217 Networked Lighting Controls For Warehouse

Presented by
Eric Strandberg LC
Sr. Lighting Specialist
November 17, 2020

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Before we begin…

During the Class

- Attendees will be muted
- Please use the chat feature in the control panel to submit questions to LDL staff
- The presenter will pause to address questions every ~10 minutes
- Please participate in the online polls.

Following the Class

- Please take the short survey
- A recording and the slide deck will be posted on LDL's webpage
- Reach out to LightingDesignLab@seattle.gov with comments or questions.

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BETTERBRICKS

Powerful Energy Ideas. Delivered by NEEA.

We'd like to thank today's event sponsor

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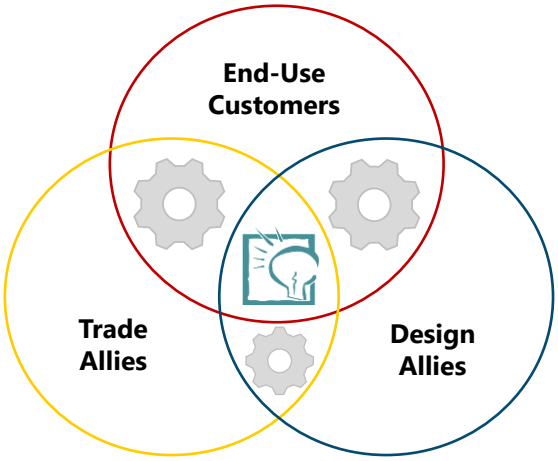
Who We Work With

It takes a village…



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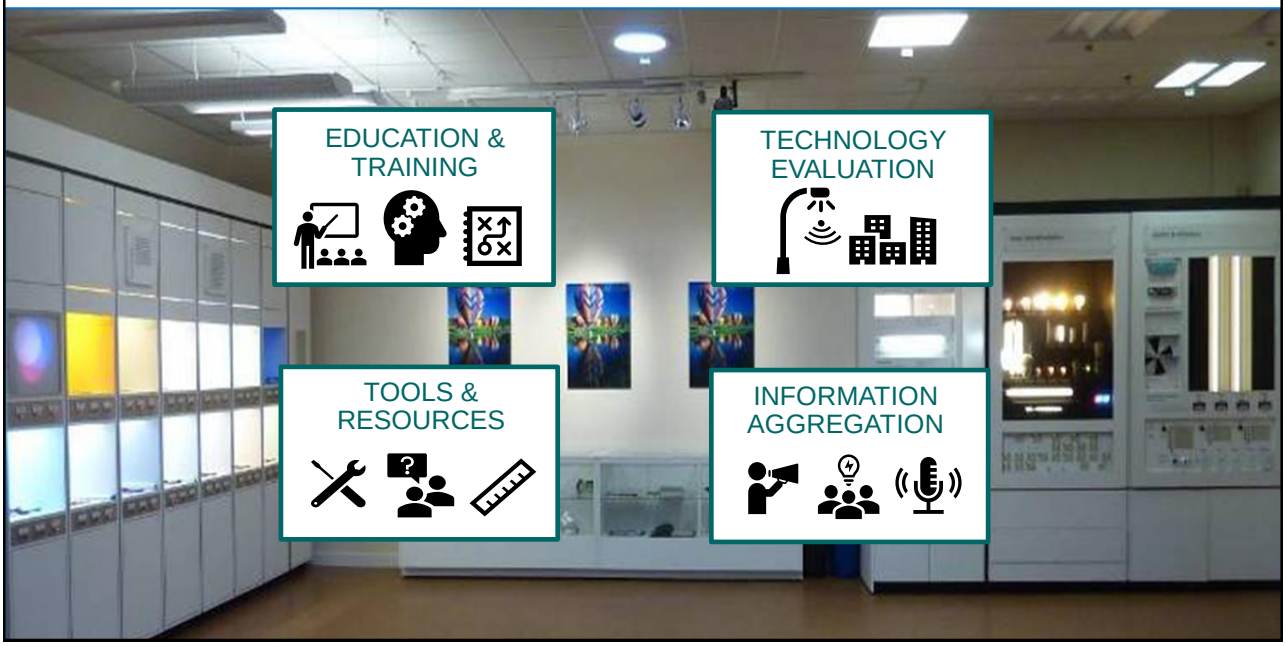
LDL's Four Core Service Areas



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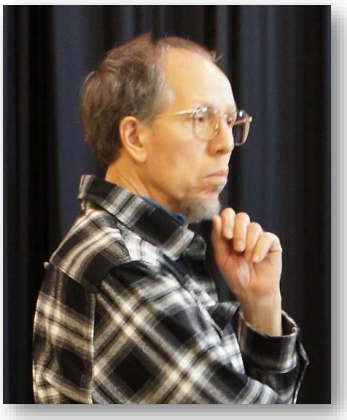

eric.strandberg@seattle.gov

Since 1995 Eric Strandberg LC, has been one of the lighting specialists at the Lighting Design Lab promoting energy efficiency and quality lighting design. With a passion for “all things lighting”, he has over 30 years in the lighting industry. This work encompasses almost every aspect of lighting design and conservation including; developing and presenting classes, writing articles, technology evaluation and project consultation.

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Energy savings potential

- Lighting can represent 60% of a warehouse energy costs.*
- 60 to 70% can be saved just by upgrading from HID to LED.*
- And over 85% when LED is integrated with NLC.*

*Justin Moon- Acuity, excerpted from Electrical Contractor article by Jason Gavin 6/2016

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Learning Objectives

- Understand common lighting control strategies
- Review the fundamental concepts of Networked Lighting Controls
- Review how lighting controls may relate to current light and health research
- Review practical application opportunities for a variety of warehouse specific spaces.

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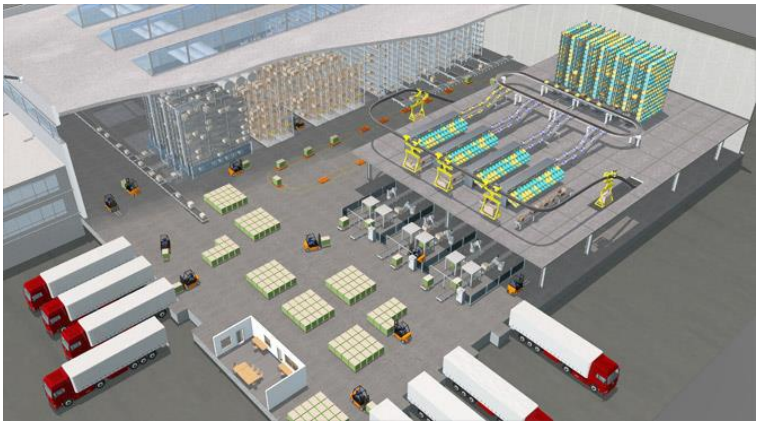
Warehouse/Industrial Spaces

- Shipping/ Receiving
- Storage Aisles
- Open Storage
- Loading Docks
- Maintenance
- Private Offices
- Shared Offices
- Restroom/Showers
- Customer Areas
- Other?



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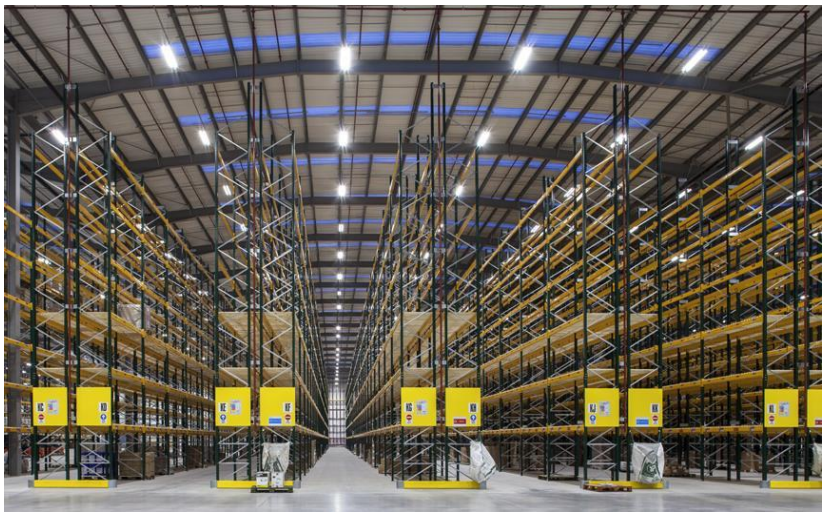
Controls Class

This class is specific to controls….

But a brief review of some of the high points of modern Warehouse Lighting might be in order.



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LED – the defacto light source du jour….

- Solid state light source
- Extremely flexible
- Potentially long lamp life
- Dynamic color opportunities
- White light
- Poor to excellent color rendering

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Architectural Impacts of LED

- Smaller fixtures
- Better efficacy
- Possibly better color
- More flexibility in control
- Longer lamp life
- Reduced maintenance
- Better optics
- Back to dimming
- Better integration
- Potential confusion
- Tunable Color

Courtesy: Lithonia, Cree, Cooper

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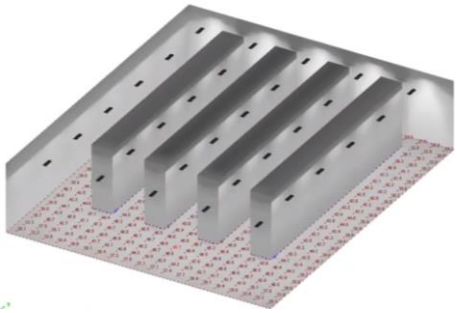
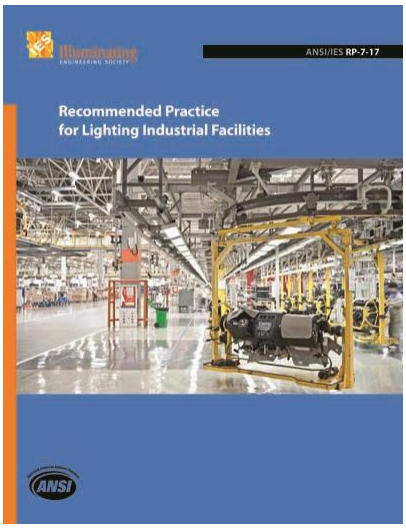
18.3 Warehouse Lighting Design Considerations

- Fixed-location racking…Because of the geometry of aisle space, which generally yields RCRs higher than 10, and because the key visual tasks are in a vertical plane, the Lumen Method of average illuminance is not effective for WH applications.
- The spacing of luminaires can be increased when the luminaires have a substantial uplight component and the ceilings have a high reflectance.





