrate and validate the performance of advanced lighting systems and the control of miscellaneous end use loads (plug loads). Berkeley Lab invites inquiries from the private sector and other research institutions about conducting cooperative testing in this facility.

CAPABILITIES

The lighting and plug loads testbed is a densely instrumented living laboratory that can be used to test real-life situations, allowing for a wide variety of control strategies ranging from fully automated control, to manual control by occupants.

Users can monitor every change in the power use and lighting conditions of the testbed continuously and in real-time. Every duplex power outlet is individually monitored and can be turned on or off by occupants, or can be programmed for other controls such as by occupancy. As an example, LED task lights can be installed and controlled based on occupancy.

Each light fixture in the testbed is individually circuited, metered, and controlled. Users can control the lights in the four rows of overhead fixtures in eight-foot segments as well as measure the input power along each eight-foot segment. Each fixture is capable of on/off and daylight dimming control.

Twenty-five ceiling-mounted photosensors measure the illumination distribution throughout the study space. Additional photocells can be installed at the tops of partitions separating the cubicles as well as at the desk surface as required to adequately sample the daylight conditions as these vary across the day.

The power metering system provided allows for very high accuracy measurements—2% for loads greater than 25W, and 0.5W for most loads less than 25W—a capability more stringent than typical commercial power meters.

CONTROLS SOFTWARE CAPABILITIES

A unique feature of the testbed is that all automated control is programmable using a customized platform developed based on National Instruments Labview software. This platform, and its data acquisition hardware, allow for a wide variety of new devices and communication protocols to be installed and controlled—including BACNET, MODBUS and 0-10V controls among others.

The sensor and controls data is logged continuously, stored in a secure database created for each experimental use, with software to allow for data visualization and management.

Users of the facility can test different control algorithms for dimming electric lighting up or down to balance the daylight in the space as well as controlling automated fenestration systems. Similarly, different controls strategies can be employed for plug loads in the office space. Considerable flexibility can be built into the algorithm to allow for individual control.

This arrangement lets teams of researchers study how individual decisions are made about light levels and equipment energy use, and what sensory input went into the decision-making process. These observations will lead to better algorithms for controlling system-wide energy use.

POTENTIAL USES

- Study the performance of new lighting controls and plug load technologies involving lighting fixtures, power supplies, plug strips, and software technologies for shedding load
- Test several different technologies at the same time, and develop control strategies to maximize the energy savings and maintain comfortable conditions within the space
- Develop tools for occupants to influence behavior around plug load and lighting energy use
- Compare two different technologies for energy performance, or visual comfort
- Study how design intent behind use of technologies matches up to their actual performance, and work out the control strategies that allow building operators to get maximum performance.

Berkeley Lab invites interested partners to contact FLEXLAB staff for more information about how to perform research with us in the new facility and demonstrate new technologies and systems that will help achieve aggressive new performance goals for America's building stock.

Partnering opportunities: Flexlab.info@lbl.gov

Facility for Low Energy eXperiments in Buildings (FLEXLAB) website.