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Designers Lighting Forum

Game On: Lighting Your Way to an Energy Code Win!

Coach Julie Donovan LEED-AP BD+C
Senior Associate, HLB Lighting

Coach Michael Jouaneh LEED-AP, WELL Faculty
Manager of Sustainability & Energy Standards, LUTRON

Coach Harold Jepsen P.E. WELL-AP
VP Standards & Industry Relations, Legrand

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Learning Objectives

At the end of this course, participants will be able to:

1. Learn key energy code lighting requirements to keep your projects designed for energy efficiency and compliance.
2. Gain understanding of what's new or coming soon in lighting and control energy code requirements to prepare your future project designs for success.
3. Acquire best practices you can apply to document your projects for success in construction, operation, efficiency, and compliance.
4. Use learnings from real-world code compliant project applications that you can use on your project designs.

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Game plan – Let's go!

Starting line up and coach's pep talk – Coach Jouaneh (MJ)

- Why care about energy codes?
- Why focus on lighting?

Training camp – MJ

- What are the latest requirements for lighting and controls?
- What's coming soon?

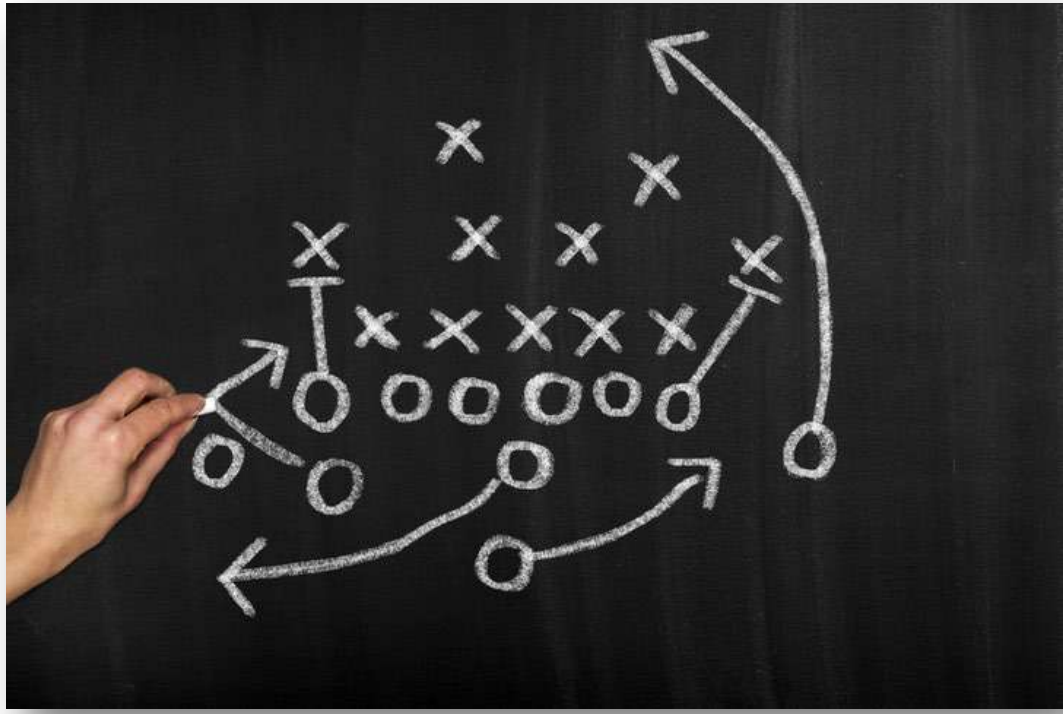
Half-time show!

Strategy sessions – Coach Jepsen and Coach Donovan

- Achieving victory – strategy for success – Coach Jepsen
- Highlight reels – Coach Donovan

Post-game analysis and fan engagement

- Key takeaways
- Questions/Answers



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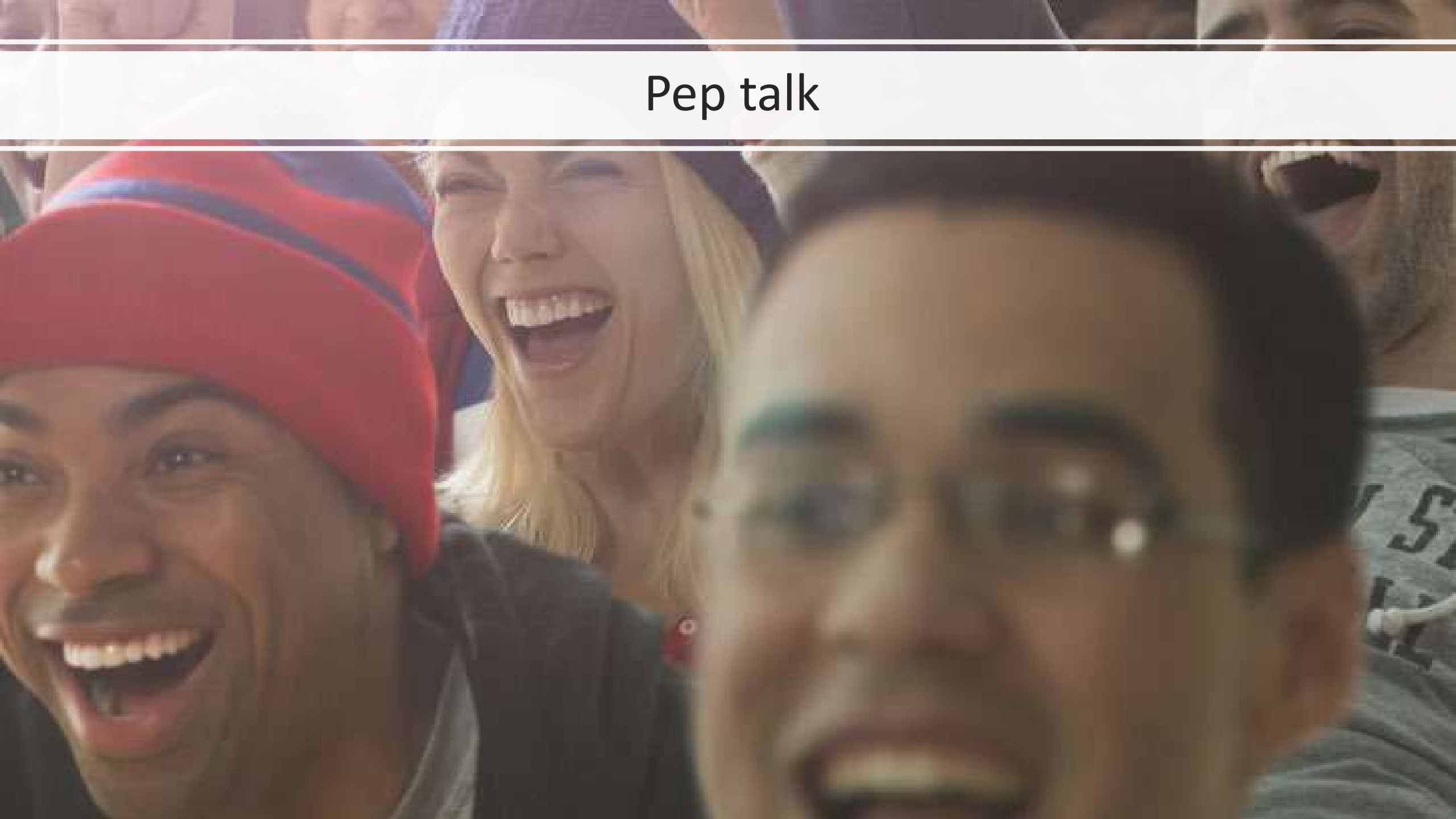
Pep talk



Why focus on building energy codes?

1. Energy efficiency
2. Cost savings
3. Environmental impact
4. Resilience and adaptation
5. Regulatory compliance
6. Promoting innovation
7. Global initiatives

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Impact of building energy codes

- According to the DOE, energy codes for residential and commercial buildings are projected to save (cumulative 2010-2040):
  - $182 billion energy cost savings
  - 840 MMT of avoided CO2 emissions
  - 16.1 quads of primary energy
- These savings equate to the annual emissions of:
  - 187 million passenger vehicles
  - 225 coal power plants
  - 106 million homes

Source: https://www.energycodes.gov/impact-analysis

Why focus on lighting?

If LEDs are super energy efficient, why continue to focus on lighting?

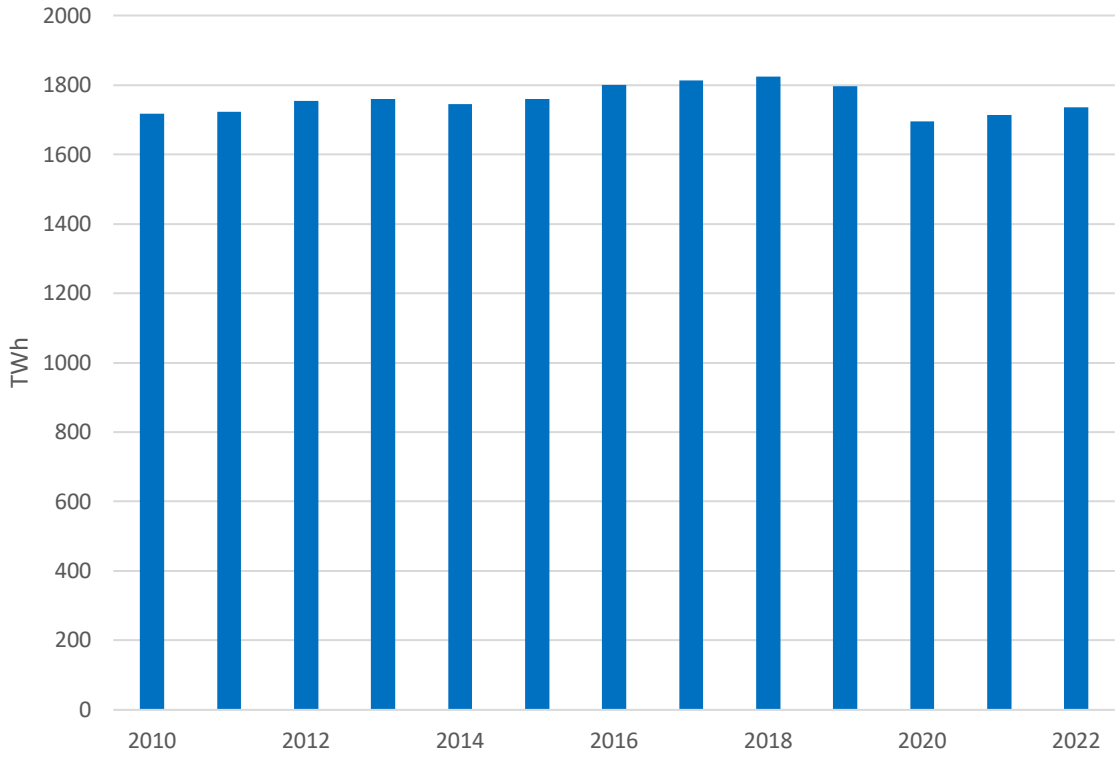
Because here come the lumens!*

Improved lighting energy efficiency coupled with decreasing costs of lighting will increase their use over time, so as seen historically, net energy use for lighting is expected to increase over the long term, not decrease.

*Source: Professor Lucas Davis from U. of C. Berkeley. Energy Institute Blog, March 27, 2023. https://energyathaas.wordpress.com/2023/03/27/here-come-the-lumens/comment-page-2/

Global electricity consumption in lighting

"Despite continued improvements in the efficacy of lighting, increasing use of lighting drove up total energy consumption in 2022, particularly in large emerging economies."



*Source: IEA, Global electricity consumption in lighting in the Net Zero Scenario, 2010-2030, IEA, Paris https://www.iea.org/data-and-statistics/charts/global-electricity-consumption-in-lighting-in-the-net-zero-scenario-2010-2030, IEA. License: CC BY 4.0

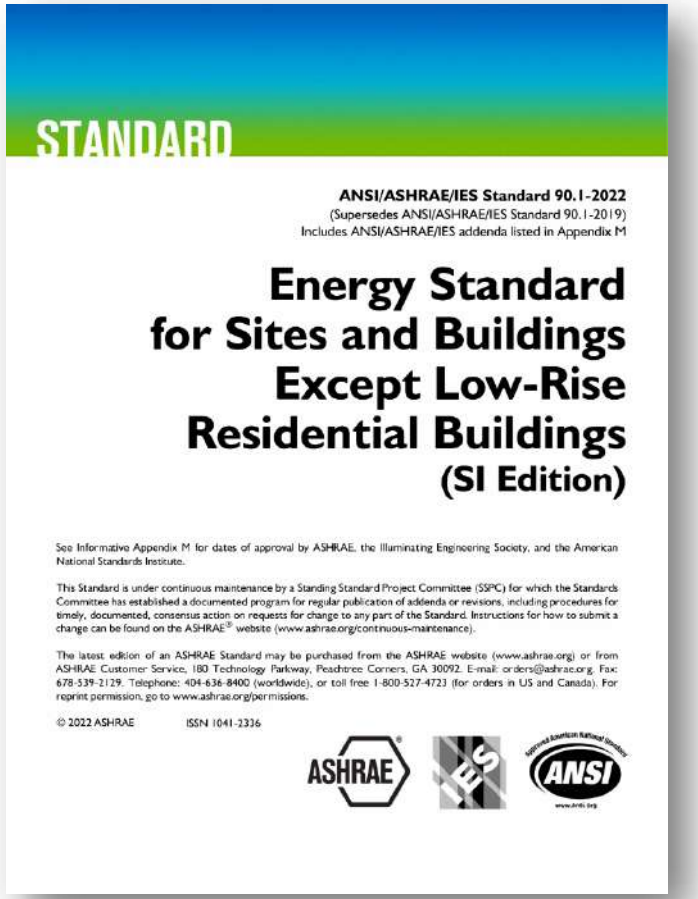
Training camp

Disclaimer

This presentation provides an overview of lighting requirements for commercial buildings and is intended for informational purposes only. It should not serve as a substitute for your state or local jurisdiction's official energy code. Please consult your local building energy code or Authority Having Jurisdiction (AHJ) for accurate and specific requirements. Code compliance can only be assured by the AHJ.