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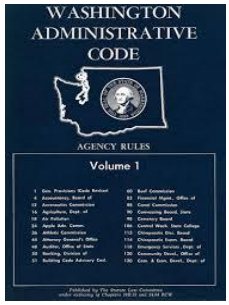
How Much Light Do I Need?*

Building Area & Task	Average Maintained Footcandles (Horizontal) (FC)	Range of Maintained Footcandles (Horizontal) (FC)	Average Maintained Footcandles (Vertical) (FC)	Range of Maintained Footcandles (Vertical) (FC)
WAREHOUSING & STORAGE				
Bulky Items—Large Labels	10		5	
Small Items—Small Labels	30		15	
Cold Storage	20	10 - 30	10	5 - 15
Open Warehouse	20	10 - 30		
Warehouse w/Aisles	20	10 - 30	10	5 - 15

*Based on Recommendations in the IES Handbook 10th Ed.



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How much light will I get? What is the efficacy?

LED Damp Rated High Bay

JCBL

9000, 12000, 15000, 18000, 24000, or 30000 lumens

LITHONIA LIGHTING

JCBL LED Damp Rated High Bay

OPERATIONAL DATA

Lumen package	Input Watts	Ambient rating	Open Reflector	Delivered lumens 3000K CCT, 70CRI	Delivered lumens 3500K CCT, 70CRI	Delivered lumens 4000K CCT, 70CRI	Delivered lumens 5000K CCT, 70CRI	Delivered lumens 3000K CCT, 80CRI	Delivered lumens 3500K CCT, 80CRI	Delivered lumens 4000K CCT, 80CRI	Delivered lumens 5000K CCT, 80CRI	Delivered lumens 3000K CCT, 90CRI	Delivered lumens 3500K CCT, 90CRI	Delivered lumens 4000K CCT, 90CRI	Delivered lumens 5000K CCT, 90CRI
30000LM	236	(-40°F-40°C) 122°F (50°C)	DALR	25277	25933	26708	26708	23847	24562	25039	25516	19554	20270	20985	20985
			DALRN	24084	24766	25448	25448	22721	23403	23857	24312	18631	19313	19995	19995
			SALR	25512	26234	26957	26957	24068	24790	25272	25753	19736	20458	21180	21180
			ACFR	27763	28549	29334	29334	26192	26977	27501	28025	21477	22263	23049	23049
			ACFRN	27483	28261	29038	29038	25927	26705	27224	27742	21260	22038	22816	22816
			ACCR	27853	28642	29430	29430	26277	27065	27591	28116	21547	22335	23124	23124
			ACCRN	26928	27691	28453	28453	25404	26166	26674	27183	20831	21594	22356	22356
			PLCR	25509	26231	26953	26953	24065	24787	25269	25750	19734	20456	21178	21178
			PLCRN	24684	25383	26081	26081	23287	23985	24451	24917	19095	19794	20492	20492

So many options so many variables

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example:** JCBL 24000LM SALR MVOLT GZ10 40K 70CRI SC6

JCBL					GZ10		
Series	**Lumens**	**Reflector**[1]	**Lens**[1,2]	**Voltage**	**Driver**	**Color temperature**	**Color rendering index**
JCBL	9000LM 9,000 lumens 12000LM 12,000 lumens 15000LM 15,000 lumens 18000LM 18,000 lumens 24000LM 24,000 lumens 30000LM 30,000 lumens	DALR Diffuse aluminum DALRN Diffuse aluminum narrow SALR Specular aluminum ACFR Frosted acrylic ACCR Clear acrylic PLCR Clear polycarbonate	(blank) Open bottom For use with aluminum reflectors ALDRP Drop prismatic ALCON Conical ALFGL Flat prismatic For use with acrylic and polycarbonate reflectors ACRDRP Drop prismatic ACRCON Conical ACRFGL Flat prismatic	MVOLT 120-277V HVOLT 347-480V 120 120V 208 208V 240 240V 277 277V 347 347V 480 480V	GZ10 0-10V dimming	30K 3000 K 35K 3500 K 40K 4000 K 50K 5000 K	70CRI 70 CRI 80CRI 80 CRI 90CRI 90 CRI

OPERATIONAL DATA

Lumen package	Input Watts	Ambient rating	Open Reflector	Delivered lumens 3000K CCT, 70CRI	Delivered lumens 3500K CCT, 70CRI	Delivered lumens 4000K CCT, 70CRI	Delivered lumens 5000K CCT, 70CRI	Delivered lumens 3000K CCT, 80CRI	Delivered lumens 3500K CCT, 80CRI	Delivered lumens 4000K CCT, 80CRI	Delivered lumens 5000K CCT, 80CRI	Delivered lumens 3000K CCT, 90CRI	Delivered lumens 3500K CCT, 90CRI	Delivered lumens 4000K CCT, 90CRI	Delivered lumens 5000K CCT, 90CRI	Comparable light source
30000LM	236	(-40°F–40°C) 122°F (50°C)	DALR	25277	25933	26708	26708	23847	24562	25039	25516	19554	20270	20985	20985	8-lamp T5HO, 400W HID
			DALRN	24084	24766	25448	25448	22721	23403	23857	24312	18631	19313	19995	19995	
			SALR	25512	26234	26957	26957	24068	24790	25272	25753	19736	20458	21180	21180	
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Wattage
Lumens
Reflector
Optics
Lens
CCT
CRI

	4K, 70CRI	3K, 90CRI
30,000 nominal lumens. 236 watts.	125 l/w	80 l/w

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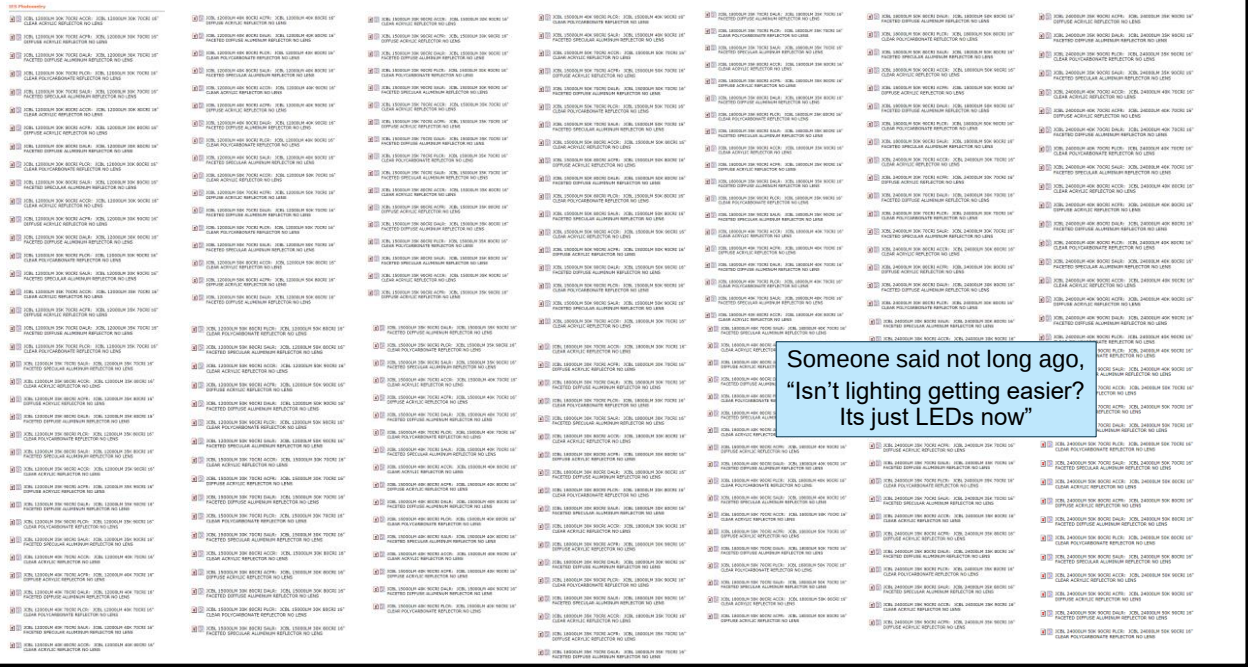
Photometric reports for just **one fixture**- …



Someone said not long ago,
"Isn't lighting getting easier?
Its just LEDs now"

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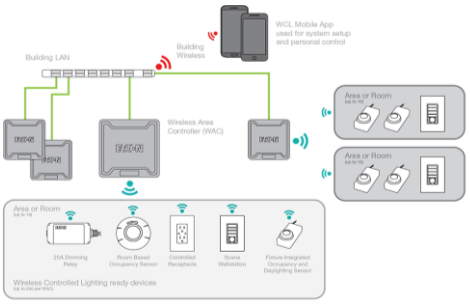
Networked Lighting Control System?



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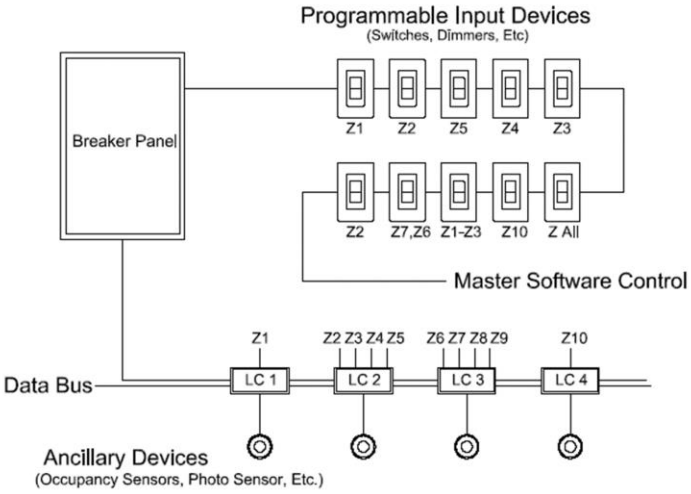
Distributed Systems

Characteristics:

- May be stand alone or integrated.
- Will be a scalable digital system.
- May incorporate scheduling capability
- Will accept input from devices including occupancy sensors and photo-controllers
- Inherently Flexible

Considerations:

- Coordinate digital protocol - LON, BacNet, etc



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Luminaire Level Lighting Controls

- Wrapping the sensors and most of the logic into the luminaire itself ensures compatibility of components.
- Simple to specify and install.
- Highly granular zoning.
- May be capable of only OS/VS and Daylight harvesting.
- Smarter systems will be more capable.
- Will require commissioning to function most effectively.

Courtesy: Acuity, Cree

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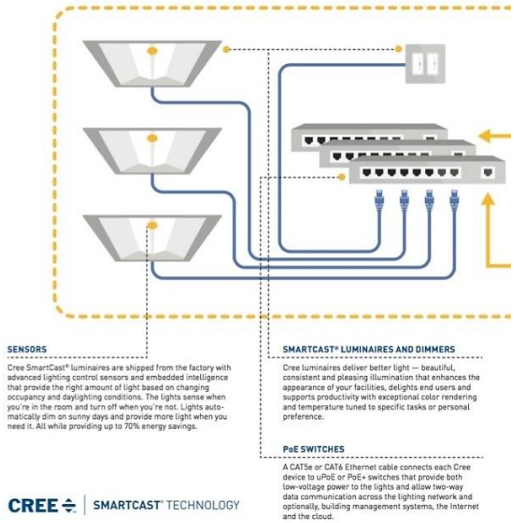
POE – Power over Ethernet

- Open Source Standard?
- Each device has a unique address
- Maximum flexibility
- Maximum commissioning
- All controls strategies possible
- Energy management software
- Lumen Maintenance
- Scheduling
- Data Logging



Courtesy: Cree

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Control Systems

Many different control systems manufacturers available.

