FLEXLAB®

SUCCESSFUL INTEGRATION OF AUTOMATED SHADING PRODUCTS AND LED LIGHTING SYSTEMS WITH LUMINAIRE-LEVEL NETWORKED SENSORS AND CONTROLS

This California Energy Commission project confirmed substantial energy savings using Integrated Technologies for Energy-efficient Retrofits (INTER).

THE CHALLENGE

Promote wider adoption of an integrated set of emerging commercial building retrofit technologies

Buildings in the United States use 71% of the nation's electricity and emit 40 percent of the nation's greenhouse gases (GHGs), and much of that electricity is consumed by building lighting and heating, ventilation, and air conditioning (HVAC). For California to ensure reliable electricity delivery and meet its GHG emissions reduction goals, this demand must be reduced. Innovative daylighting and shading systems help, but before investing in these technologies building owners must be confident of their energy, economic, and comfort benefits.

THE SOLUTION

In this California Energy Commission EPIC funded project, the New Buildings Institute, Lawrence Berkeley National Laboratory (Berkeley Lab), and TRC Companies, Inc. — a global consulting, engineering and construction management firm — turned to the U.S. Department of Energy's FLEXLAB® facility to (1) evaluate the energy performance of the INTER shading and daylighting control system and (2) evaluate the system's visual and thermal comfort performance.

> **"The FLEXLAB® study provided us the energy and operational characteristics we needed to refine the scope for the field study phase. The FLEXLAB results unexpectedly became an even greater value due to the M&V changes at the field installations following occupancy reductions since COVID-19. Having these reliable dynamic measurements will help us make the case for retrofits with these technologies."**
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> **Cathy Higgins, NBI, Research Director/PI**

THE BOTTOM LINE

The INTER system increased both energy savings and cost savings

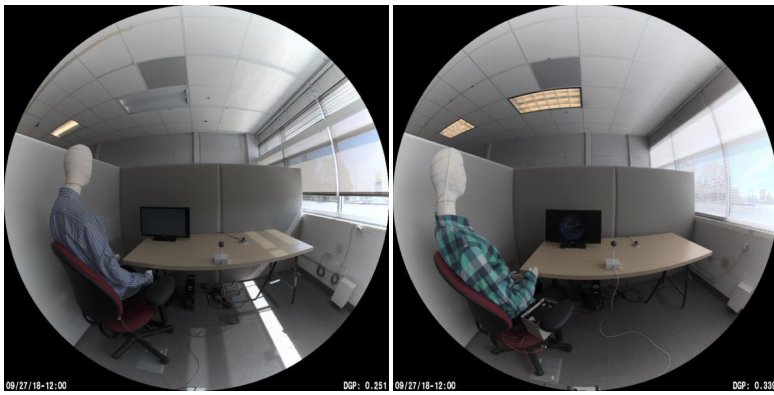
With the retrofit to the INTER system of automated shading products and light-emitting diode (LED) dimmable lighting with luminaire-level daylight controls, lighting energy savings increased substantially. HVAC load decreased for all configurations when in cooling mode, and provided additional energy savings beyond the lighting in summer and fall seasons. Some HVAC load penalty (negative savings) was observed in heating mode. No meaningful difference was measured for thermal comfort near the window wall for most cases.

THE EXPERIMENT

- Researchers used the FLEXLAB® facility to test the technologies over three seasons against two baseline scenarios: (1) an existing building baseline with manually operated venetian blinds and fluorescent lighting with no daylight-based dimming, and (2) a California Title 24 code-compliant baseline with manually operated venetian blinds and lower-wattage fluorescent lighting with zonal daylight-based dimming. The test case and the baseline cases were tested at the same time under identical conditions using two cells of the FLEXLAB testbed.
- The project consisted of four main tests. For each test, both the test case and baseline test chambers had the same HVAC, interior partition, orientation, and plug loads. However, the lighting, shading, and façades differed between the test cells.
- Each desk had emulated thermal loads typical of an actual office, including plug loads from a desktop computer and monitor, and a heat-generating mannequin with the thermal load profile of an actual occupant.
- Sensors on each desk measured work area light levels, and illuminance sensors in the halls measured the surrounding work area. Wall-mounted temperature sensors measured air temperature and mean radiant temperature sensors monitored thermal comfort near the window wall.
- In each cell, two cameras with glare sensing software and processors monitored glare conditions to assess visual comfort. Images were analyzed automatically.

THE RESULTS

- The self-powered INTER shading system functioned as intended through the test.
- The shading system Wi-Fi hub was successfully programmed to discover and control the blinds and shade motors using a smartphone application. Automated changes in shade height were possible through a scheduling feature.
- The ability of the reflective louvers to direct sunlight onto the ceiling deep into the test cell was confirmed visually and through photographs for different tilt angles.
- For the existing baseline case, lighting savings ranged from 62% in winter to 76% in summer.
- For the Title 24 baseline, the lighting energy savings ranged from 49% in winter to 62% in summer.
- All configurations reduced HVAC load in cooling mode. Most of the HVAC load difference was due to lower-wattage electric lighting in the retrofit case.
- The mean radiant temperature near the window wall was essentially the same for both the baseline and retrofit cases, the illuminance design criterion was met, and glare was adequately controlled.



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