ASHRAE 90.1

- Jointly sponsored by ASHRAE and IES
- 90.1-2022 is the current version
- New construction, additions, and alterations
- For commercial buildings and residential structures 4 or more stories
- National reference standard for commercial buildings and energy baseline for all LEED projects
- Interior and exterior lighting and lighting control requirements
- Includes simplified lighting compliance path for smaller buildings



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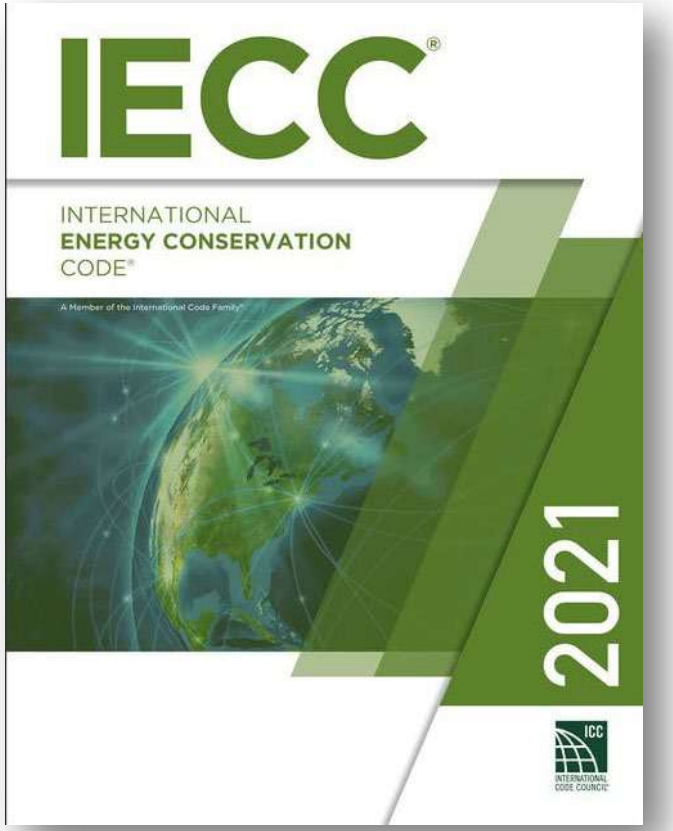
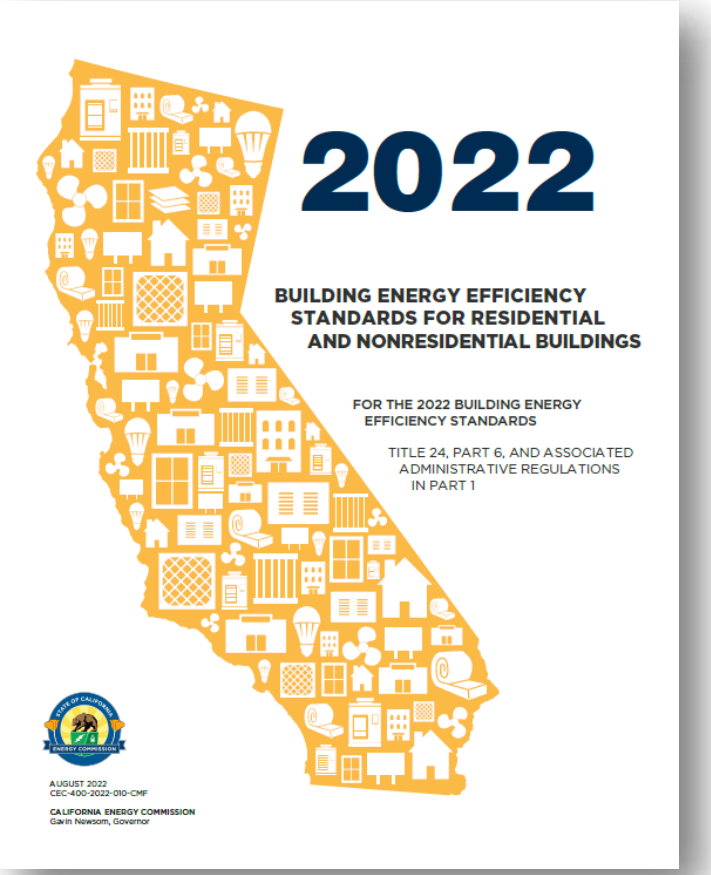
International Energy Conservation Code (IECC)

- Created by the International Code Council
- IECC 2021 is the current version
- New construction, additions, and alterations
- Covers commercial and residential buildings
- Allows use of 90.1-2019 as an alternate compliance path
- Part of a set of codes, known as the I-Codes
- Interior and exterior lighting and lighting control requirements



California Title 24, Part 6

- Title 24, Part 6 is California's energy efficiency code
- Title 24 2022 is the current version, effective Jan. 1, 2023
- Affects all newly constructed or altered commercial and residential buildings
- Considered to be the strictest energy code in the U.S.
- Interior and exterior lighting and lighting control requirements



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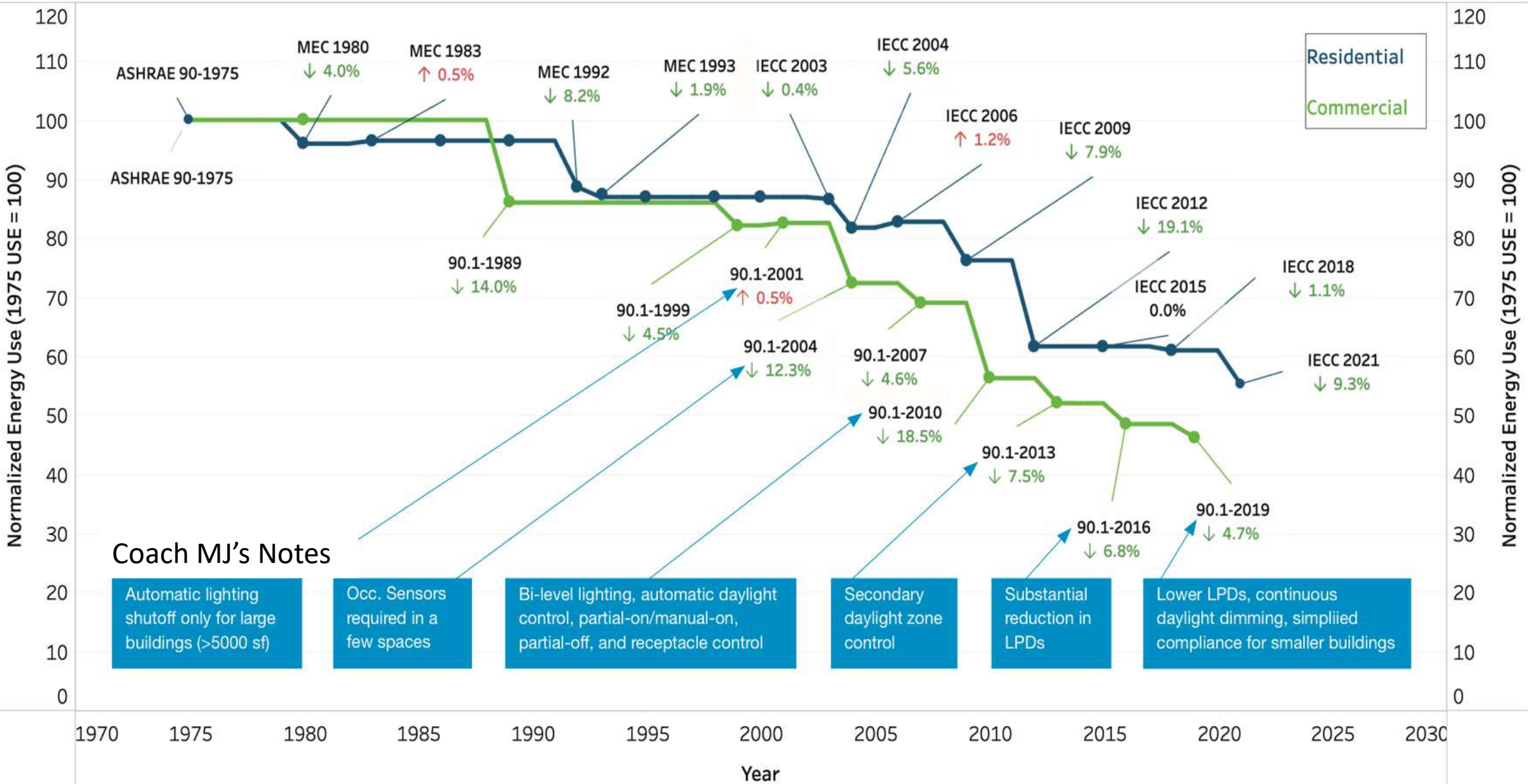
U.S. DEPARTMENT OF ENERGY

Estimated Improvement in Residential & Commercial Energy Codes
(1975 - 2021)

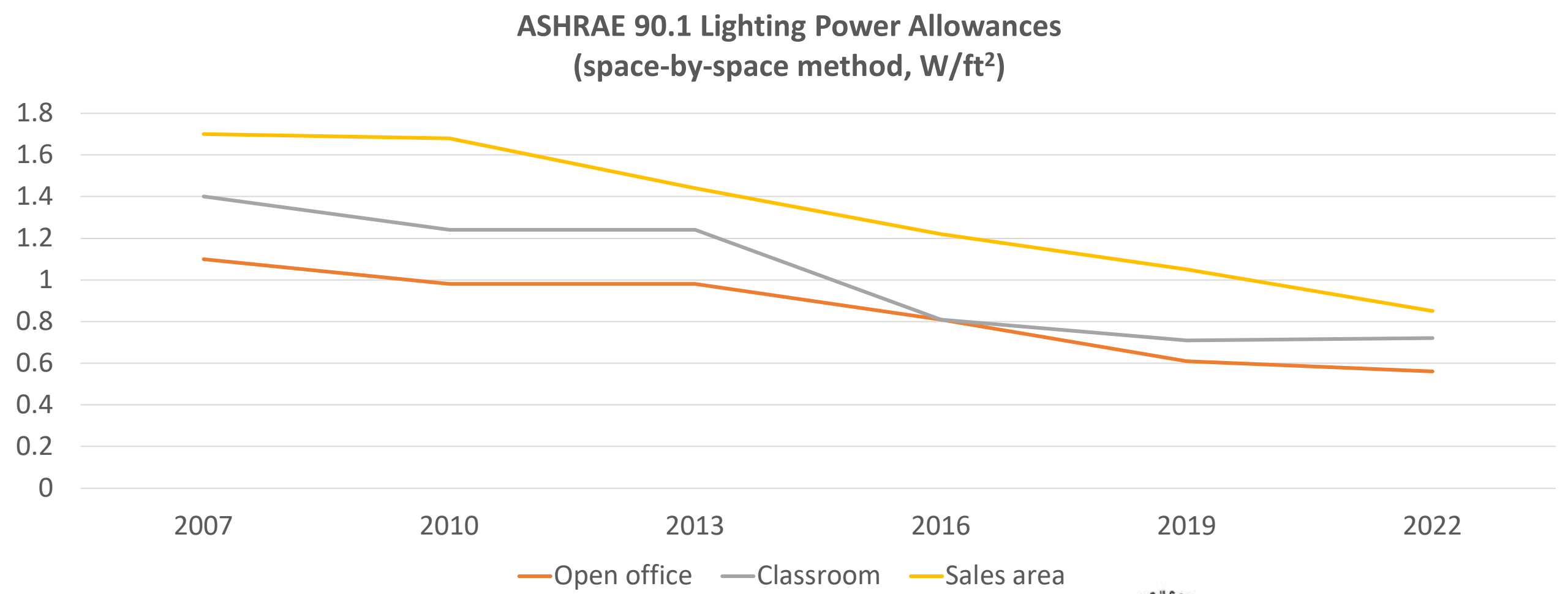
Pacific Northwest NATIONAL LABORATORY



Coach MJ's Notes

- Automatic lighting shutoff only for large buildings (>5000 sf)
- Occ. Sensors required in a few spaces
- Bi-level lighting, automatic daylight control, partial-on/manual-on, partial-off, and receptacle control
- Secondary daylight zone control
- Substantial reduction in LPDs
- Lower LPDs, continuous daylight dimming, simpliied compliance for smaller buildings

Lighting power allowances



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Automatic lighting shutoff

Intent

- Eliminate lighting waste when spaces, areas, or buildings are vacant

Requirements

- Automatic lighting shutoff control is required in all interior spaces
- Override of automatic shutoff allowed for not more than 2 hours

Common exceptions (varies by code)

- Lighting required for 24/7 spaces
- For 90.1, up to 0.02 W/sf (or 0.1 W/sf for Title 24) of lighting may be uncontrolled

Occupant sensor control

- Classrooms
- Conference/meeting rooms/offices
- Employee lunch/break rooms/lounges
- Restrooms
- Storage rooms (90.1 / IECC)
- Rooms used for copying and printing (90.1 / IECC)
- Dressing, locker, and fitting rooms (90.1 / IECC)
- Spaces less than 300 ft2 (IECC)
- Multipurpose rooms less than 1,000 ft2 (T24)
- Laundry/washing area (90.1)
- Mother's/wellness room (90.1)
- Healthcare control room (MRI/CT/radiology/PET) (90.1)
- Medical supply room (90.1)
- Telemedicine (90.1)

Manual/Local control

Intent

- Allow occupants to control unnecessary lighting

Requirements

- At least one lighting control for each room or space enclosed by ceiling-height partitions that allow occupants to turn lights off
- Readily accessible to occupants (some exceptions)
- Remote location is allowed but must have an indicator that identifies the lights served and their status (off or on)

Multilevel lighting control

Intent

- Allow occupants to moderate light levels to save energy

Requirements

- Multilevel lighting controls must allow occupants to set lighting levels to less than full light output in addition to OFF:
  - Controls that can reduce lighting by at least 50% or continuous dimming to 20% of full light output (IECC)
  - Continuous dimming to 10% of full light output for some spaces (90.1)
  - Continuous dimming to 10% for LEDs, or a minimum of 5 steps for most other light sources including OFF and ON (T24)

Light control solutions

- Dimmers, scene controls…

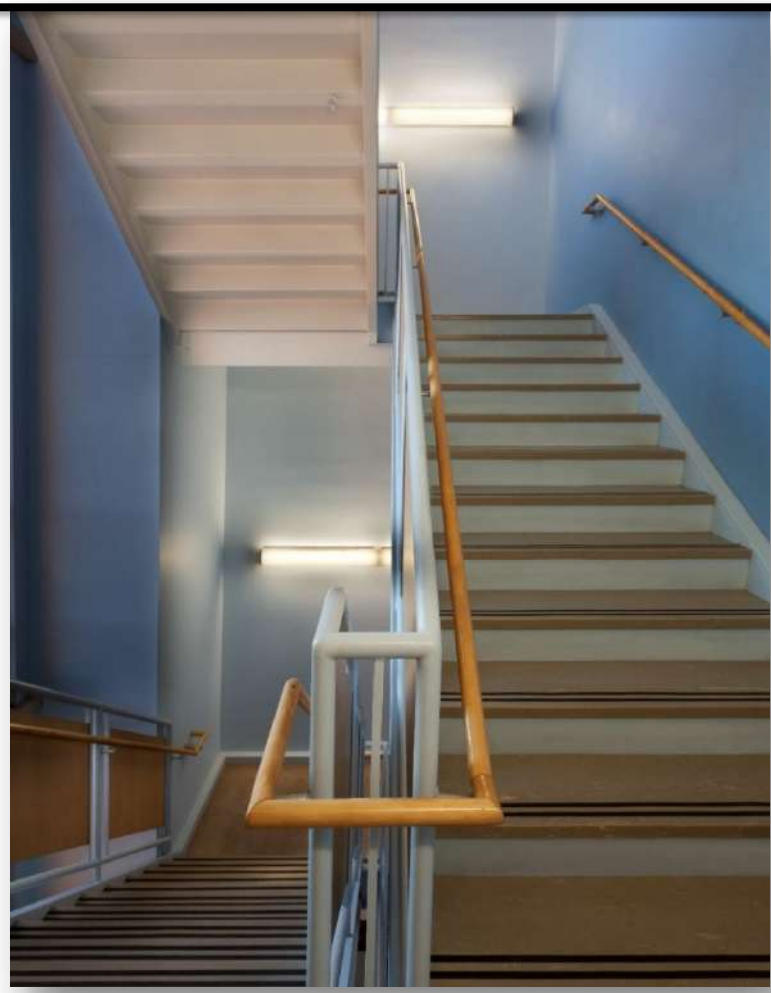
Automatic partial-off lighting

Intent

- Reduce lighting energy in spaces or areas while vacant

Requirements

- Lighting shall be automatically reduced by at least 50% when vacant (80% for open offices)
- IECC / 90.1 / T24: Warehouse aisles, corridors, and open offices (NEW! For 90.1 and T24)
- 90.1 / T24: Library stacks, stairwells, parking garages, and some lobbies (90.1 only)



Hotel guestroom control

All lighting and switched receptacles in hotel/motel guest rooms must automatically turned off when the room is vacant for 20 minutes or less.