- Acuity nLight Air
- Audacy by Ideal
- Cooper Wavelinx
- Cree Smartcast
- DigitalLumens
- Encellium Edge
- ETC Echoflex
- Lutron Vive
- LinkT air

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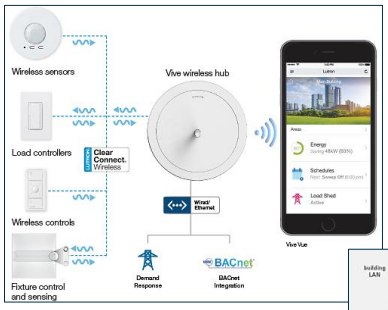
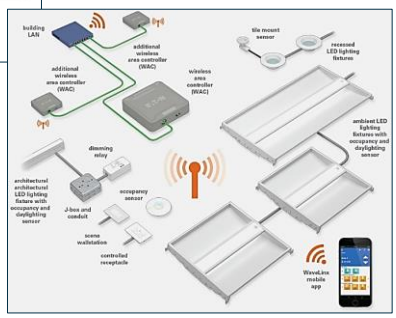
Networked Lighting Controls Today

- Distributed
- Wireless
- More Capable
- More Complex
- Less Complicated
- Less Costly
- Easier to Install / Commission
- Compatible
- Integrated
- Better!





Courtesy: Lutron, Eaton

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Typical Control Strategies

- Manual Switching
- Manual Dimming
- Scene / Preset Control
- Occupancy Sensing
- Vacancy Sensing
- Daylight Harvesting
- Task Tuning
- Time Scheduling
- Astronomic Scheduling

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Manual Switching

- Line voltage
- Low voltage with relays
- Zones or groups
- Simple to design
- Easy to understand
- May not meet codes

Courtesy: GE, Leviton

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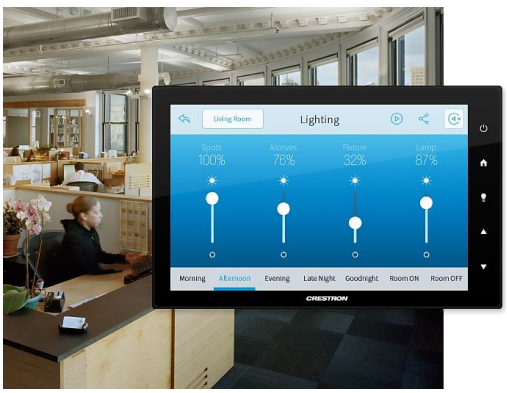
Manual Dimming

- Line voltage
- Low voltage remote dimming
- Networked System
- Zones or groups
- Simple to design
- Easy to understand
- Users like personal control



Courtesy: Lutron, Leviton, Crestron

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Scene / Preset

- Grouping of zones at specific levels
- More complicated
- Simply Repeatable
- May be confusing
- Consider engraving

Courtesy: Lutron, Leviton, Pharos

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Occupancy Sensing

- Automatically turn lights on or off depending on occupancy
- May have some residual angst over older systems
- Supplanted by vacancy sensors in many cases.
  - Public spaces
  - Corridors / Stairwells
  - Toilet rooms
  - Warehouses
  - Parking garages
  - Site lighting

Courtesy: **Lighting Controls Association, 2017.**

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Vacancy Sensing

- Automatically turn lights off when no occupants are present
- Requires manual touch to turn on.
- May have some residual angst over older systems.
- Users may require some training.
  - Almost all enclosed commercial spaces
  - Offices
  - Breakrooms
  - Storage

Courtesy: **Lighting Controls Association, 2017.**

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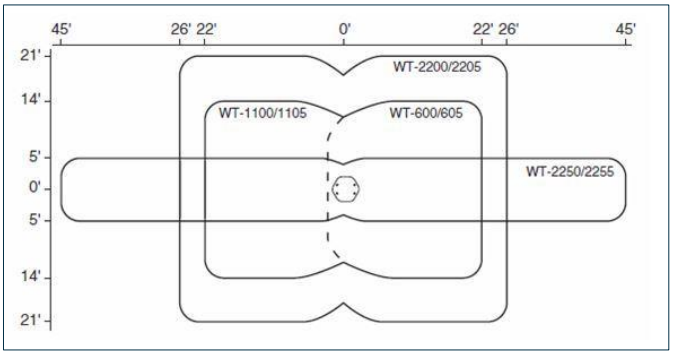
Sensor coverage patterns

- Be sure to select a pattern appropriate for the tasks.
  - Open area
  - Aisles
  - Small area w/out walls



Courtesy: **Lighting Controls Association, 2017.**

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Task Tuning / High Trim

- Setting a high trim tuned to deliver the target illuminance level.
- Can reduce glare
- Can balance brightness
- Can save as much as 20-30% of the energy in a typical system.
  - Offices
  - Education
  - Public Spaces
  - Circulation
  - Warehouse / Industrial

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Time Scheduling

- Lighting is governed by time-of-day events rather than occupancy or vacancy sensing.
- Multiple calendars required for effective use.
  - Areas in which OS/VS would pose difficulty

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Daylight Harvesting

- Luminaires are governed by photo-sensors determining real time daylight availability
- Continuous range dimming is preferable to threshold-based switching.
  - Offices
  - Public Spaces
  - Circulation
  - Warehouse / Industrial

Courtesy: Sunoptics

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Newer Controls Strategies

- Tunable White
- Circadian Lighting
- Specific color tuning adjusting the correlated color temperature / SPD along the black body radiator curve.
- Meant to affect mood or alertness.
- Generally based on LED capabilites

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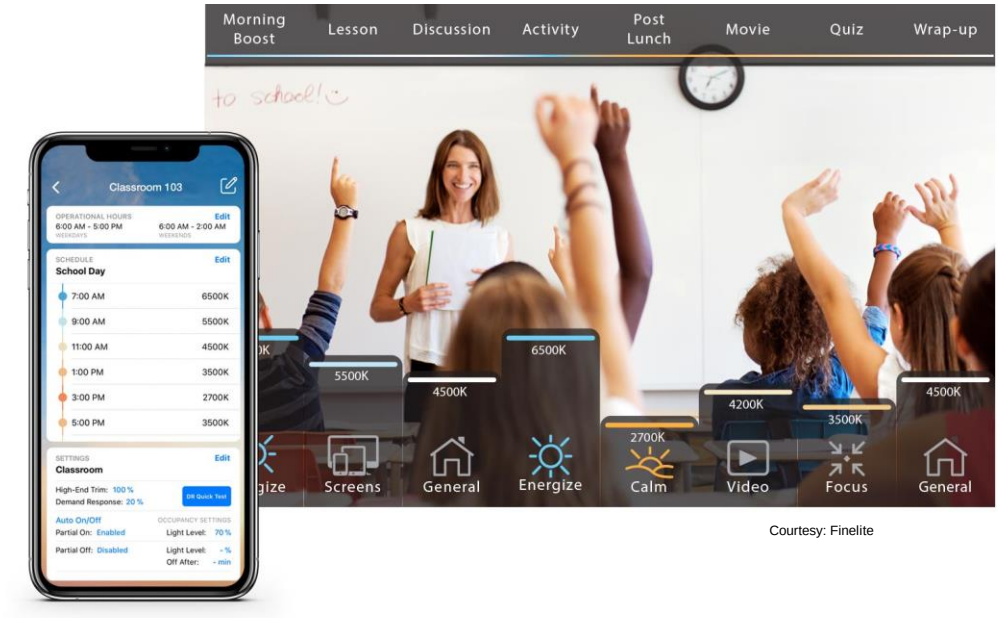
Tunable White



Courtesy: Finelite

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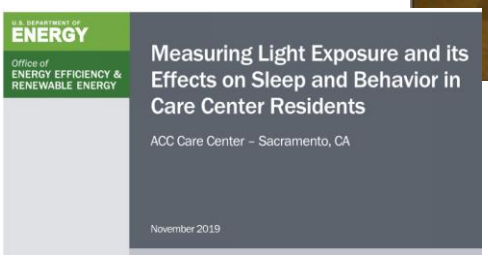
Circadian Controls

ACC Care Center



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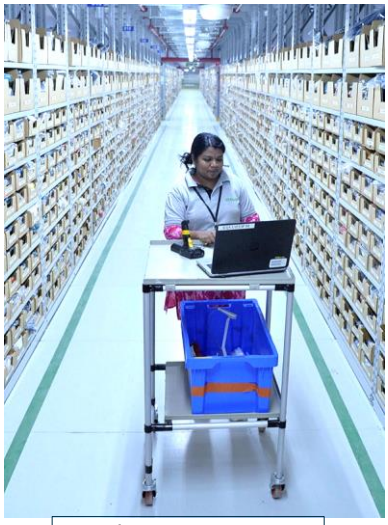
Circadian Controls- Possible scenarios for a typical day.*



Morning- 6500K, 110%

Day- 4000K, 90%

Evening- 3000K, 75%

* For concept only.- Not vetted scientifically

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Circadian Rhythm and Light Spectrum

Can electric lighting stand in for daylight?

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Color tuning an interior space

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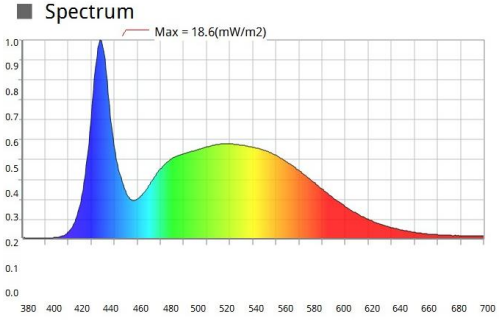
Color tuning an interior space 6500K



6126K
82 CRI (R9=11.7)
574 lux (53 fc)

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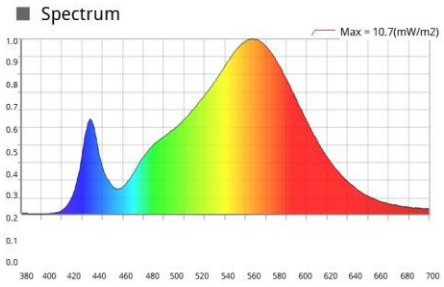
Color tuning an interior space 3000K



2934K
84 CRI (R9=18)
526 lux (49 fc)

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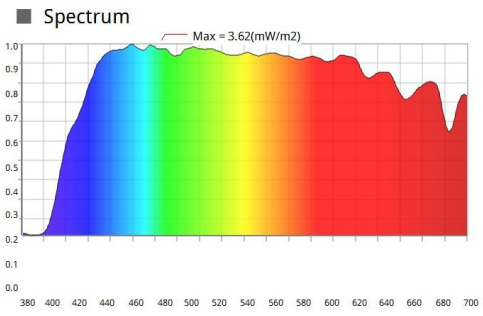
Color tuning an interior space Solatubes only (cloudy)



5220K
98 CRI (R9=97)
252 lux (23 fc)

Parking Lot Outside
5450K
99 CRI (R9=98)
6,609 lux (614 fc)

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Historic factory buildings incorporated daylight. Why?

