

### About the Project

IMEG, a national engineering and design consulting firm, put innovation to the test when designing their new Chicago office. In collaboration with Pacific Northwest National Laboratory (PNNL), IMEG implemented several emerging lighting techniques as part of a study to better understand the physiological and psychological impacts on occupant comfort, well-being, and energy savings.

### Project Goals

- ▶ **Implement emerging lighting techniques and technologies** with the goal of studying the outcomes to create a body of evidence-based research available to share with the design community.
- ▶ **Study the impacts of lighting for circadian support.** IMEG is collaborating with PNNL to understand the physiological and psychological impacts of these cutting-edge design concepts and integrated strategies.
- ▶ **Support occupant wellness.** For IMEG, creating a welcoming and holistic workplace for their employees and visitors was a top priority. Their goal was to create an environment in harmony with the body's circadian rhythm.
- ▶ **Design for efficiency.** Daylight harvesting and dimming protocols allow a greater balance between occupant needs and energy use.

### Lighting and Integration Strategies

The team examined several advanced lighting strategies and implemented the following:

- ▶ **Tunable lighting for circadian support.** IMEG selected luminaires with minimal glare and tunable color temperature between 3000-4000 K. The IMEG team relied on scientific research to develop a daily schedule with targets for Equivalent Melanopic Lux, a measure of the non-visual effects of light on humans. Beyond following the sun, a scheduled early afternoon Equivalent Melanopic Lux boost is being assessed to support future evidence-based design to see whether it mitigates the post-lunch slump.



In collaboration with PNNL, IMEG implemented several emerging lighting techniques in their new Chicago office. © 2021 Andrew Bruah Photographer

### PROJECT QUICK FACTS

- ▶ **Size:** 16,500 sq. ft.
- ▶ **Occupancy:** 42
- ▶ **Year Completed:** 2020
- ▶ IMEG partnered with architectural firm Perkins Eastman on the design for their new office.

### KEY STRATEGIES AND OUTCOMES

- ▶ IMEG employed the following **advanced lighting strategies**:
  - ▶ Tunable lighting for circadian support
  - ▶ Creating a biophilic fractal experience
  - ▶ Combining DALI Type 8 drivers with wireless sensors
  - ▶ Integrated acoustic lighting
- ▶ Advanced lighting and integration strategies led to several **positive outcomes** for IMEG:
  - ▶ Improved energy efficiency
    - Design resulted in a lighting power density (LPD) 37 percent below International Energy Conservation Code (IECC) 2018
    - The fractal layout resulted in five percent less LPD than a comparable symmetric layout
    - Reduced everyday energy use
  - ▶ Improved user experience
  - ▶ Visual comfort

► **Creating a biophilic fractal experience through lighting.** To optimize occupant satisfaction, IMEG took their cues from nature. Softer biophilic design elements and rich accents were used in the reception area to balance the steely structure of an engineering firm. The layout of the office space was also carefully considered to evoke a fractal experience that is not only less straining for the eyes, and therefore more comfortable, but also more energy efficient. In fact, the fractal layout was found to have five percent less LPD than a comparable symmetric layout with similar illuminance targets.

► **Combining DALI Type 8 drivers and wireless sensors.** To save energy and create balanced illumination throughout the building, DALI Type 8 drivers were programmed to optimize the output of each luminaire section. Wireless occupancy sensors zoned with a small footprint were employed to meet the IECC zoning requirements and to make sure staff were comfortable and safe working after hours.

► **Integrated acoustic lighting.** In the break room and other designated meeting places, IMEG installed suspended acoustic luminaires to create visual softness and reduce ambient noise.

## Outcomes

As part of PNNL's study, the design team monitored the outcomes of this design and gathered input from occupants who benefit from the ease of controls, energy reduction, and increased security.

Additional benefits include:



Integrated acoustic lighting at IMEG breakroom.  
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- **Energy efficiency.** Design resulted in an LPD 37 percent below IECC 2018. Less efficacious tunable luminaires in the open office were offset with a diligent selection of the balance of luminaires.
- **Improved user experience.** Thoughtful programming and attention to user interfaces led to more intuitive office-wide touch screen control stations that give employees the ability to override lighting scenes and sequences when needed.
- **Visual comfort.** A fractal layout in coordination with micro-optics and glare control of the luminaires greatly improved occupant comfort.