Additionally, thermostats shall be configured to automatically setback/setup by 4 degrees. When unrented, they shall be set to 80 degrees or higher for cooling and 60 degrees or lower for heating.

Control solutions

- Guestroom control systems that can detect when the room is occupied and automatically adjust lighting, HVAC, and receptacles accordingly

Daylight zone control

Intent

- Save lighting energy in daylighted spaces

Requirements

- Luminaires in daylight zones shall have automatic daylight-responsive controls
  - Automatic continuous daylight dimming
  - Automatic full OFF required

Key exceptions

- Spaces where the lighting power in all daylight zones is less than:
  - 75 W (90.1)
  - 150 W (IECC)
  - 120 W (T24)

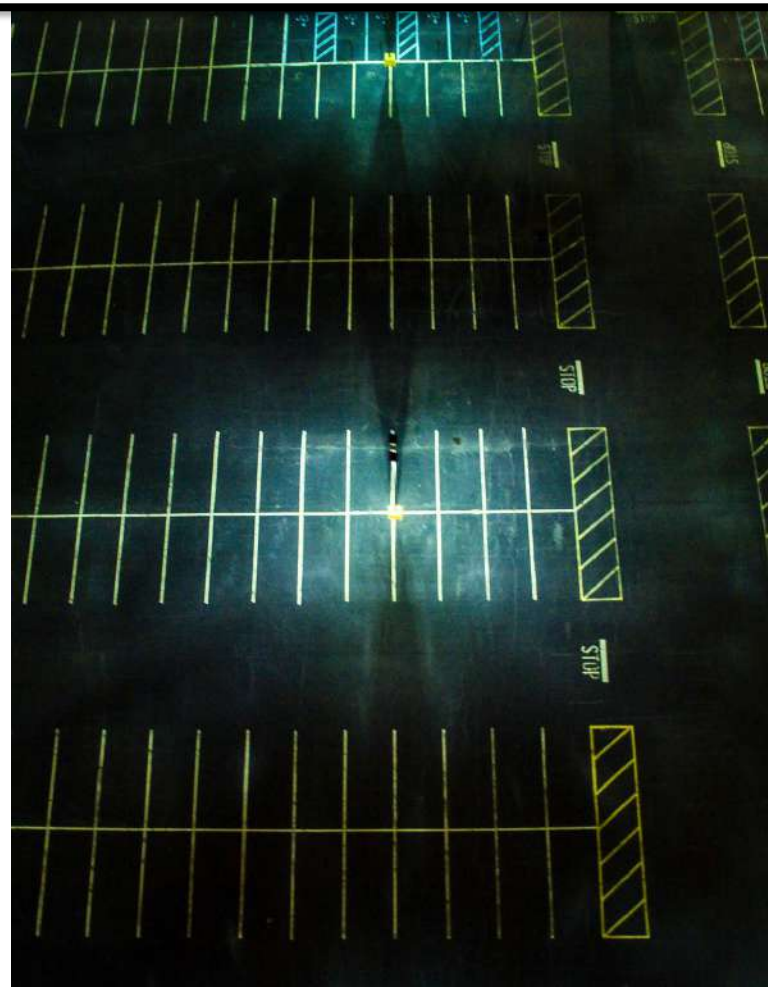
Exterior lighting control

Intent

- Eliminate wasted exterior lighting

Requirements

- Daylight shutoff
  - Automatic off when daylight is available or during daylight hours
- Decorative lighting shutoff
  - Façade and landscape lighting automatically shut off after business operations or between midnight/closing time to 6 am/opening time (90.1/IECC)



Exterior lighting control (cont.)

Lighting setback

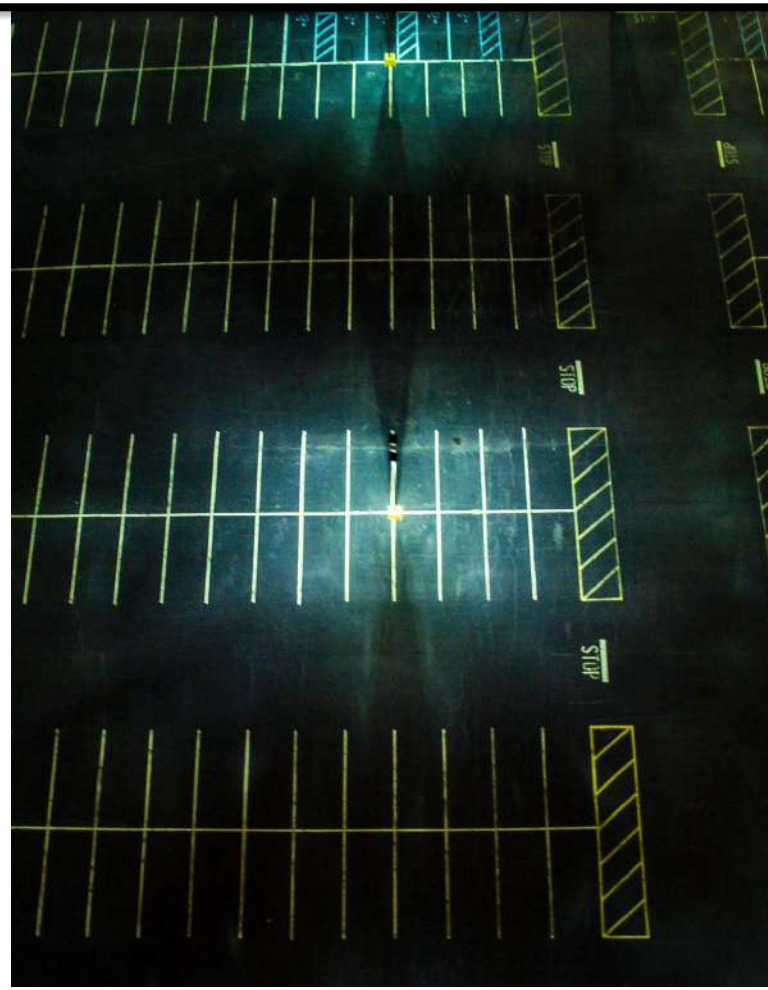
- Other lighting automatically reduced by at least 50% from midnight to 6 am or when no activity is detected (90.1/IECC)

Parking lot lighting setback

- Poles 24 ft. or less are automatically controlled so that lighting is reduced by at least 50% when no activity is detected. Not more than 1,500 watts of lighting power shall be controlled together.

Light control solutions

- Astronomical timeclocks, time switches, daylight, and motion sensors



Functional testing

Intent

- To ensure that controls are calibrated, adjusted, programmed, and in proper working condition

Requirements

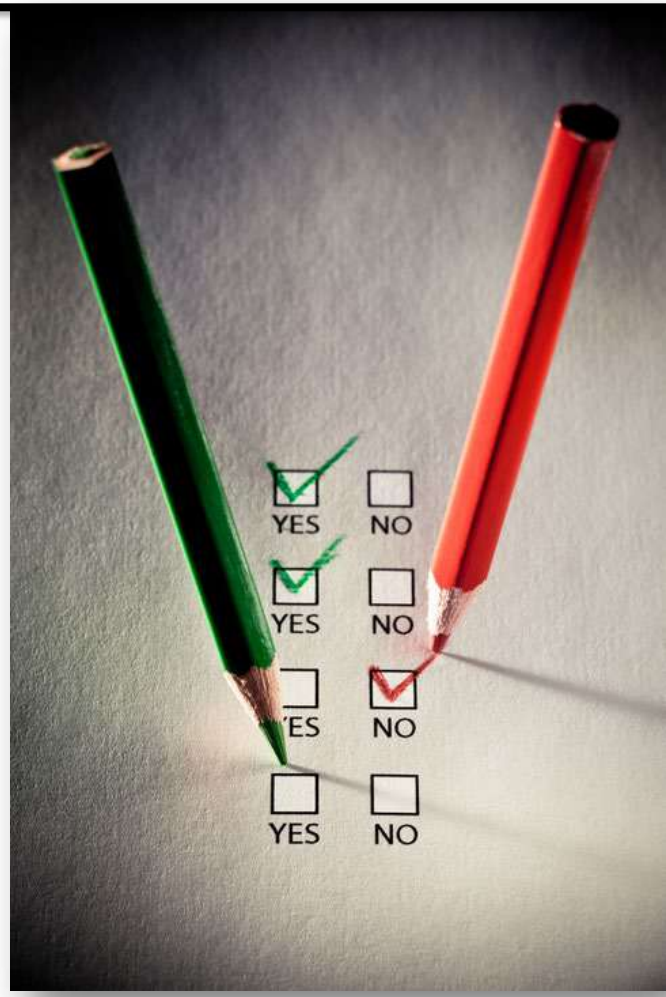
- Confirm that the following devices have been functionally tested:
  - Occupancy sensors
  - Photosensors
  - Time Switches (timeclock)
  - Demand responsive lighting (T24 only)

Additional efficiency options (ASHRAE 90.1-2022)

All projects must obtain a certain number of points (credits) by choosing different energy efficiency packages. Office buildings, for example, need to obtain 50 points. There are 6 lighting packages.

Lighting related energy efficiency packages:

- Continuous dimming and high-end trim
- Occupancy sensor control areas
- Increased daylight control area
- Lighting control for residential buildings
- Reduced LPD
- Lighting load management



Additional efficiency options (IECC 2021)

Projects must do some of the following additional energy efficiency measures:

- More efficient HVAC
- Reduced LPD
- **Enhanced digital lighting controls** → *Enhanced digital lighting controls*
  - *Continuous dimming*
  - *Individually addressable fixtures*
  - *Smaller daylight zones*
  - *Reconfigurable*
  - *Load shedding*
- On-site supply of renewable energy
- Dedicated outdoor air systems
- High-efficiency water heating
- Enhanced envelope performance
- Reduced air infiltration
- Energy monitoring
- Fault detection and diagnostics
- Efficient kitchen equipment

Lighting alterations (IECC 2021)

When at least 10% of the total luminaires in a space are replaced, then the lighting alteration must meet the same lighting power and control requirements as for new construction.

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Lighting alterations (ASHRAE 90.1-2022)

Interior lighting

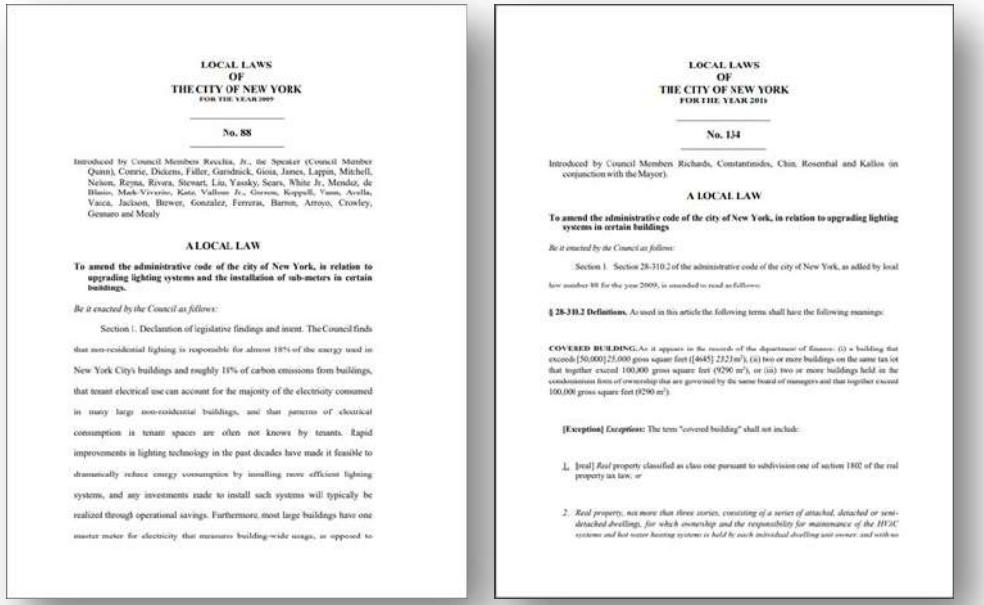
- Alterations of more than 2000W of lighting power shall meet the same requirements as new construction.
- Alterations of 2000W or less in lighting power shall meet the lighting power allowances OR the new wattage must be 50% less than the original wattage. Plus, manual/local control and automatic lighting shutoff must be met.

Exterior lighting

- Base lighting power allowance not permitted.
- Alterations of more than 10 luminaires or more than 20 linear ft. shall meet new same requirements as new construction.
- Alterations of 10 luminaires or less or the combined length of retrofitted or new luminaires is less than 20 linear ft., then alternation must meet the lighting power allowances or the new lighting shall be at least 50% lower in wattage than the original lighting.