Because they had to!

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Light and Health

There is a huge amount of research going on today with respect to light and human physiology / non visual effects of light.

- Circadian systems
- Sleep impacts
- Aging Populations
- Dementia
- Behavior Modification
- Alerting Functions
- Blue Light Hazard
- Flicker

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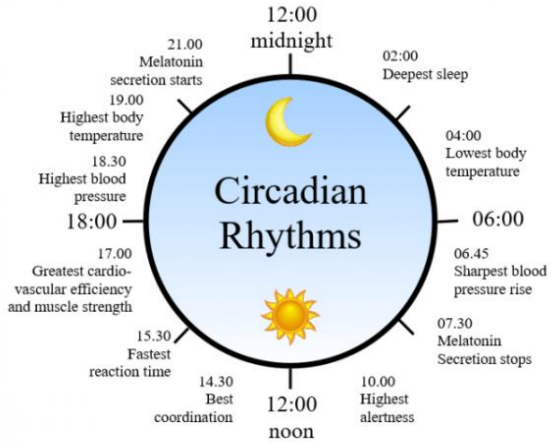
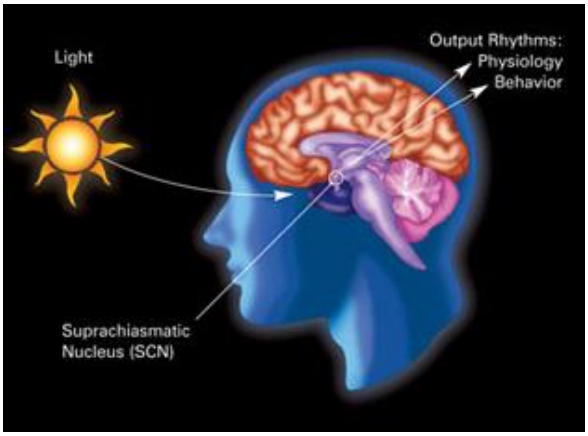
Light has a role in circadian rhythm?





Courtesy: NIGMS/NIH

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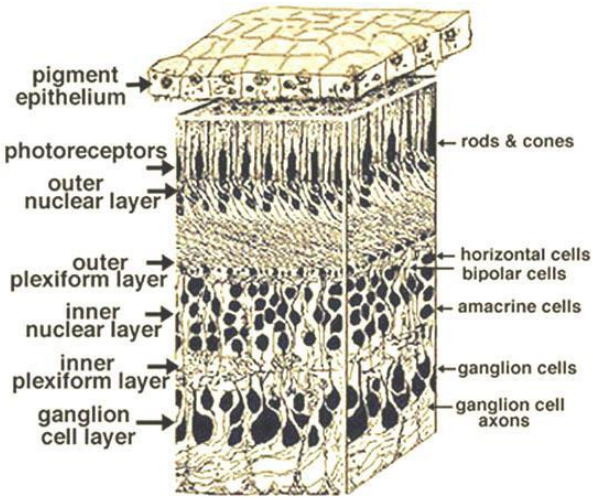
What about non-visual light stimulus?

- A new photo-receptor was identified in 2002 in humans.
- Melanopsin-expressing, Intrinsically Photosensitive Retinal Ganglion Cells ipRGC
- Studies suggested that existing visual structures – rods and cones – were unrelated to light response and the circadian timing cycle.



Courtesy: webvision.med.utah.edu

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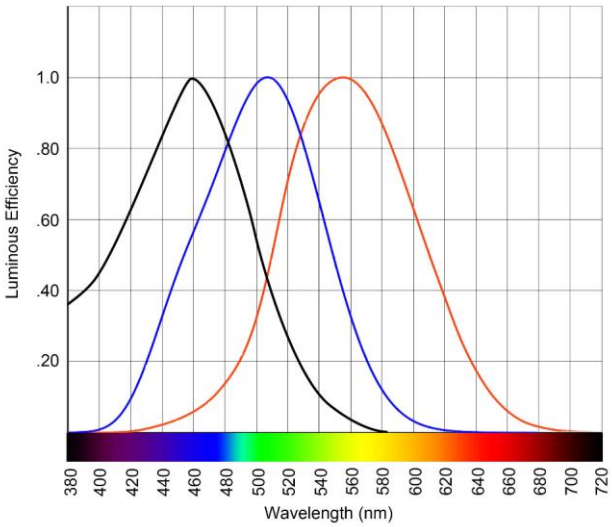
ipRGC

Intrinsically Photosensitive Retinal Ganglion Cells

- Non vision forming light receptors
- Slow response
- Melanopsin

- Circadian Rhythm
- Pupil Size
- Melatonin suppression



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Key Light Stimulus Variables

- Intensity
- Distribution
- Spectral Power Distribution
- Duration – Dose
- Timing

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Intensity

- How much light is incident on the eye
- Lux
- Typically measure at eye height for most environments

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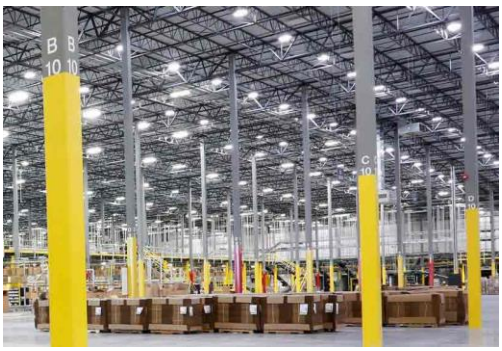
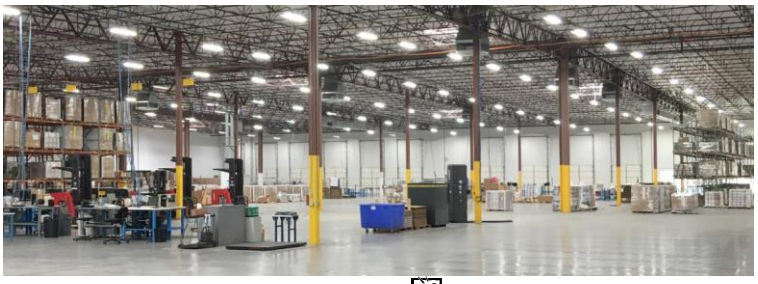
Distribution

- Direction of light matters
- 90 degrees from nadir and higher
- Think about blue sky light





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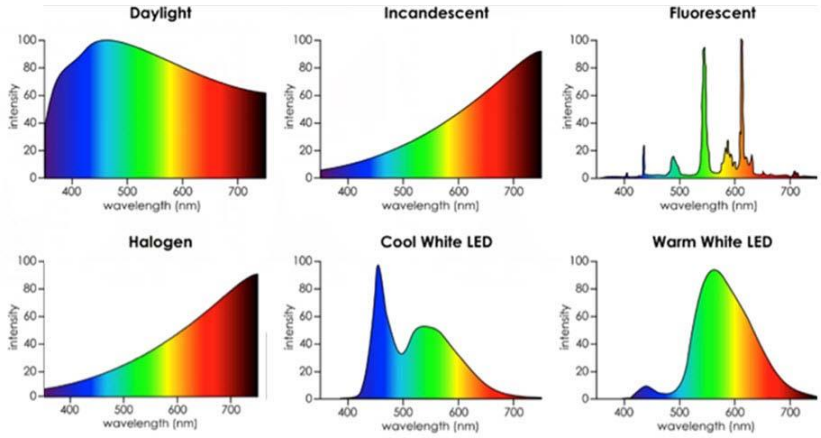
Spectral Power Distribution

- What wavelengths are present in the light source
- Heavy reliance on blue wavelengths
- Research is showing this may not be as important as thought



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Duration - Dose

- How long are you subjected to the light stimulus?
- At what intensity was the light stimulus?

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Timing

- What time are you subjected to the stimulus?
- Resetting the circadian clock at 5:30 pm may not be the best choice for day active workers.

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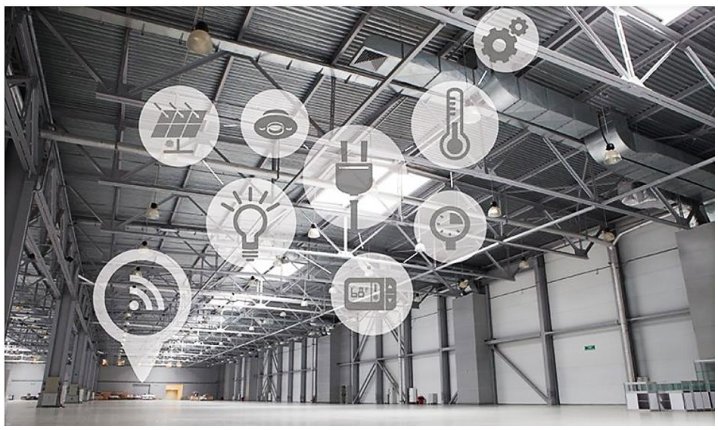
Lighting Controls to the Rescue

- Intensity
- Distribution
- Spectral Power Distribution
- Duration – Dose
- Timing

- If only we had a convenient means of manipulating most of these variables….



Courtesy MatrixLED

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What Do We Know?

- Well……
- The research is ongoing…
- Consensus standards have yet to be promulgated…
- There are limited practical application research examples.

- There's a lot of interest in the public press and the with the public.

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Hardware Evolution

- Line voltage switch
- Three way switch
- Contactor
- Low voltage hardwired relay
- Wallbox dimmers
- Preset control dimming
- Luminaire addressable hardwired
- Zone control wireless
- Luminaire addressable wireless
- POE (Power Over Ethernet)
- IOT (Internet of Things)

Remember that a parallel evolution in controllable light sources has been taking place, enabling NLC.

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Why use advanced lighting controls?