## IMEG Recommendations

IMEG shares the following advice for building owners and lighting designers taking on similar projects:

- **Review product samples in person.** Consider reviewing the optical qualities and see the luminaires in person before specifying or purchasing. A Lambertian distribution may not be as comfortable to work under as one with more advanced optics. Evaluate lighting control stations for ease of use and functionality. IMEG recommends dimming controls with separate raise/lower buttons or sliders. These are generally more intuitive than those with press-and-hold dimming buttons.
- **Coordinate occupancy zones with furniture layout.** This makes sure that zones aren't partially in and out of workstations. To achieve alignment, consider overlaying the lighting plan with the furniture layout when determining zones.
- **Attend to the details to satisfy different illumination needs.** Staff who primarily work on computers often desire much less illumination than those who do paper-based tasks. A DALI protocol allows for tighter optimization and balanced illuminance levels while further reducing energy use. As an alternative, if the layout is symmetrical, IMEG recommends lowering overall illumination and using task lights for staff with higher illumination needs. However, this may not result in the enhanced balance that an individually addressable control protocol could provide.
- **Provide training in multiple formats.** Even with a highly technical staff, the control system was complex enough that IMEG established a multifaceted educational approach to support the cross-generational staff. To ensure success and adoption,

IMEG recommends creating material to suit a wide variety of learning styles and preferences, from written content to short video tutorials.

- ▶ **Carefully consider tunable technology as it pairs with static white.** IMEG noticed the diminished color quality of two-channel tunable white light is more apparent when it's near static white luminaires. There are a variety of ways this could be mitigated, both architecturally and with a variety of newer variations on tunable technology, depending on budget and architectural layout. IMEG recommends carefully evaluating technology and placement prior to implementing tunable lighting near a static system.
- ▶ **Pay attention to perception.** IMEG finds that luminaires with at least partial vertical illuminance or glow are perceived as "brighter" and the space is viewed as being as safer at night and when it is unoccupied and the lighting is dimmed down to 20 percent, following IECC 2018. When considering zoned partial-off occupancy sensors in office applications, IMEG recommends surveying how spaces are perceived at night and selecting luminaires with vertical lensing or glow.
- ▶ **Design office spaces to function as videoconferencing spaces in the post-Covid era.** To manage this, the lighting and controls need to be appropriate. IMEG suggests providing approximately three times as much vertical illumination on the face in comparison to the wall behind the participant. Additionally, providing zone-based controls in lieu of scene-based controls is critical to achieving this. IMEG also recommends:
  - ▶ Talking with owners to see how they will use the space and adjusting the lighting and controls accordingly.

- ▶ Reviewing the orientation of windows to furniture, as well as shading. Optimally, staff will face the windows for both views and light on the face and will be provided with shading to mitigate glare.
- ▶ **Be aware that software for complex controls systems can be challenging and may not always be intuitive.** Additionally, owners will learn over the course of six months to a year what really works for them and may find that there are areas where they wish to change illuminance levels, auto off delay times, or more holistic scheduling changes.
  - ▶ IMEG recommends including check-ins at six month or a year in requests for proposals. Design teams should also include it in their contract documents for the lighting controls technicians.

## About the ILC

The Integrated Lighting Campaign (ILC) is a program designed to help facility owners and managers take advantage of savings opportunities and benefits of advanced lighting controls and of integrating lighting systems with other building or business systems in their facilities. ILC serves as a resource for relevant research regarding new advanced lighting controls and integrated lighting systems and provides a platform to recognize exemplary projects shared by ILC participants and supporters.



## For More Information

- ▶ On the ILC and how to join, visit: <https://integratedlightingcampaign.energy.gov/>
- ▶ To learn about Better Buildings Technology Campaigns visit: <https://betterbuildingsolutioncenter.energy.gov/alliance/tech-campaigns>

## ILC Organizing Partners

This effort is a collaboration between the DesignLights Consortium® (DLC), Illuminating Engineering Society (IES), the International Facility Management Association (IFMA), interNational Association of Lighting Management Companies (NALMCO), the Lighting Controls Association (LCA), U.S. General Services Administration (GSA), and the U.S. Department of Energy.