NYC Local Law 88 & 134

- NYC Counsel enacted Local Law 88 in 2009 in reaction to research finding non-residential lighting to be responsible for almost 18% of the energy used in New York City's buildings and roughly 18% of carbon emissions from buildings.
- The intent of the local law was to force building owners to upgrade their lighting and control systems to meet current energy code requirements.
- Requires lighting power density requirements that likely cannot be achieved with fluorescent lighting. This impacts a large installed base of fluorescent lighting in NYC.
- In 2016 NYC Council enacted Local Law 134 which amended Local Law 88.
- Local Law 134 reduced the size of buildings that were eligible for exemption.
- Requires buildings to meet energy code active at the time of the update.
- This is required to be completed and reported on prior to January 1, 2025



LOCAL LAWS
OF
THE CITY OF NEW YORK
FOR THE YEAR 2009

No. 88

A LOCAL LAW

To amend the administrative code of the city of New York, in relation to upgrading lighting systems and the installation of sub-meters in certain buildings.

Be it enacted by the Council as follows:

Section 1. Declaration of legislative findings and intent. The Council finds that non-residential lighting is responsible for almost 18% of the energy used in New York City's buildings and roughly 18% of carbon emissions from buildings, that tenant electrical use can account for the majority of the electricity consumed in many large non-residential buildings, and that patterns of electrical consumption in tenant spaces are often not known by tenants. Rapid improvements in lighting technology in the past decades have made it feasible to dramatically reduce energy consumption by installing more efficient lighting systems, and any investments made to install such systems will typically be realized through operational savings. Furthermore, most large buildings have one master meter for electricity that measures building-wide usage, as opposed to

LOCAL LAWS
OF
THE CITY OF NEW YORK
FOR THE YEAR 2016

No. 134

Introduced by Council Members Richards, Constantinides, Chin, Rosenthal and Kallos (in conjunction with the Mayor).

A LOCAL LAW

To amend the administrative code of the city of New York, in relation to upgrading lighting systems in certain buildings

Be it enacted by the Council as follows:

Section 1. Section 28-310.2 of the administrative code of the city of New York, as added by local law number 88 for the year 2009, is amended to read as follows:

§ 28-310.2 Definitions. As used in this article the following terms shall have the following meanings:

COVERED BUILDING. As it appears in the records of the department of finance: (i) a building that exceeds [50,000] 25,000 gross square feet ([4645] 2323 m²), (ii) two or more buildings on the same tax lot that together exceed 100,000 gross square feet (9290 m²), or (iii) two or more buildings held in the condominium form of ownership that are governed by the same board of managers and that together exceed 100,000 gross square feet (9290 m²).

[Exception] Exceptions: The term "covered building" shall not include:

1. [real] *Real* property classified as class one pursuant to subdivision one of section 1802 of the real property tax law; *or*

2. *Real property, not more than three stories, consisting of a series of attached, detached or semi-detached dwellings, for which ownership and the responsibility for maintenance of the HVAC systems and hot water heating systems is held by each individual dwelling unit owner, and with no*

https://www.nyc.gov/html/gbee/downloads/pdf/ll134of2016.pdf

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What's coming next for lighting?

- More spaces required to have dimming controls
- More spaces required to have occupancy sensors
- Lower daylight responsive control wattage threshold to match 90.1-2022 (75W)
- Demand responsive lighting for larger buildings
- Automated window shades are an option in the energy credit section

Summary

- Automatic shut-off
- Manual/local control
- Hotel guestroom control
- Occupant sensor control
- Automatic partial-off lighting
- Automatic daylight zone control
- Multilevel lighting (continuous dimming)
- Exterior lighting control
- Functional testing of controls
- Energy efficiency options
- Lighting alteration requirements
- Coming soon for lighting in energy codes

Easy as 1-2-3

Provide these 3 things and your projects will meet most, if not all, of the mandatory lighting control requirements in your energy code:

1. Give occupants control of their lighting
2. Turn lights OFF when spaces are vacant, or scheduled to be vacant
3. When daylight is available, use it!

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Half-time

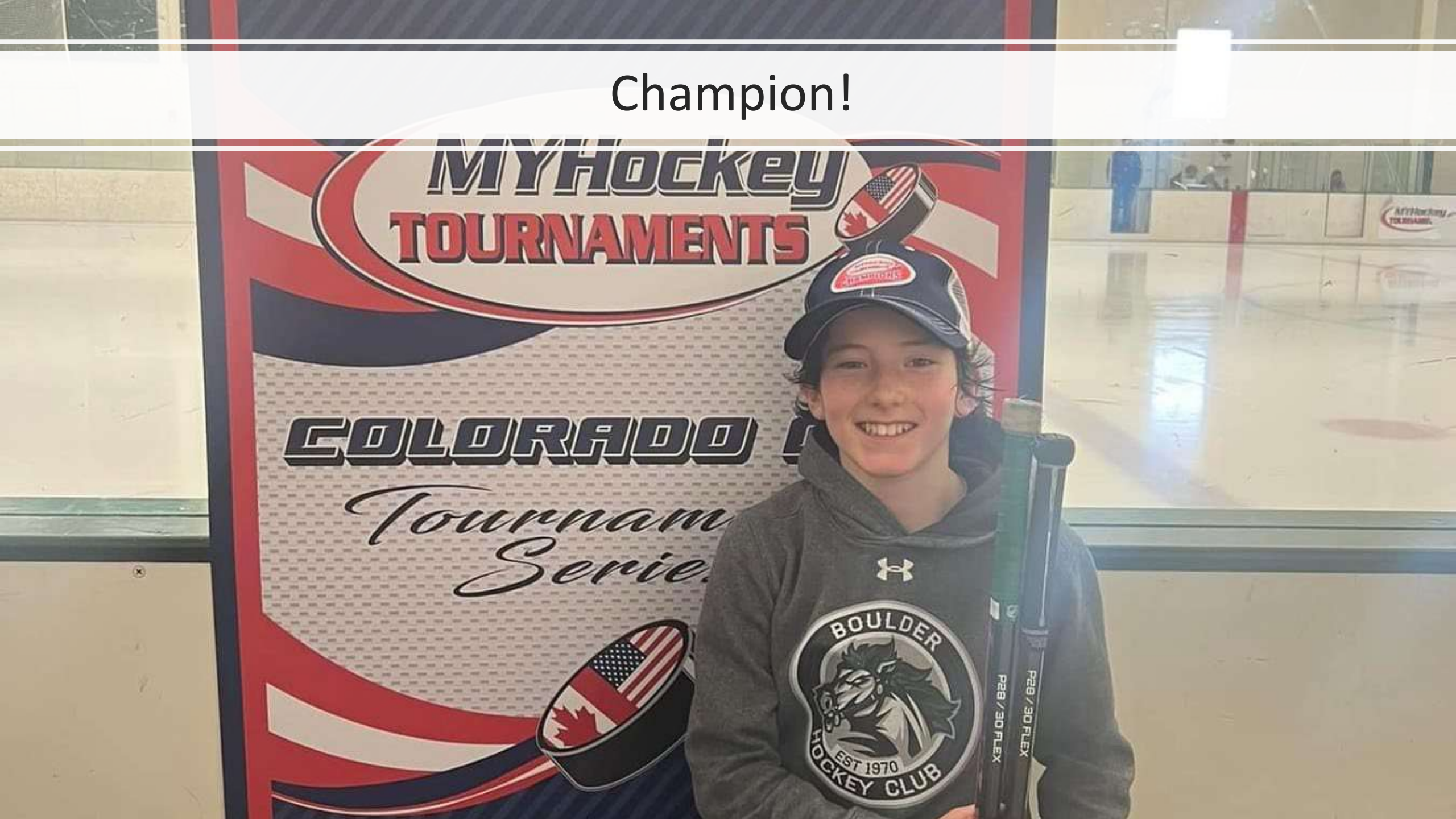
Avery

Shootout!

Shootout!

Goal!!!!!!!!!!!!!!

Champion!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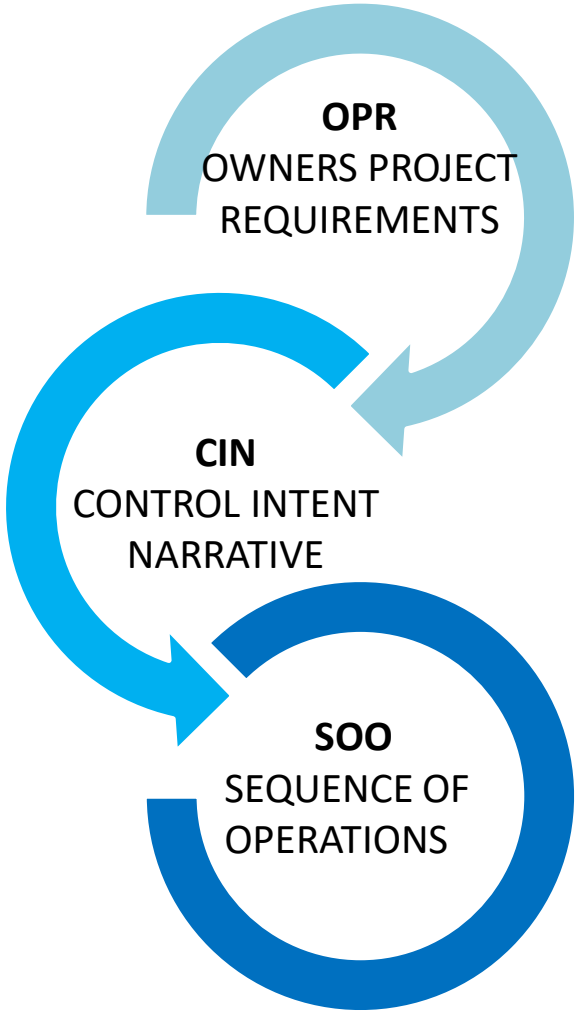
Achieving victory – strategies for success

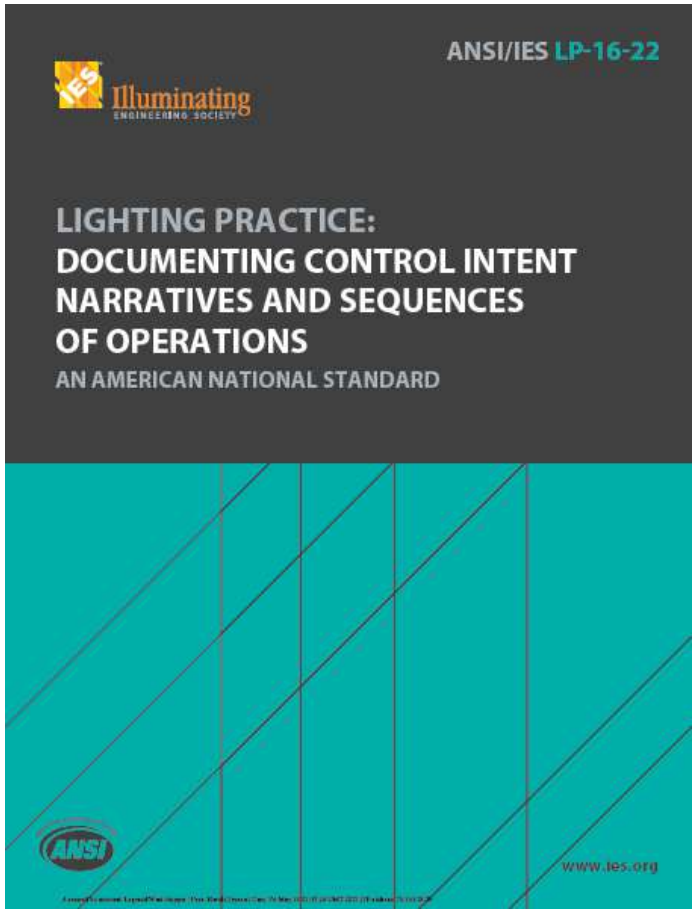
Lighting Control Operation- Origination



- *Owner's point of view*
- *Operational expectation by space*
- *Systems interactions*

- *Descriptive, guiding, narrative*
- *Broadly describes intent*
- *Requirements being followed*
- ***WHAT** controls are to do*

- *Contractually enforceable*
- *Specifies function, set points, timing*
- ***HOW** controls are to operate*



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OPR - Space Use Characteristics

Open Office

- LEED Silver
- WELL standard Silver
- Aggressive energy efficiency
- Area functional use: software development
- Light level flexibility: users prefer lower levels

Who writes Owner Project Requirements?

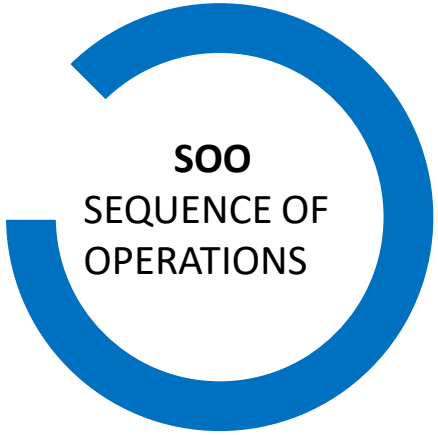
CIN – Control Intent Narrative

Open Office

- "XYZ" energy code compliant - choices
  - Continuous dimming manual control
  - Auto full off – occupancy sensor
  - Automatic daylight responsive control
- LEED – point contribution, aggressive efficiency
  - High-end trim
- WELL standard – occupant controllability
  - Continuous dimming user control
- Space use parameters: 7am – 6pm, 30FC task level
- Maintain means of egress illumination

Determine who writes Control Intent Narrative

SOO – Contractual Control Operation



Open Office

1. Set high end trim task illuminance for 30fc(adj) at full on
2. Manual on/off/dim lighting in all zones (a, b, c) uniformly with dimmer switch
3. In each ≤600 ft^2 zone (a, b, c), auto-on lighting to last level when occupancy detected. All other zones shall remain unaffected. Auto off lighting in each individual zone within 20min of occupants leaving.
4. Lighting in primary and secondary daylight areas shall continuously dim and turn off based on daylight contribution to maintain at least 30FC(adj) at task level