- Flexibility
- Productivity
- User Satisfaction
- Maintenance
- LEED / WELL / LBC
- Energy Savings
- Energy Codes
- Staff Wellness
- Aesthetics

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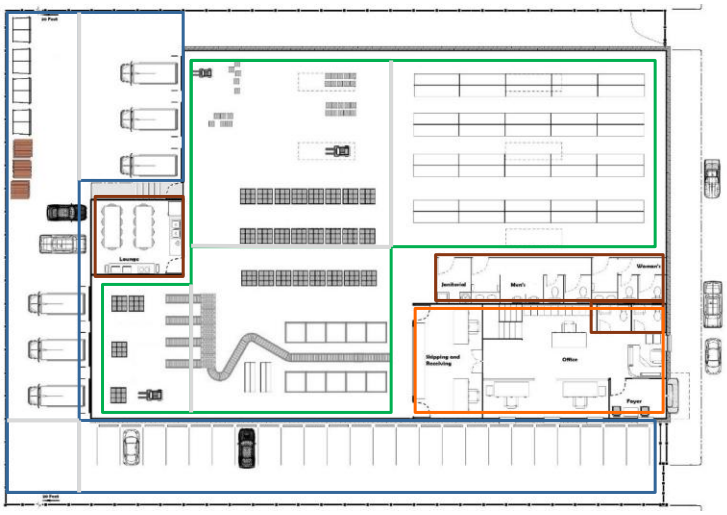
Typical zoning for a warehouse

- Master switch or timeclock for warehouse area. *(In green.)*
- Main office lighting on a switch. *(In orange.)*
- Photocell for exterior. *(In dark blue.)*
- Occupancy sensors for restrooms and lounge. *(In dark red.)*



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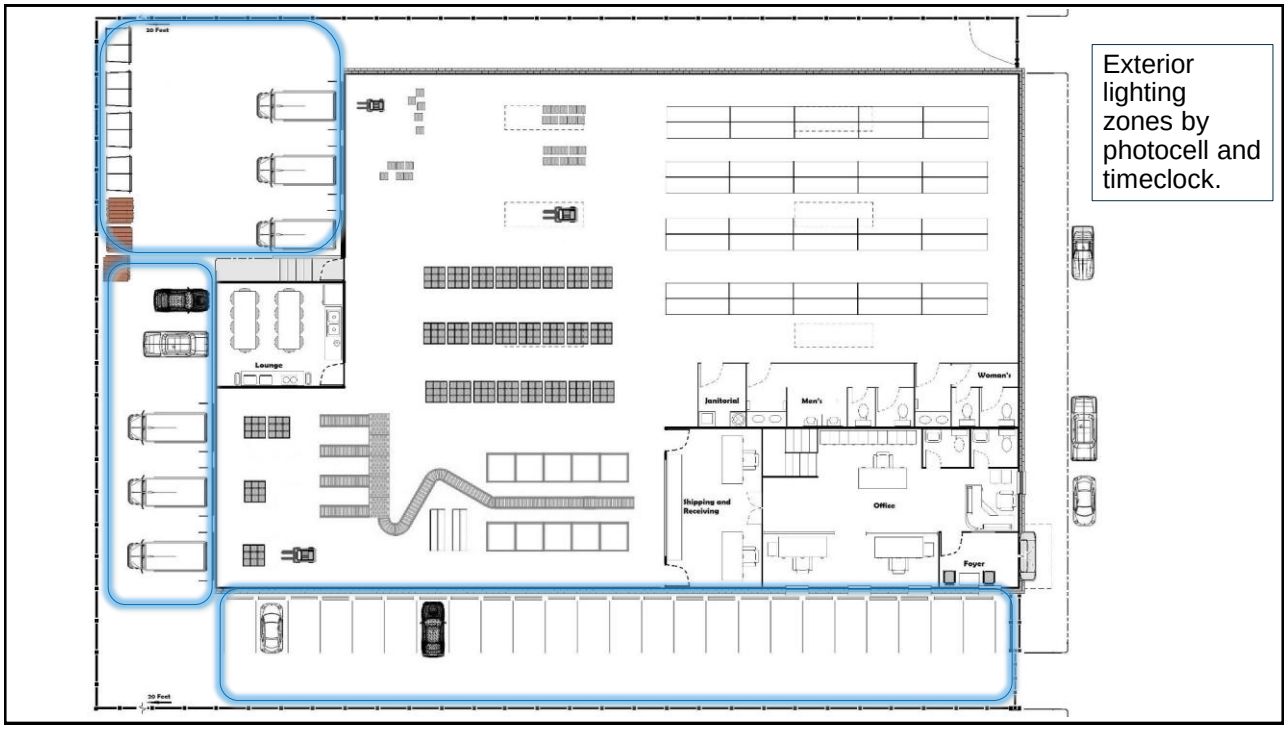
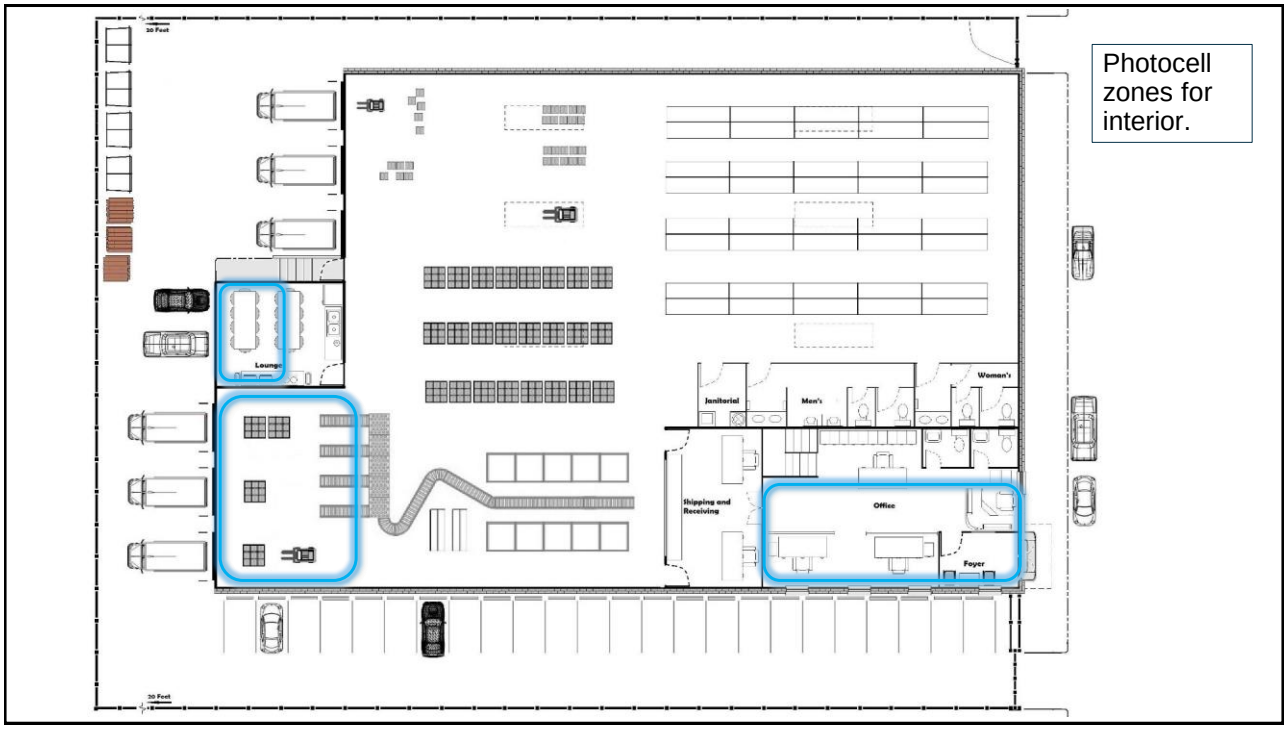

Exterior lighting zones by photocell and timeclock.
Lounge
Janitorial
Men's
Women's
Shipping and Receiving
Office
Foyer
30 Feet

61


Photocell zones for interior.
Lounge
Janitorial
Men's
Women's
Shipping and Receiving
Office
Foyer
30 Feet

62

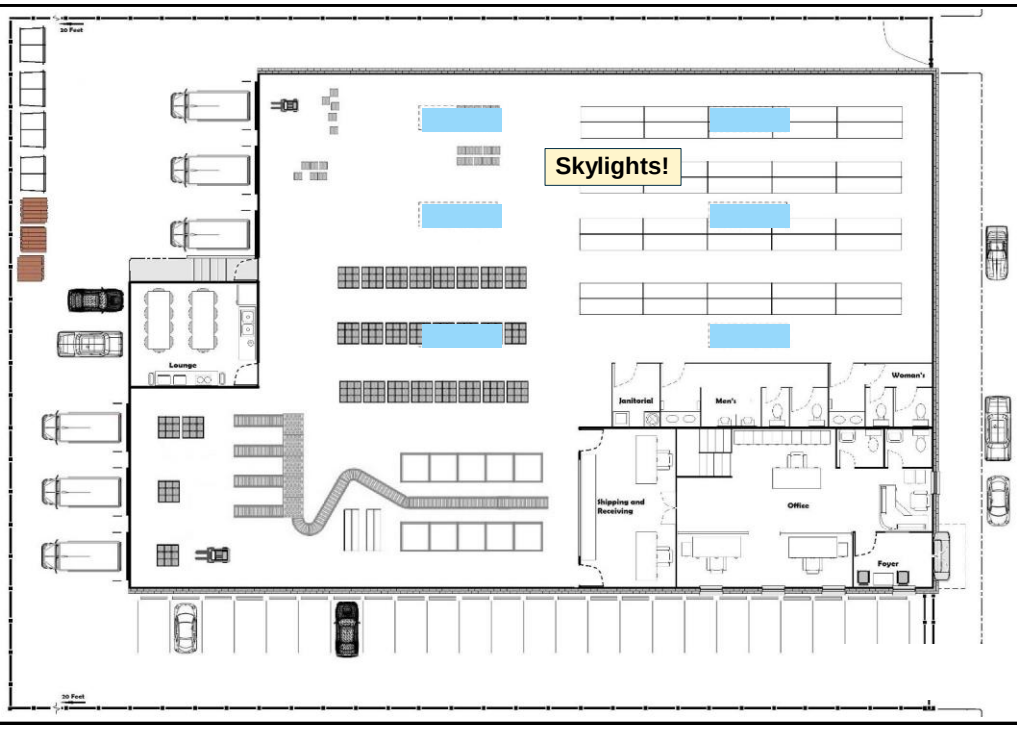


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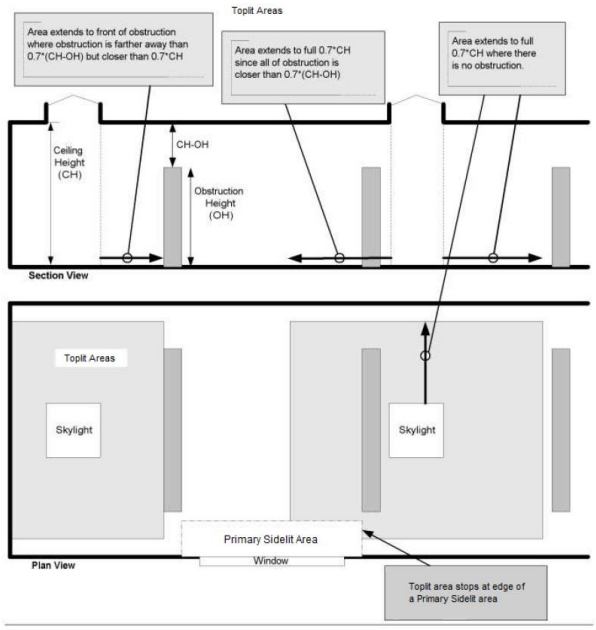
FIGURE C405.2.4.3(1)
TOPLIT ZONE UNDER A ROOFTOP FENESTRATION ASSEMBLY