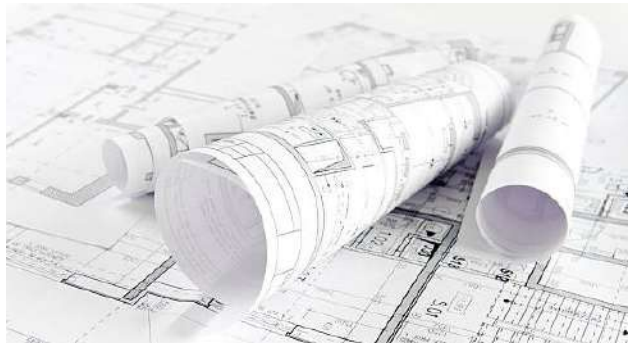
Corridor/circulation area SOO separate

Determine who writes the sequence of operations

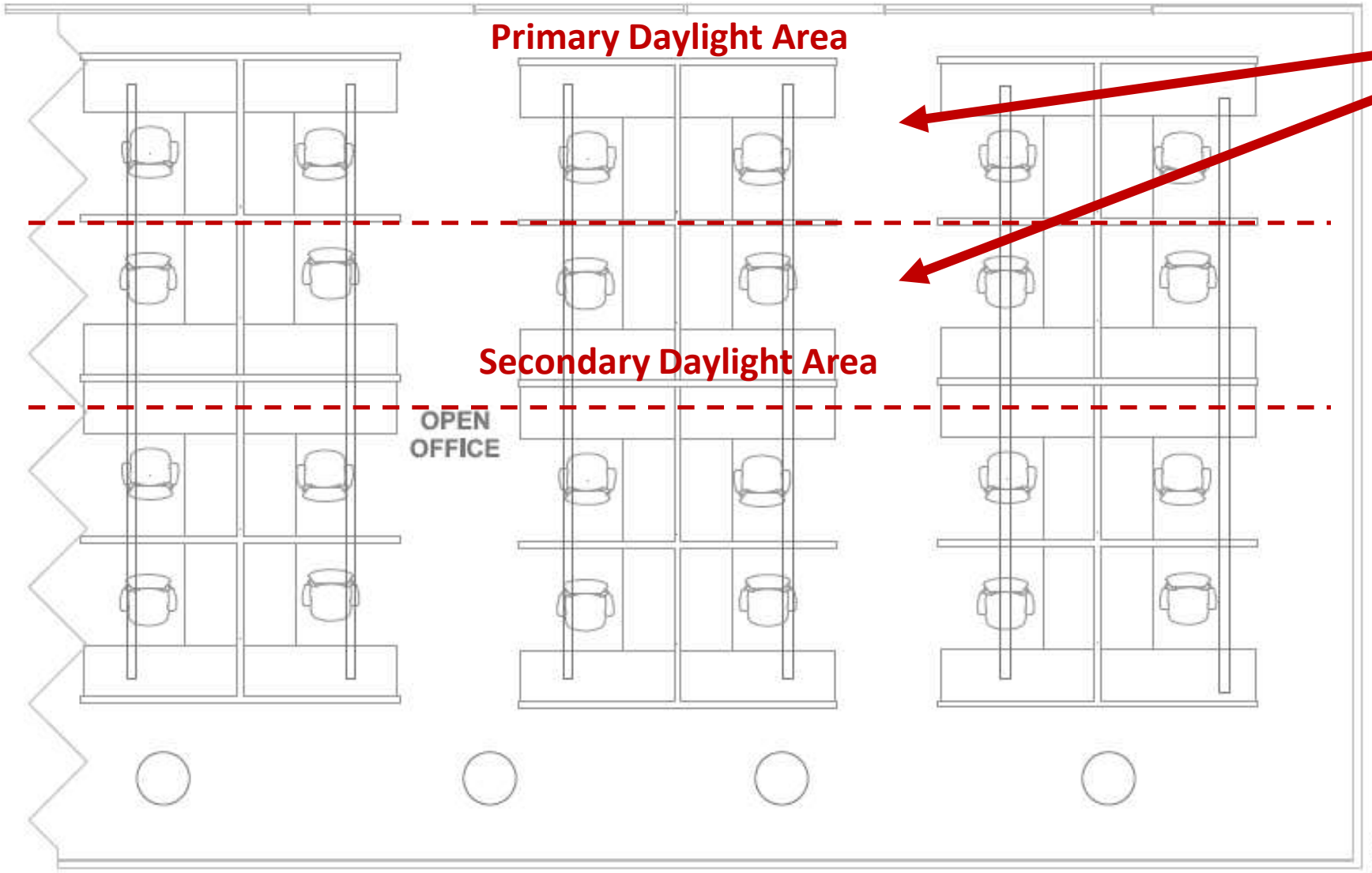
Roles and Responsibilities

- A long relay race, many handoffs
- Defined roles and responsibilities
  - Create Game Plan
  - Execute Game Plan
- Know “Who Does What”

Create Game Plan	Execute Game Plan
Owner	Manufacturer’s Rep
Architect	Controls vendor
Lighting Designer	Control Systems Integrator
Interior Designer	Construction Manager
Electrical Engineer	Installing Contractor
Lighting Control Specifier	Startup Provider
	Commissioning provider
	Facilities Engineer
	End User

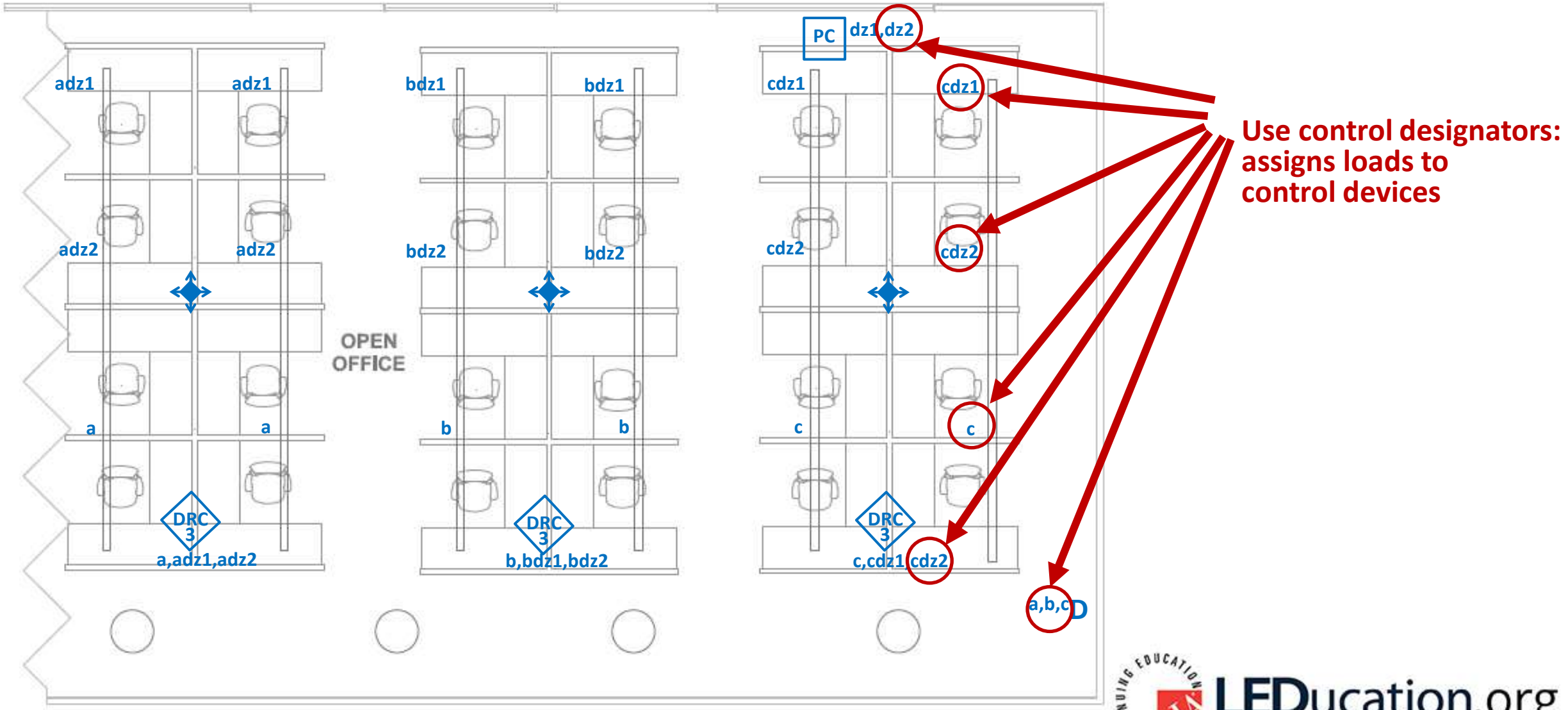


Document for Compliance – Clear CDs



Clarify daylight areas

Design for Compliance – Clear Construction Docs (CDs)



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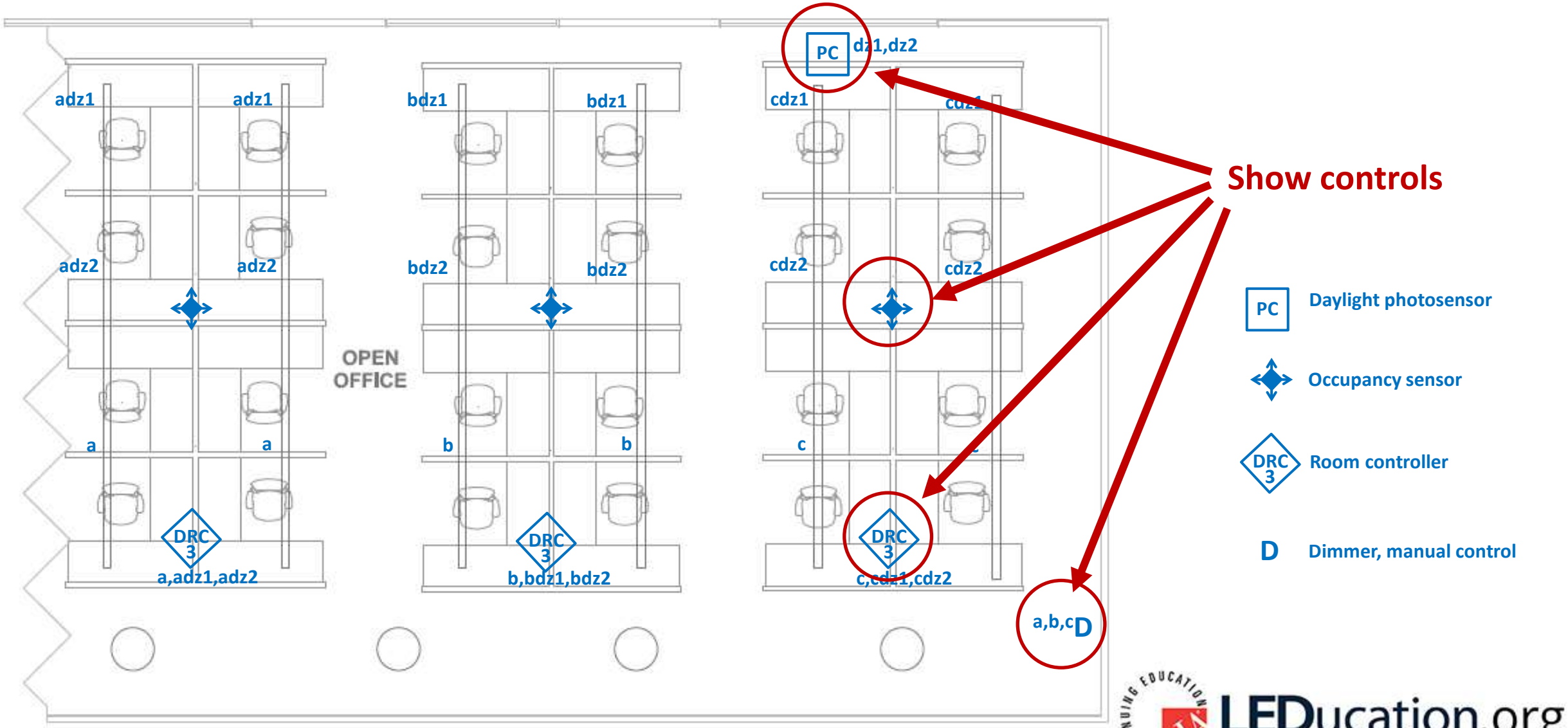
Design for Compliance – Clear Construction Docs (CDs)



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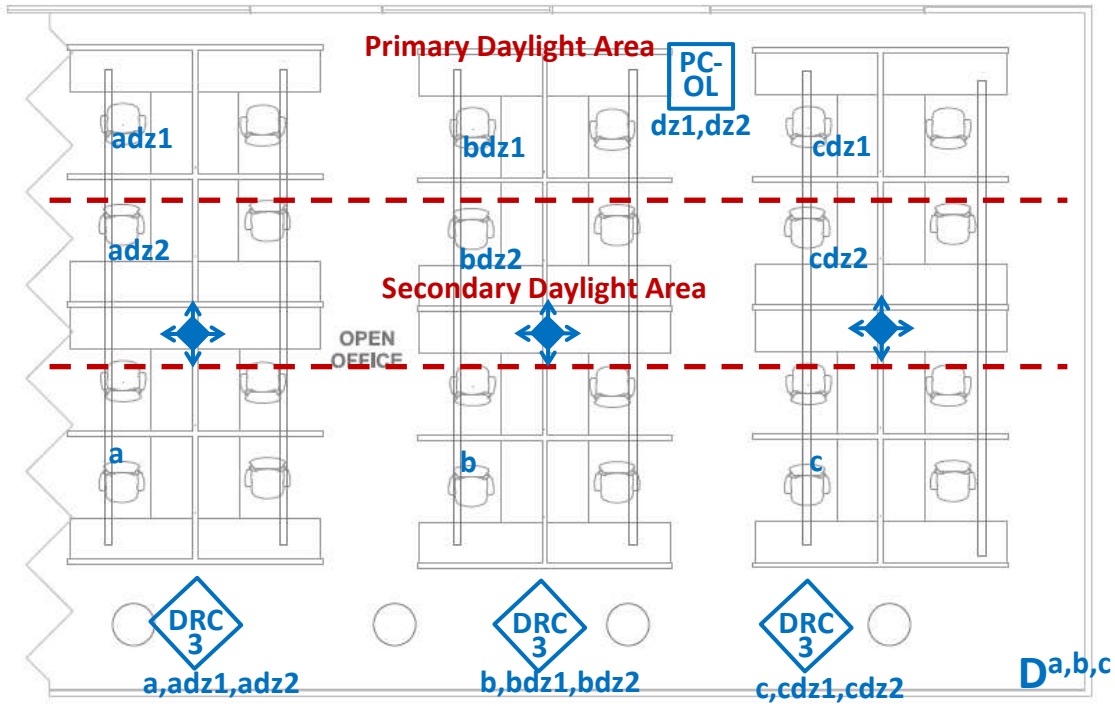
Design for Compliance – Clear Construction Docs (CDs)

Lighting Sequence of Operation

1. Set high end trim illuminance for 30fc at full on
2. Manual on/off/dim lighting in all zones (a, b, c) uniformly with dimmer switch
3. In each ≤600 ft^2 zone (a, b, c), auto-on lighting to last level when occupancy detected. All other zones shall remain unaffected. Auto off lighting in each individual zone within 20min of occupants leaving.
4. Lighting in primary and secondary daylight areas shall continuously dim and turn off based on daylight contribution to maintain at least 30FC(adj) at task level



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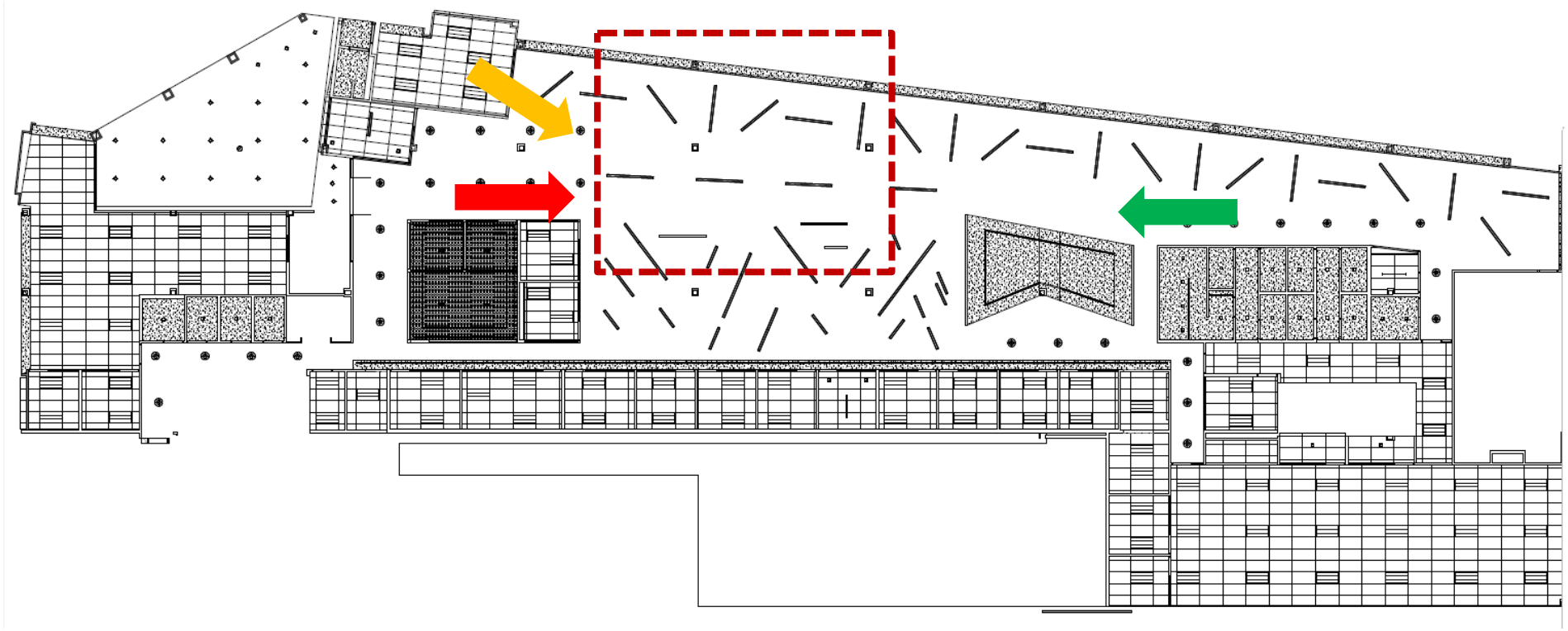
Highlight reels

OPEN OFFICE DESIGN

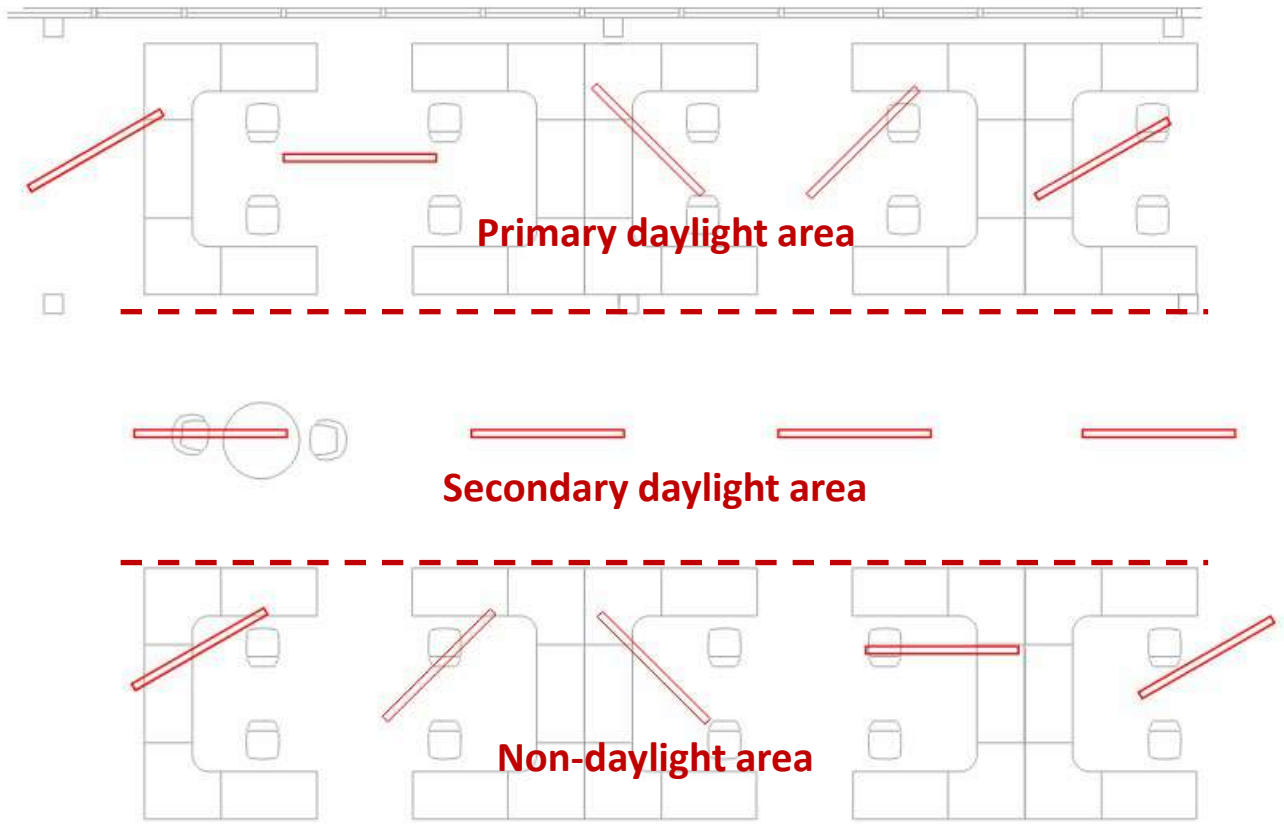
Open Office - Key Design Considerations

- Meet lighting power allowance
- 600SqFt control areas
- Should zone lighting turn off or go to 20% courtesy level?
- Primary, secondary daylight areas
- Manage corridor/circulation paths separately
- Control task/accent/decorative lighting separately

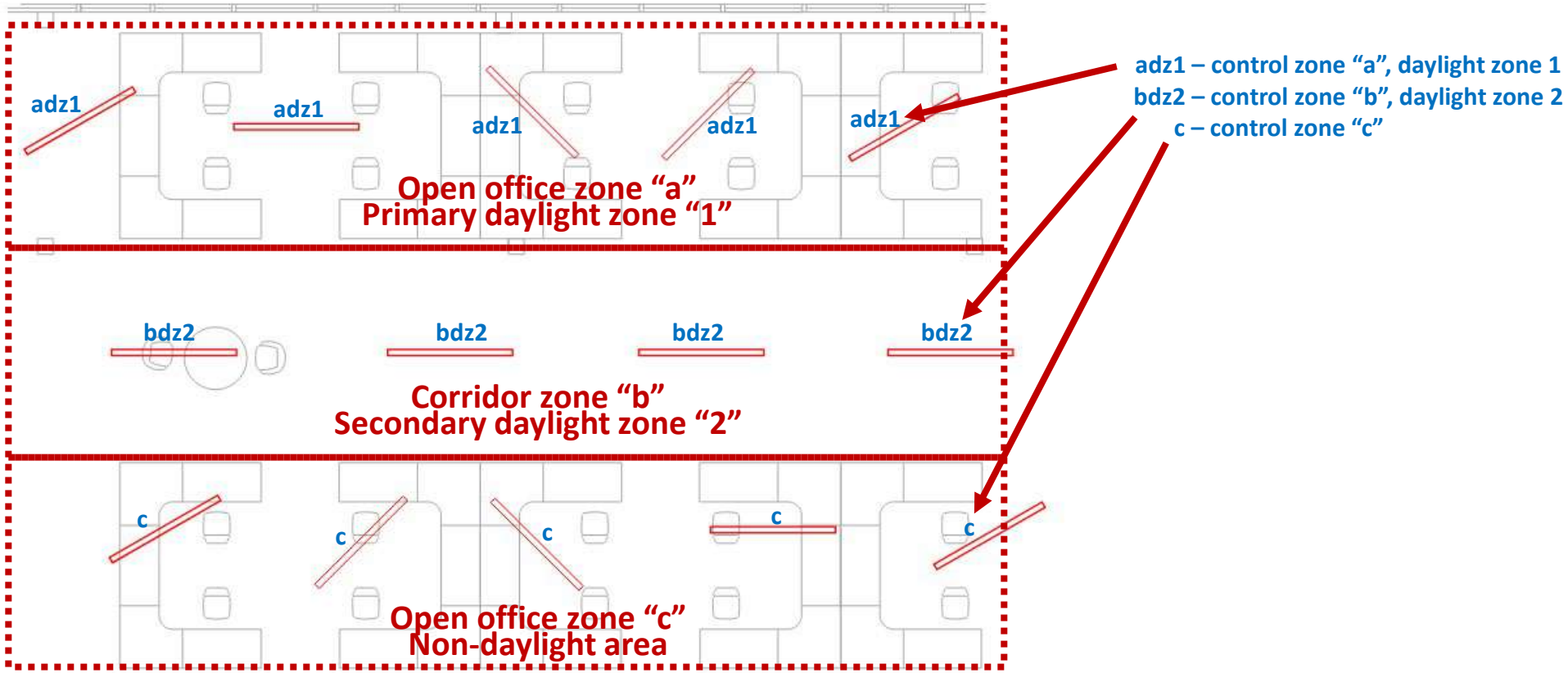
Open Office - Design Breakdown



Open Office - Design Breakdown



Open Office - Design Breakdown



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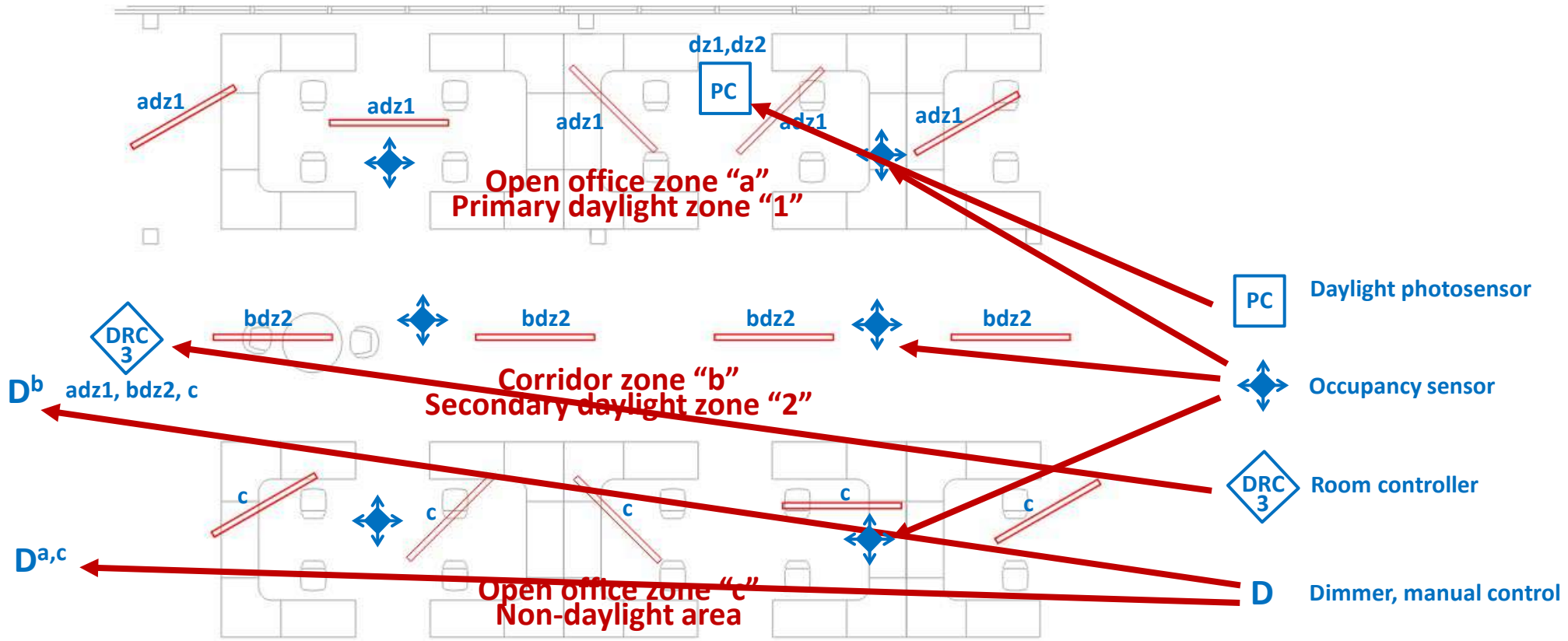
Open Office - Design Breakdown



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Open Office – Sequence of Operation

Lighting Sequence of Operation

1. Set high end trim illuminance for 30fc(adj) at full on
2. Lighting in primary and secondary daylight areas shall continuously dim and turn off based on daylight contribution to maintain at least 30FC(adj) at task level
3. Manual on/off/dim lighting in all zones (a, c) uniformly with dimmer switch
4. In each ≤600 ft^2 zone (a, c), auto-on lighting to last level when occupancy detected. All other zones shall remain unaffected
5. Auto off lighting in each individual zone within 20min of occupants leaving