2018 WA St Energy Code Daylight Zones

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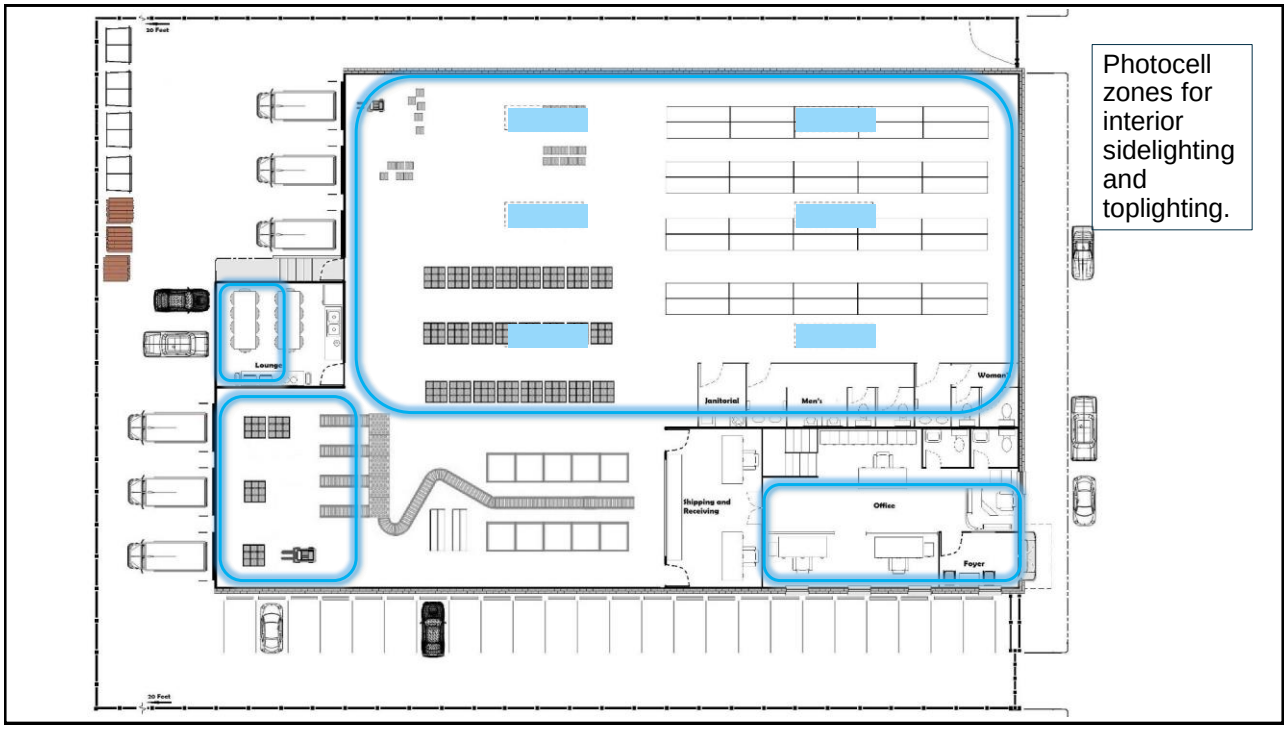
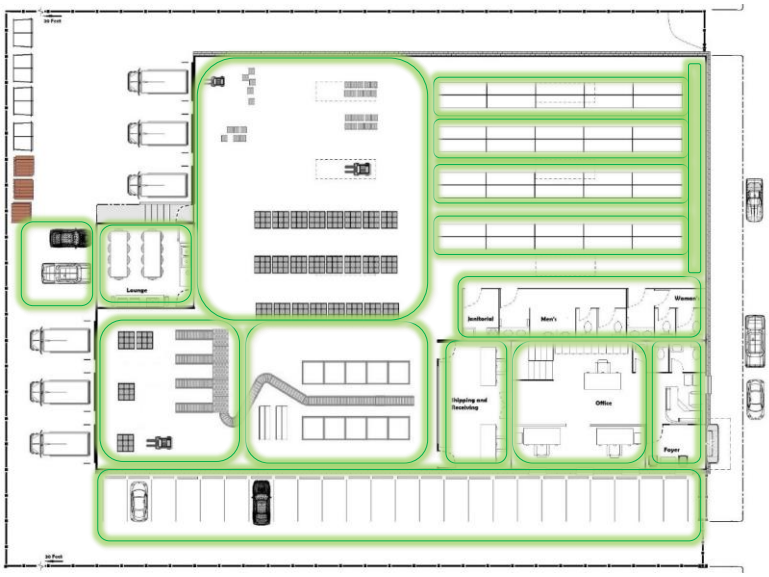

Photocell zones for interior sidelighting and toplighting.
Lounge
Janitorial
Men's
Women
Shipping and Receiving
Office
Foyer

65


Occupancy zones for interior and exterior
Lounge
Janitorial
Men's
Women
Shipping and Receiving
Office
Foyer

66



Occupancy zones for interior and exterior- Possible Sequence of Operation:

- Minimum 10% during regular hours for interior. (unless daylight 3x target.)
- Aisles go to 85% upon occupancy for 3 fixtures around activity. (Task tuning).
- Back aisle goes to 50% upon any aisle activity. (To mitigate contrast)
- Egress fixtures go to 110% upon egress event (power failure, fire, earthquake, etc.) due to lack of contribution.

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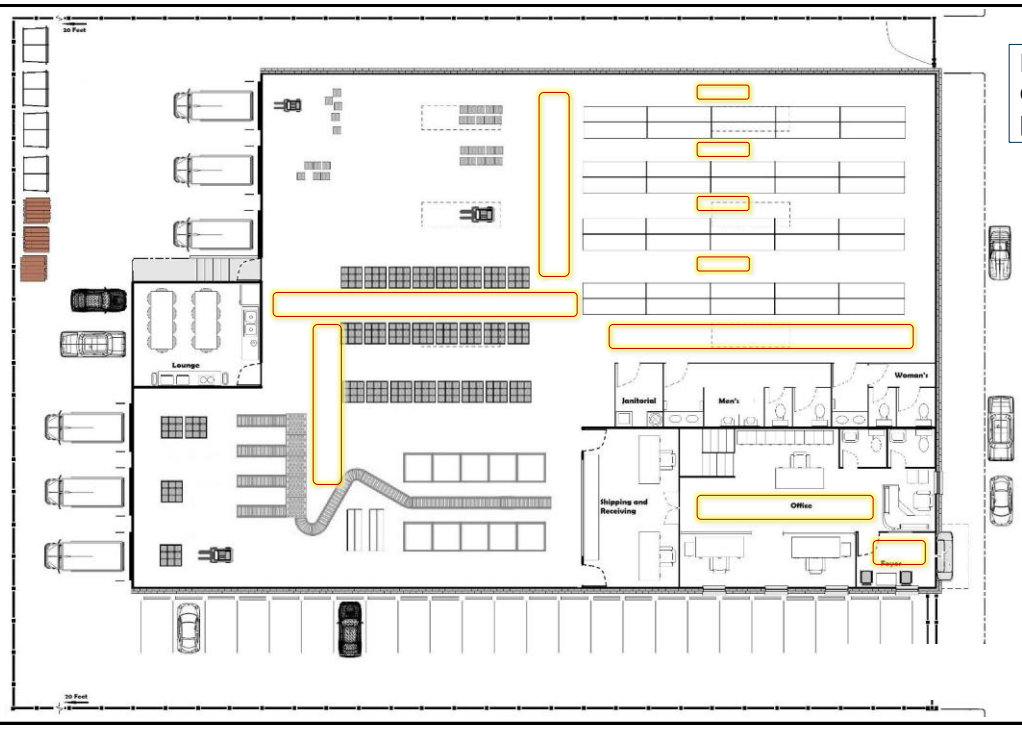
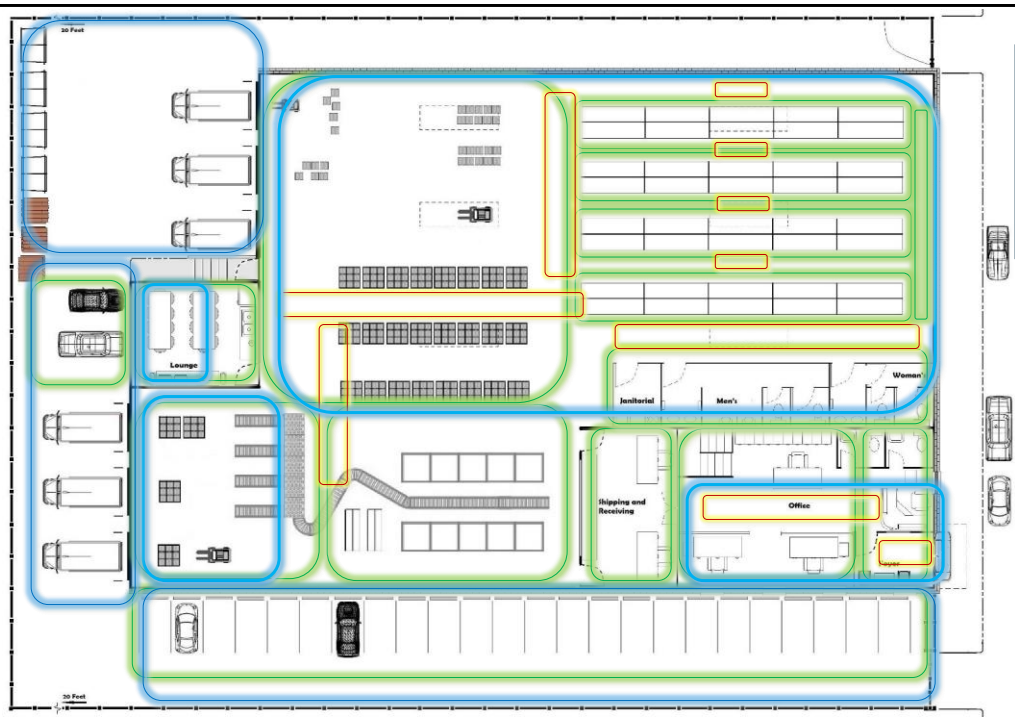


Possible egress paths.

68



Adding in all the zones together makes for a complicated controls zoning plan.