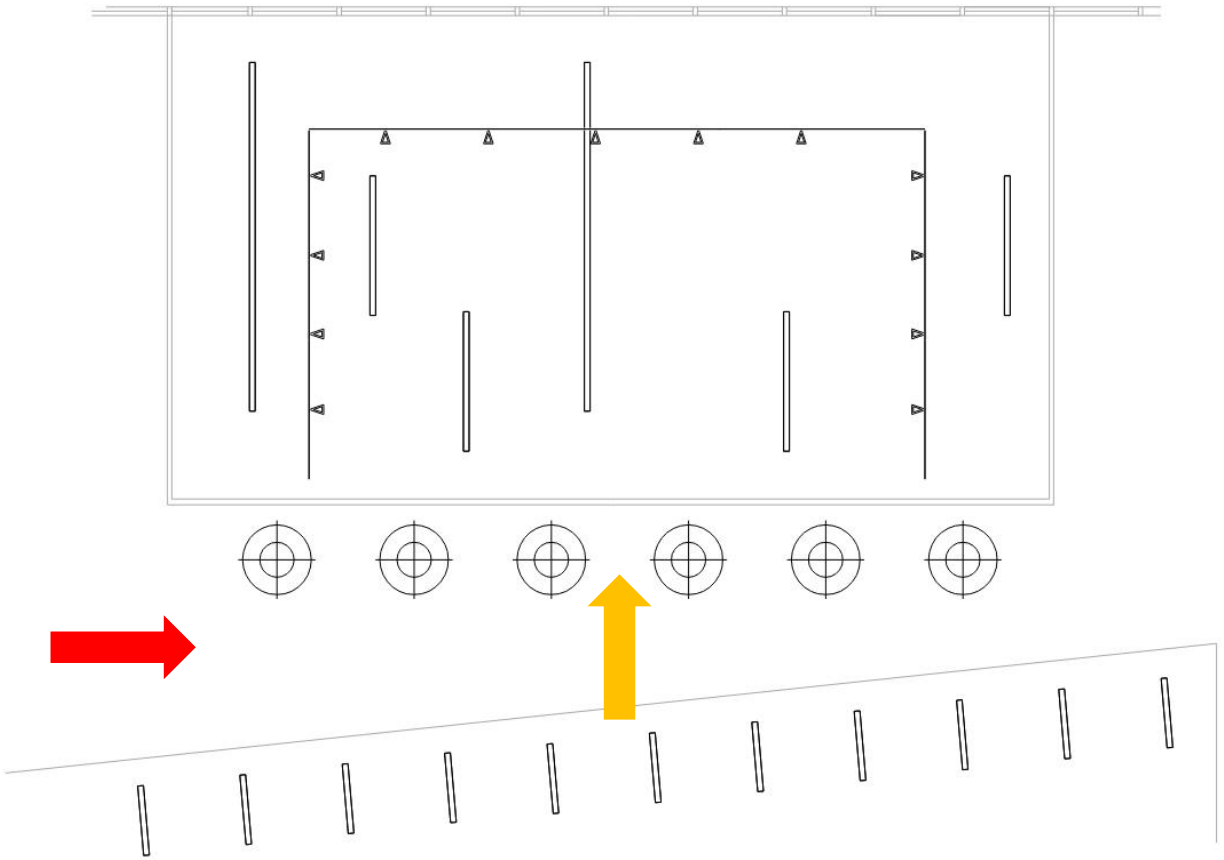
RETAIL DESIGN


STEELERS PRO SHOP

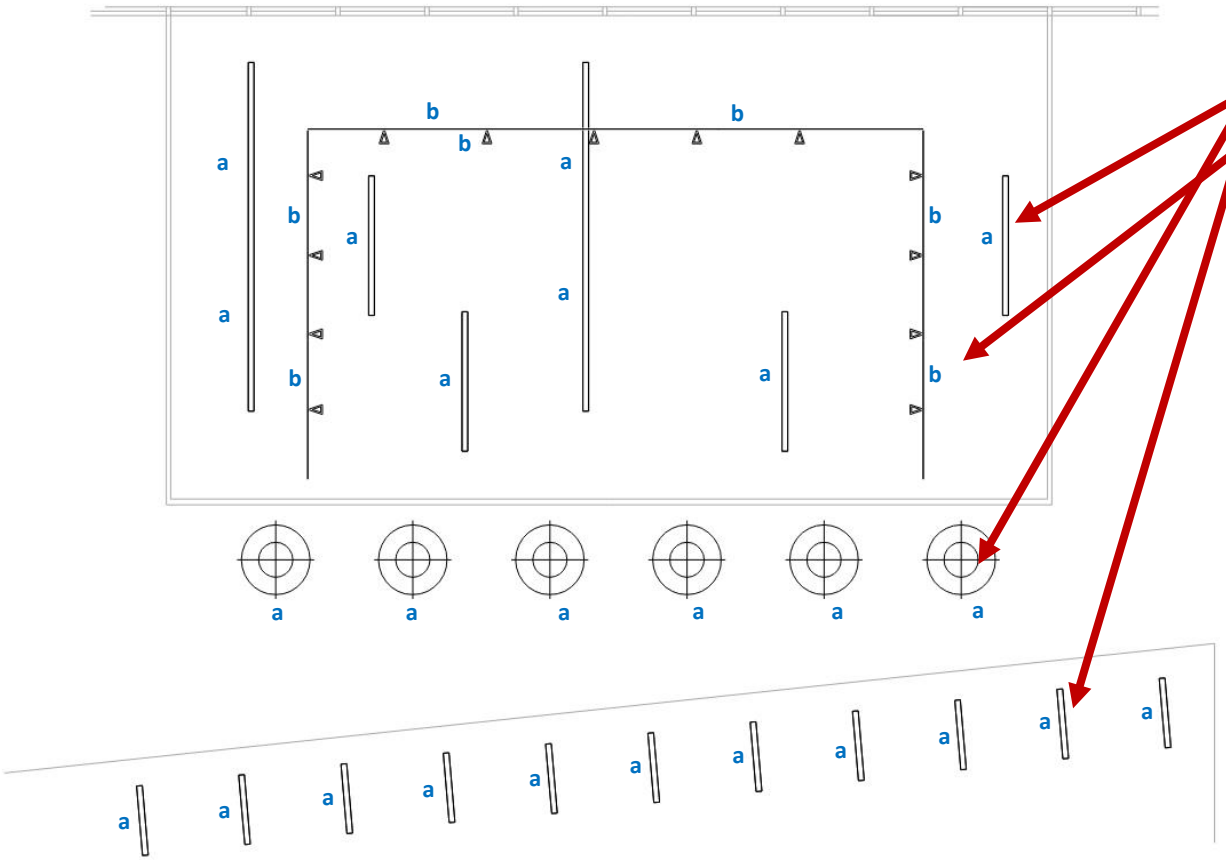
Retail Sales Area - Key Design Considerations

- Meet lighting power allowance
- Scheduled control environment
- First floor daylight sidelighting exempt (IECC) or not required in retail at all (ASHRAE 90.1)
- Decorative lighting schedule off during nonbusiness hours
- Control display, accent and case lighting separate from general
- Sensitivity to cash register areas
- Back of house occupancy sensor control yields greater savings

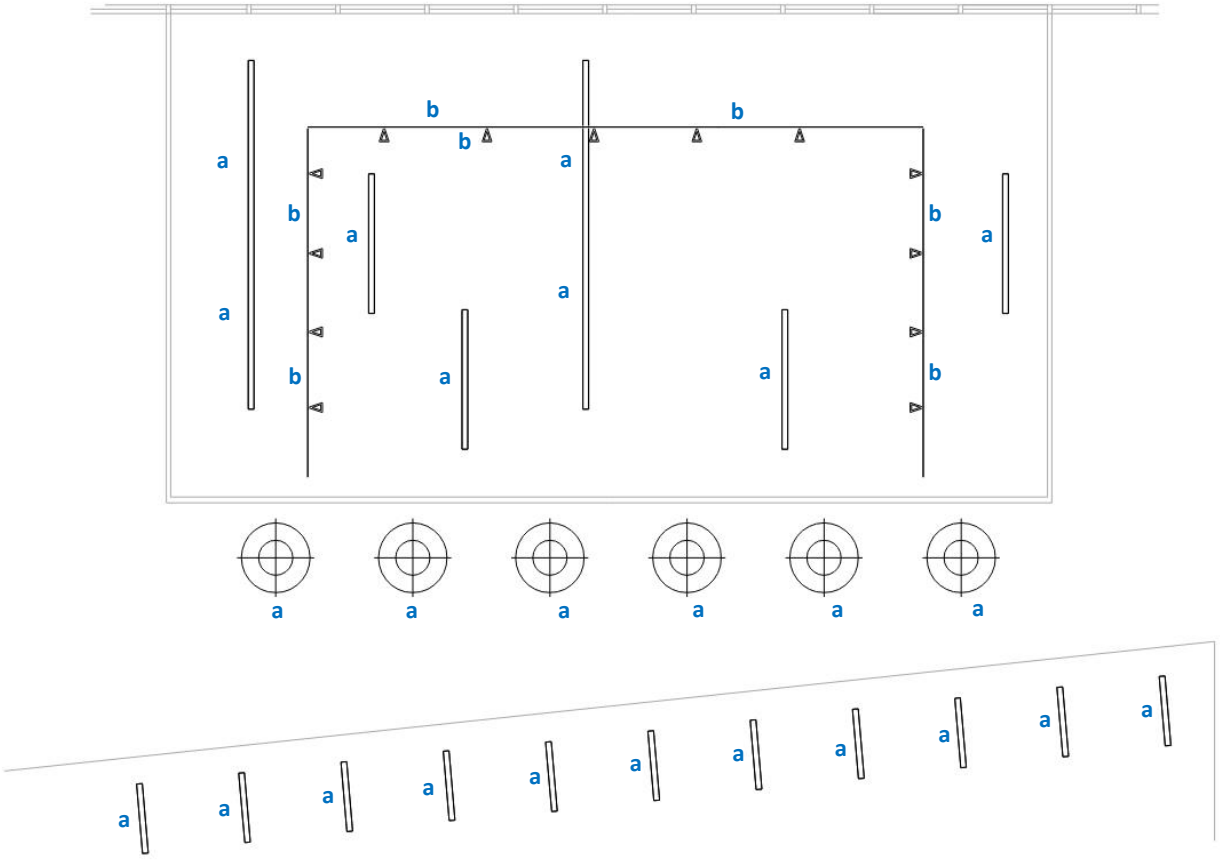
Retail Sales Area – Design Breakdown



Retail Sales Area – Design Breakdown



Retail Sales Area – Design Breakdown



D^aD^b

D – Dimmer switches behind customer service

LCP

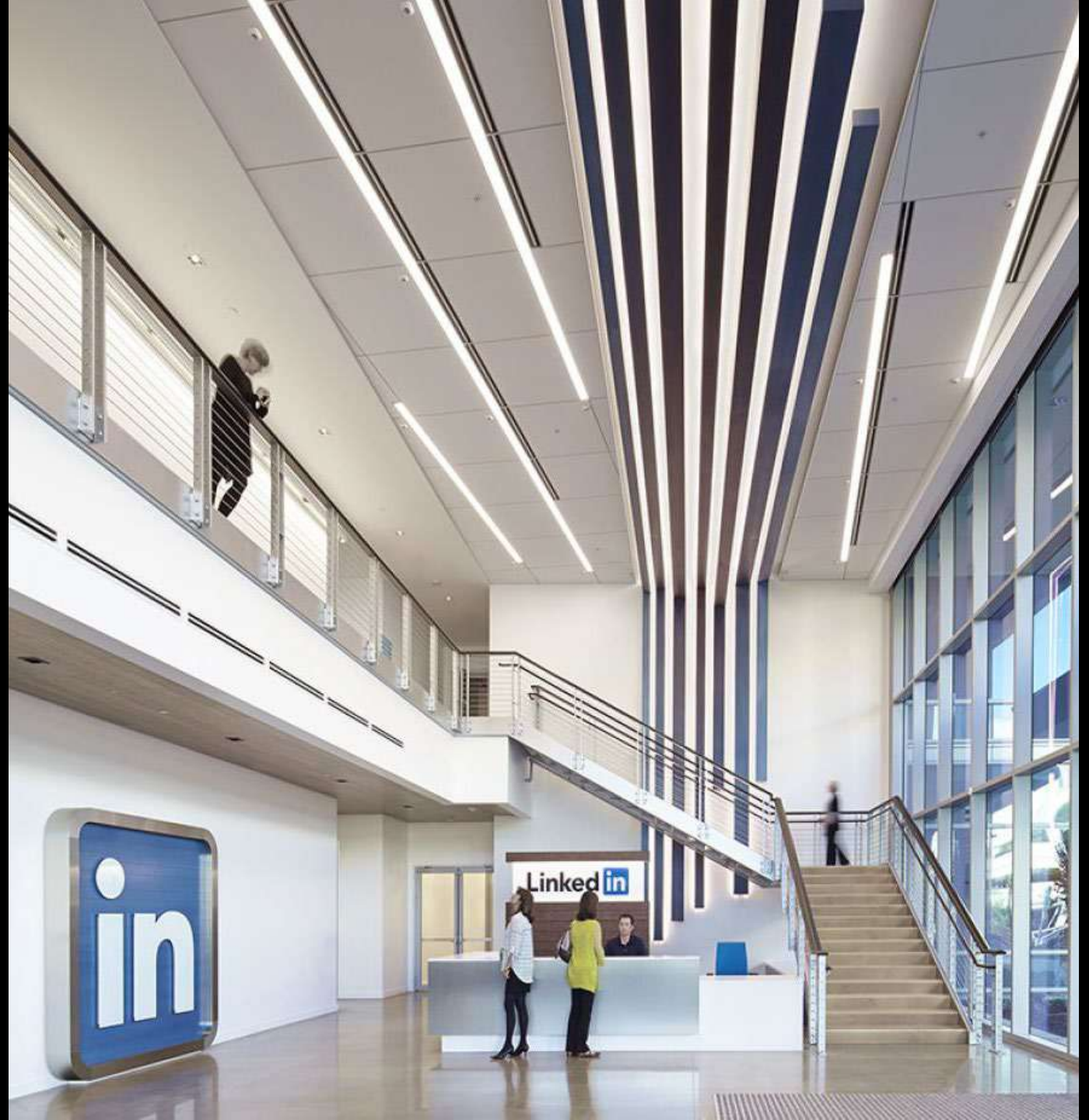
LCP - Lighting control panel (back of house)

Retail Sales Area – Sequence of Operations

Lighting Sequence of Operation

1. Set high end trim illuminance for 30fc (adj) at full on
2. Manual on/off/dim control general lighting
3. Manual on/off control accent/display/case lighting
4. General lighting on to 50%
   Mon-Sun at 8:00am (adj)
5. General, case/display/accent lighting full on
   Mon-Sun 9:55am (adj) during business hours
6. General on to 50%, case/display/accent lighting off
   Mon-Sat 9:00pm (adj), Sun 7:00pm (adj)
7. General lighting off
   Mon-Sat 10:00pm (adj), Sun 8:00pm (adj)
8. All lighting scheduled off during holidays
9. Manual switches shall override lighting on to no more than two hours outside of scheduled on times