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WaveLinx- Connected Lighting System

- Wireless
  - With its intuitive mobile application used for programming, WaveLinx Wireless is easy to install and get running. Its rich portfolio of wireless sensors, control devices and accessories make it the ideal solution for indoor and outdoor applications.
- Wired
  - Offers all functions needed to meet your applications from a floor to a complex. The system includes the ILP series panels that can perform multi zone 0-10V dimming, multi loop DALI based addressing, multi zone relay switching.
- WaveLinx Lite
  - Eliminates all the hassles associated with a complex lighting controls solution making the commissioning process intuitive and flexible

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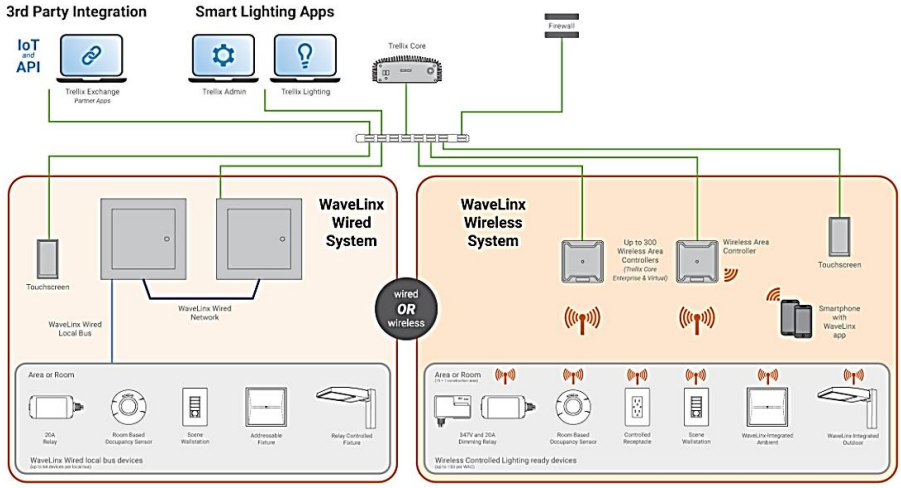
WaveLinx- Connected Lighting System



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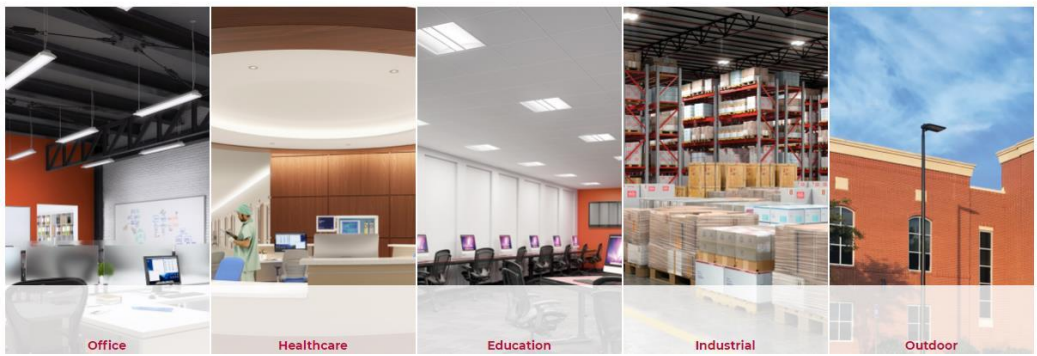
WaveLinx- Connected Lighting System

Designed to meet all commercial/industrial applications

WaveLinx is an ideal solution for both small and large projects. Scale from one room to an entire floor, or from one building to multiple buildings and sites.

Ideal for these spaces:



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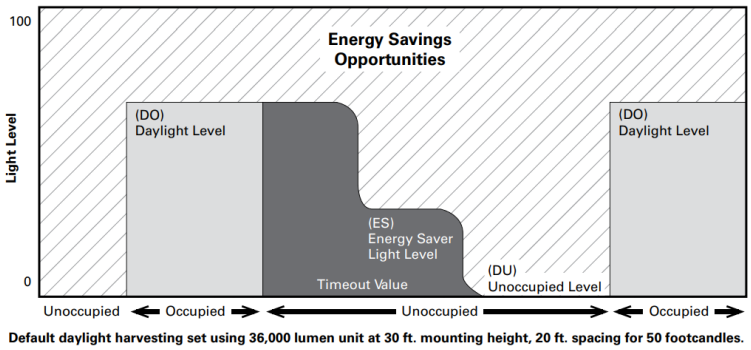
WaveLinx- Connected Lighting System- w/ LLLC



Default daylight harvesting set using 36,000 lumen unit at 30 ft. mounting height, 20 ft. spacing for 50 footcandles.

Metalux

VHB

LED High Bay Luminaire

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Connected Systems CLICK HERE

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WaveLinx- Connected Lighting System
Case Study- Warehouse distribution, Spanaway, WA

"The goal of the project was to provide a low maintenance easy to use solution that would only use lighting in locations requiring it for use and avoid having lights burn all day for no reason.
Energy savings as a result of zoned occupancy control was roughly 30-50% in comparison to a standard timeclock control of the space."
–Justin Blair SeaTac Lighting

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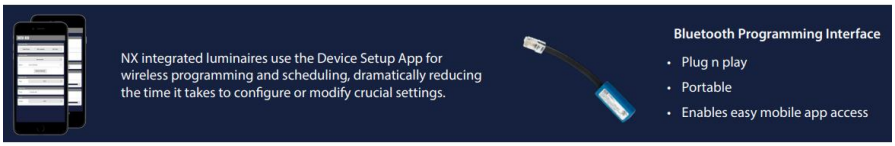
NX- Distributed Intelligence

- Wired
  - Where the ceiling is accessible, low-voltage Cat5 cable connects the system together.
- Wireless
  - When areas controlled by NX are not as accessible, wireless accessories can be added anywhere along the way
- Hybrid
  - NX allows any combination of these networks. The system can be configured and managed wirelessly using the mobile App designed for both Android™ and iOS platforms.

Room Controllers

Daylight Sensors



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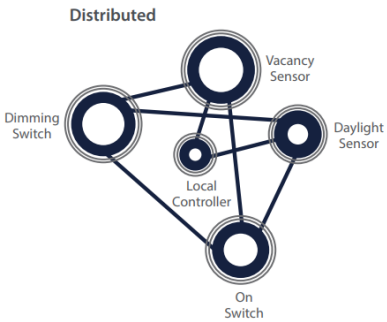
NX- Distributed Intelligence

- The NX system utilizes the Distributed Network Architecture, or DNA. Each part in the NX system always knows what its role is.
- This structure allows NX to scale from a single intelligent fixture to an entire building or campus using only parts needed for the task without, central processors or gateways.
- NX systems are flexible, easy to design with and can be used in a wide variety of applications, including education, office, industrial and outdoor venues



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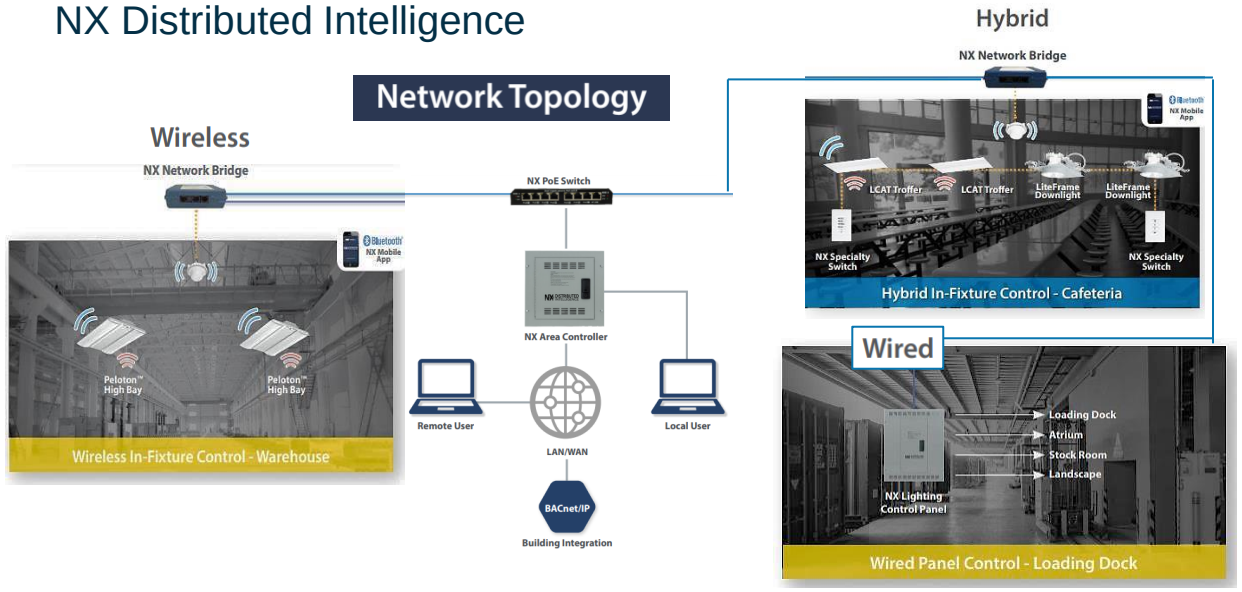
NX Distributed Intelligence



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NX- Distributed Intelligence- w/ LLLC

PEL

PELOTON™ HIGH PERFORMANCE HIGH BAY

Shown with NXSPWH option

Columbia LIGHTING

HUBBELL Lighting PLS (206) 323-2200 lighting design lab

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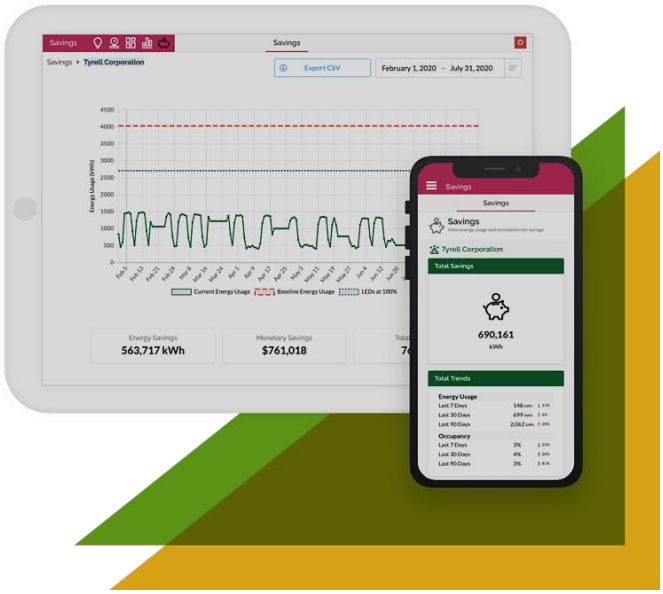
SiteWorx

- SiteWorx Sense
  - Meter and monitor equipment, utility services, sensory data, and environmental conditions.
- SiteWorx Area
  - Observe occupancy and activity in facility in real-time.
- SiteWorx Tune
  - Optimize lighting and reduce energy use.