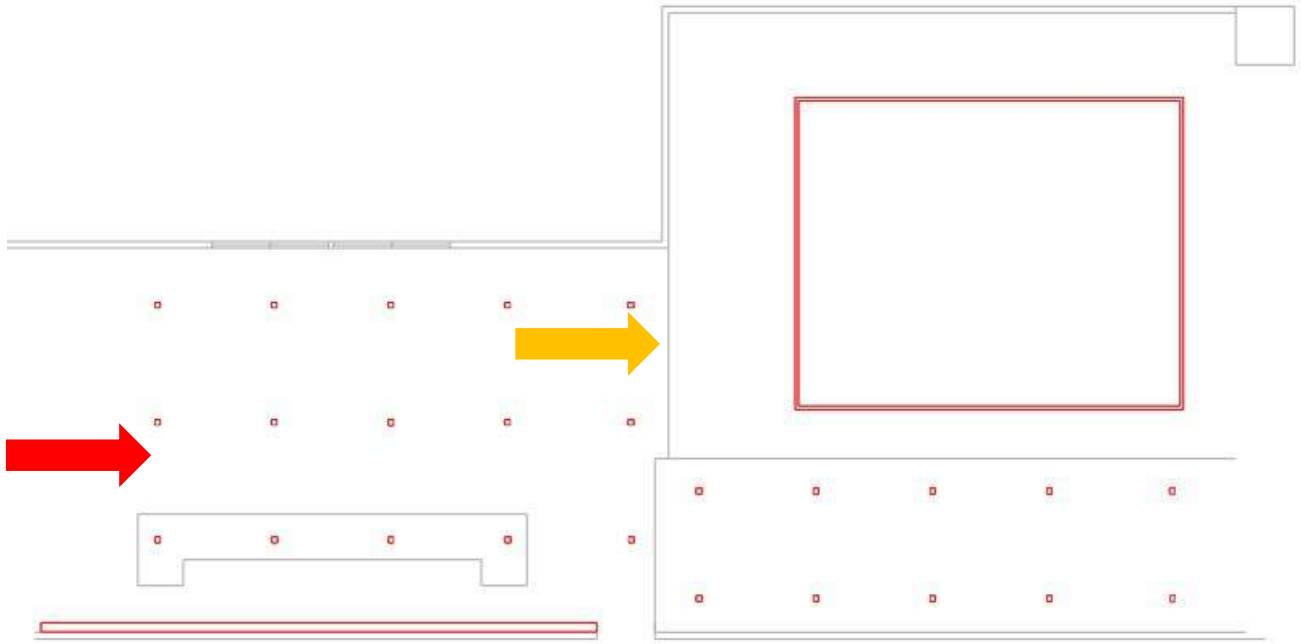
LOBBY DESIGN


Linked in

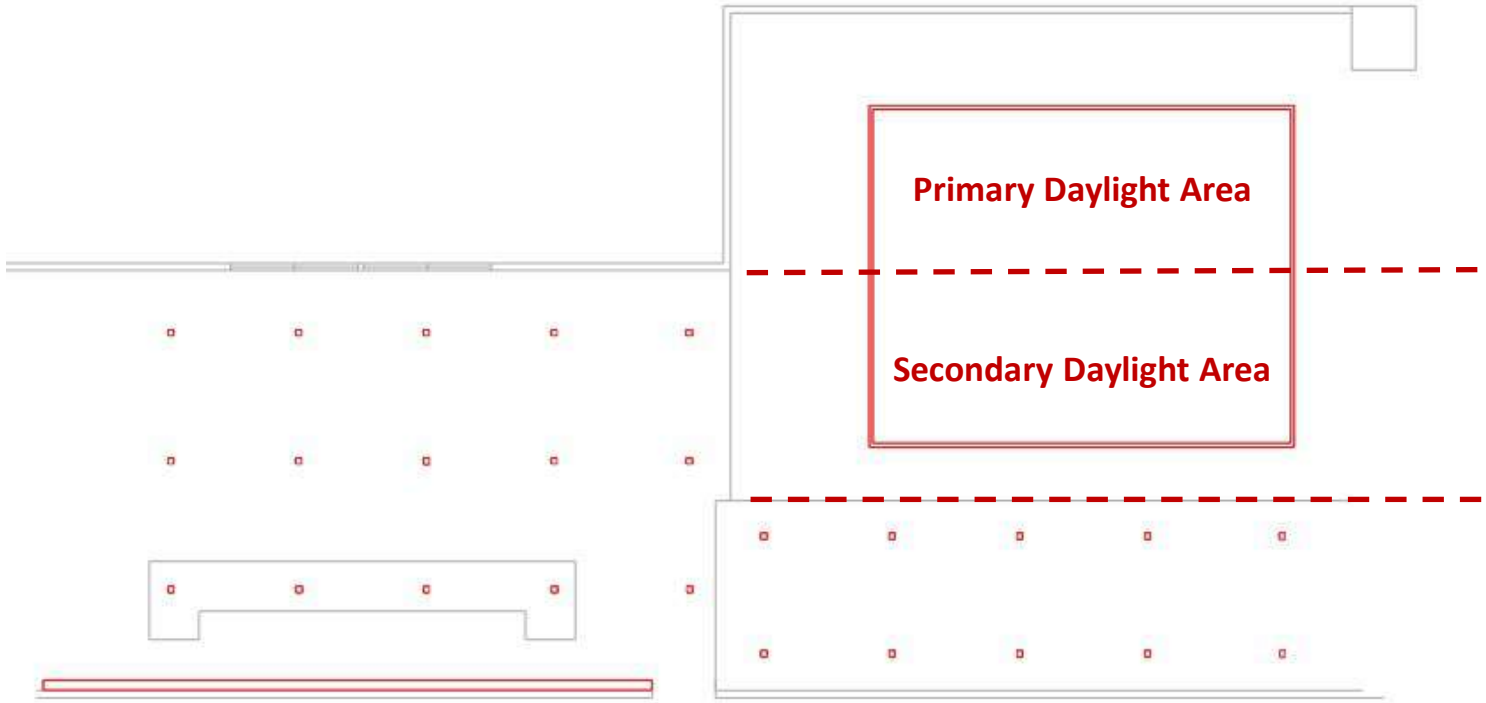
Lobby - Key Design Considerations

- Meet lighting power allowance
- Scheduled or occupancy control?
- Space of security and means of egress, maintain 1fc minimum
- Control accent/decorative lighting separately
- ASHRAE 90.1 requires auto partial off of lighting
- Primary, secondary daylight areas
- Daylight projection factors

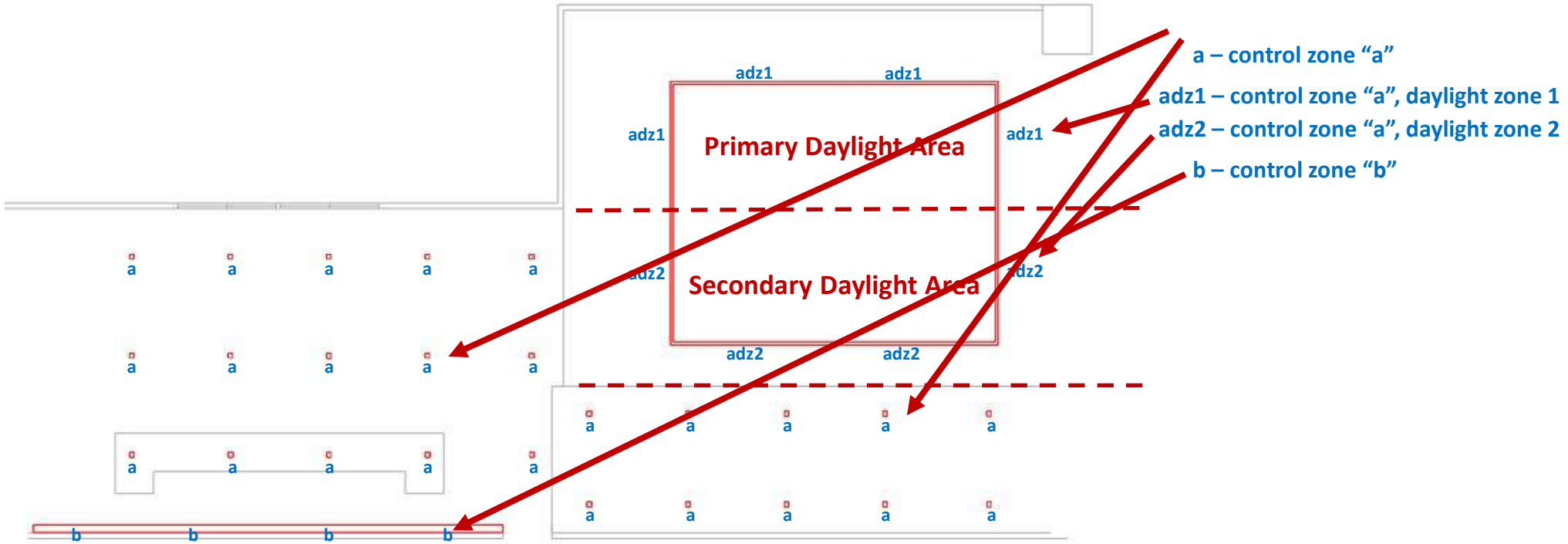
Lobby - Design Breakdown



Lobby - Design Breakdown



Lobby - Design Breakdown



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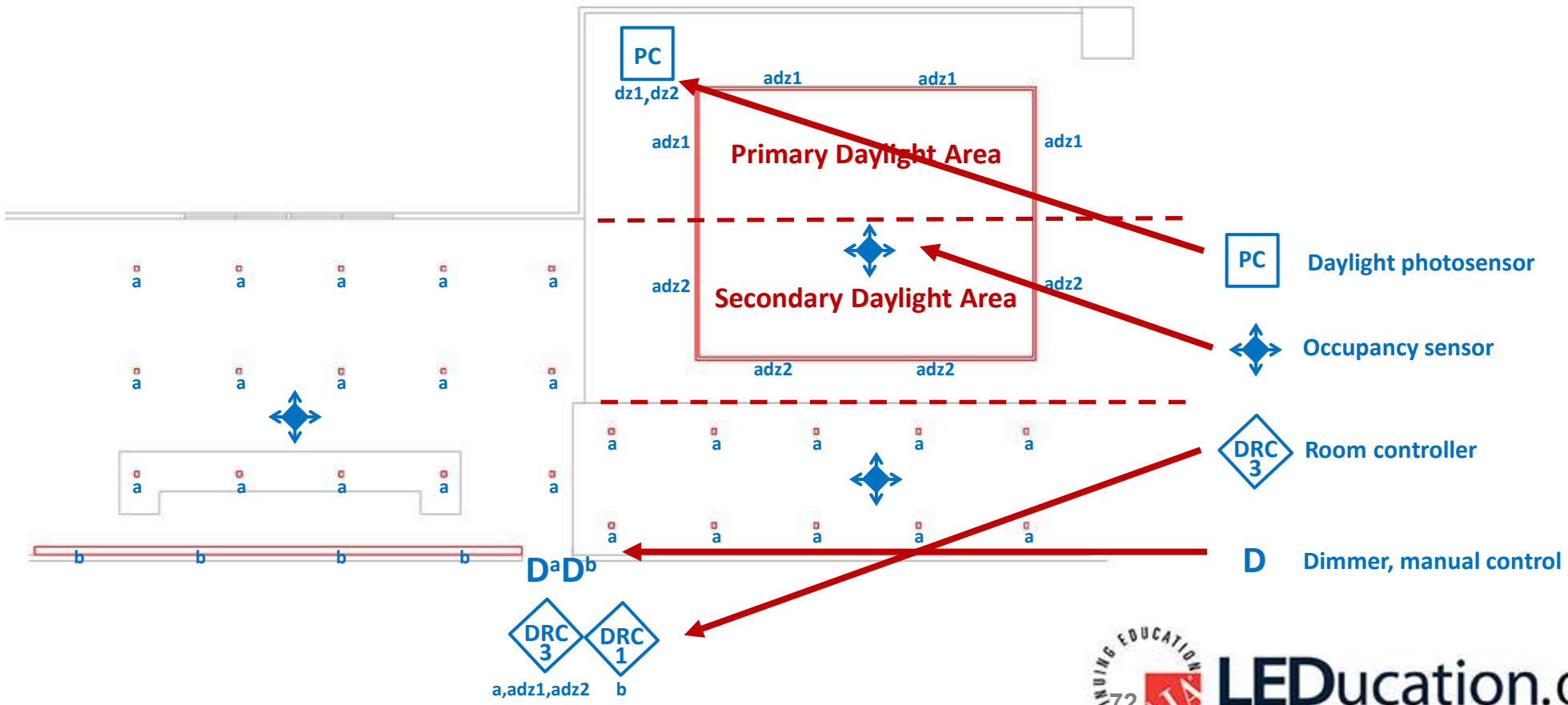
Lobby - Design Breakdown



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Lobby – Sequence of Operations

2021 IECC

Lighting Sequence of Operation

1. Set high end trim illuminance for 25fc(adj) at full on
2. Lighting in primary and secondary daylight areas (adz1, adz2) shall continuously dim and turn off based on daylight contribution to maintain at least 25FC(adj) at task level
3. Manual on/off/dim control general lighting (a)
4. Manual on/off control accent lighting (b)
5. General (a) & accent (b) lighting On to 100% Mon-Sat at 7:30am(adj), Sun scheduled off
6. General (a) & accent (b) lighting turns off Mon-Fri 6:00pm(adj), Sat 1:00pm(adj), Sun off
7. All lighting scheduled off during holidays
8. After scheduled hours, auto on lighting (a) when occupants enter the lobby, automatic off within 20min of occupants leaving the lobby

ASHRAE 90.1-2019

Additional requirement

During operating hours, reduce lighting (a) power ≥50% lighting power within 20min of occupants leaving the lobby

Post-game analysis

Key Winning Strategies

- **Know the rules -** Know your project's mandatory energy code requirements for lighting power and controls.
- **Create a game plan -** Create and document a code-complaint design with OPR, CIN, and SOO.
- **Play execution –** Execute the plan with the application and the people using the space in mind.

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Trade Show and Conference

Thank you

Questions?

Coach Julie Donovan
jdonovan@hlblighting.com

Coach Harold Jepsen
harold.jepsen@legrand.com

Coach Michael Jouaneh
mjouaneh@lutron.com

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This concludes The American Institute of Architects Continuing Education Systems Course

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