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SiteWorx Tune

- SiteWorx Tune uses innovative controls, such as:
  - occupancy sensing
  - task tuning
  - daylight harvesting
  - progressive dimming
  - automatic setback

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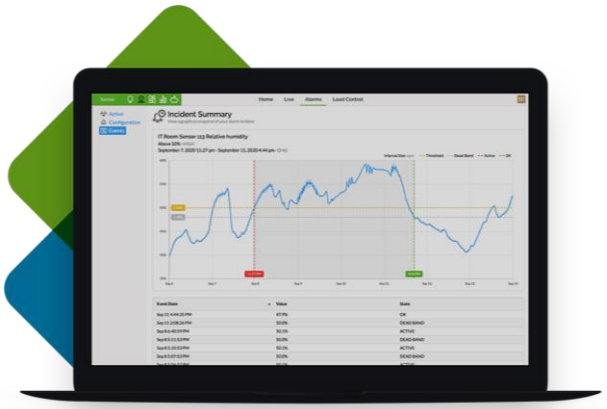
SiteWorx Sense

- SiteWorx Sense is a facility, utility, and process monitoring and management application.
- **Meter and monitor:**
  - Key equipment and processes. Detect changes in temperature, vibration in machinery.
  - Energy consumption, wastewater flow, gas and steam usage, etc.
  - Environmental conditions to verify temperature, relative humidity, air quality, decibel levels and other variables to ensure adherence to environmental health and safety standards.



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SiteWorx Area

- **Monitor and observe:**
  - Historical occupancy patterns for your site on an intuitive heatmap. Monitor occupancy changes over time to understand the operating rhythm of your facility.
  - Critical spaces and zones to know exactly how and when these spaces are being used.
  - Asset location for safety and efficiency. Get a persistent record of where people, equipment, and goods are.

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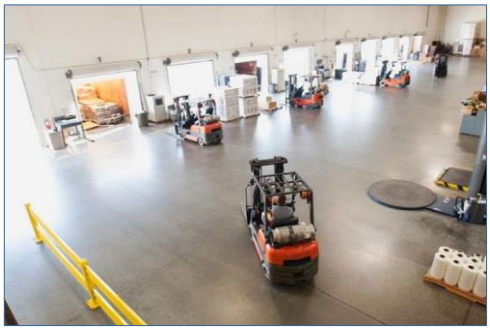
SiteWorx Lightelligence w-LLC

- **RLE-** With an interchangeable smart sensor and Bluetooth® technology



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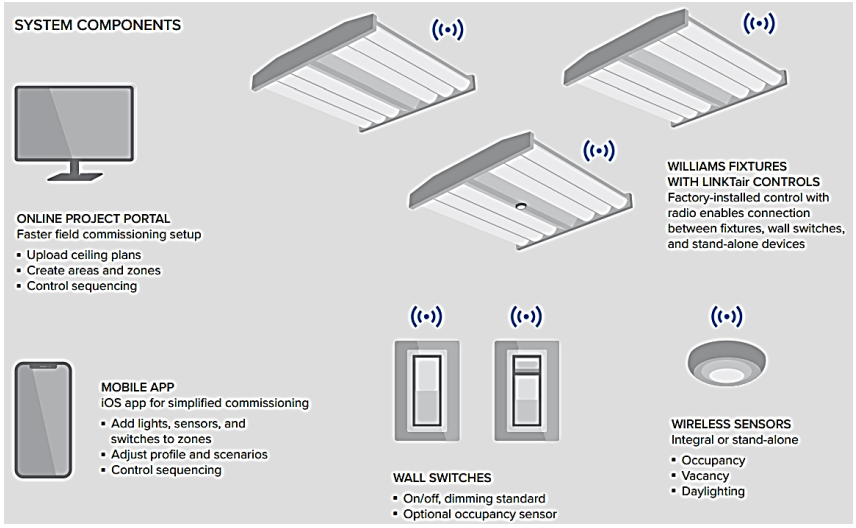
LINKTair- Wireless Control Solution



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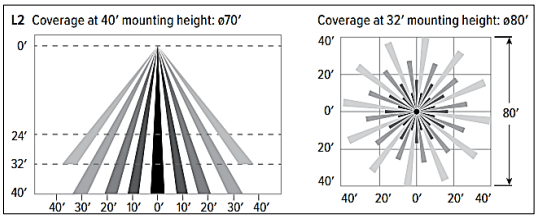
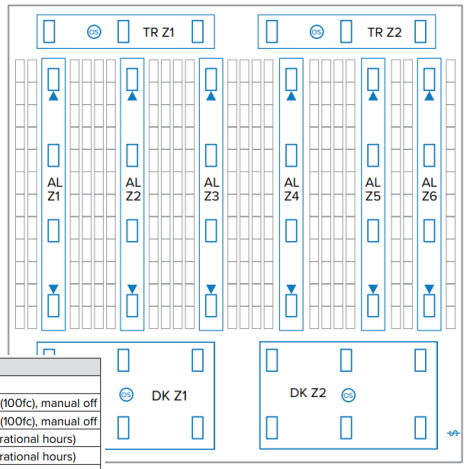
LINKTair- Wireless Control Solution





ZONE NAME	CONTROL DEVICE	LOCATION	CONTROL TYPE	SEQUENCE OF OPERATION [1]
ALL LIGHTS	Wall switches	Near dock doors	Manual control	Manual on, auto on/off via OCC, manual off
DK Z1	OCC sensor	Ceiling mount	OCC sensor w/daylighting	Manual on, auto on/off via OCC (15 min delay) or daylight (100fc), manual off
DK Z2	OCC sensor	Ceiling mount	OCC sensor w/daylighting	Manual on, auto on/off via OCC (15 min delay) or daylight (100fc), manual off
AL Z1	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
AL Z2	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
AL Z3	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
AL Z4	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
AL Z5	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
AL Z6	OCC sensor	Integral fixture	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
TR Z1	OCC sensor	Ceiling mount	OCC sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)
TR Z2	OCC sensor	Ceiling Mount	OCC Sensor	Auto on (10 min to 30%, 10 min off delay) /auto off (all operational hours)

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LINKTair- Wireless Control Solution – w/ LLLC

GH LED Compact Modular High Bay

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Simplysnap- On-Site Controller

- Stand-alone functionality out of the box managed locally via LAN or via the WPA2-PSK*-secured Wi-fi interface.
- Secure, 2.4 GHz line-of-sight wireless mesh network connects up to 1,000 fixtures to a SimplySNAP site controller up to a mile away.
- Use the web-based user interface to manage your system via Ethernet or wireless connection to a PC, tablet, or smartphone.

*Wi-Fi Protected Access – Pre-Shared Key

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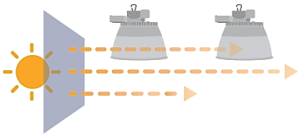
Simplysnap- On-Site Controller



EASY DAYLIGHT HARVESTING & AUTOMATED DIMMING

Ambient light and motion sensors ensure both optimal energy savings and human convenience. Daylight harvesting monitors the amount of ambient light in an area, automatically adjusting light levels to conserve energy. If movement is detected in a previously vacant area, any dimmed lights return to their original brightness for security and safety.

EASILY PROGRAM ZONES, SCENES, EVENTS, AND SCHEDULES

The Synapse® SimplySNAP wireless control solution gives you multiple options to adjust light levels and schedule triggered events, such as dimming or switching luminaires based on time of day. Motion and ambient light sensors can be set and monitored for individual luminaires and for designated zones.

ENSURES MAXIMUM SECURITY

Integrated or stand-alone—either choice is worry free. SimplySNAP can be managed locally via LAN or via the WPA2-PSK-secured Wi-Fi interface, with no Internet connection needed. Security is made easy with enforced password complexity with time delay and unique secure sign-ins for multi-user environments.

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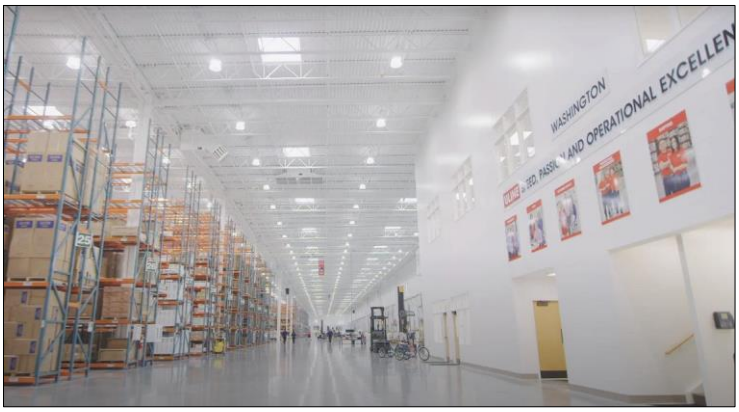
Simplysnap- On-Site Controller



LED HIGH-BAY/LOW-BAY
KBL Series

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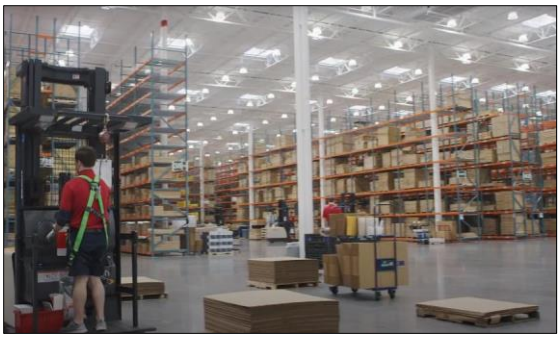
Simplysnap- On-Site Controller- Case Study- ULINE, Lacey, WA

- 800,000-square-foot warehouse facility.
- 3,014 KBL Series high-bay luminaires.
- ULINE wanted to integrate the system in a way that would tie into the main building systems.
- 50% LED savings, 30% Occupancy savings, 5% Daylight harvesting.
- 20% of costs compared to HID = $500,000 /yr.



"The installation of the Synapse®-enabled Cree Lighting luminaires is extremely easy. The electrical contractor only had to worry about getting the power to the box, allowing us to save money on the installation," - ULINE Director of Engineering, Mike McConnell

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nLight- Lighting Controls Platform

- A distributed digital lighting controls platform.
- Integrates:
  - Time-based
  - Daylight-based
  - Sensor-based
  - And manual lighting controls through its connected, intelligent digital devices

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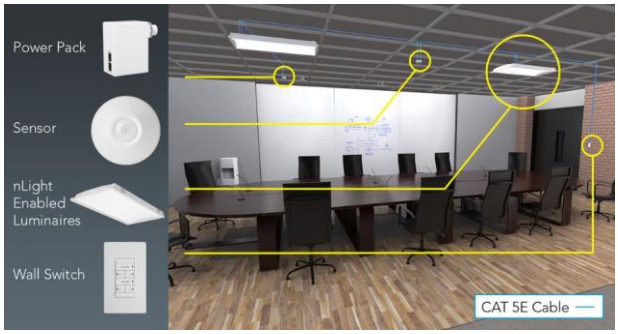
nLight- Lighting Controls Platform

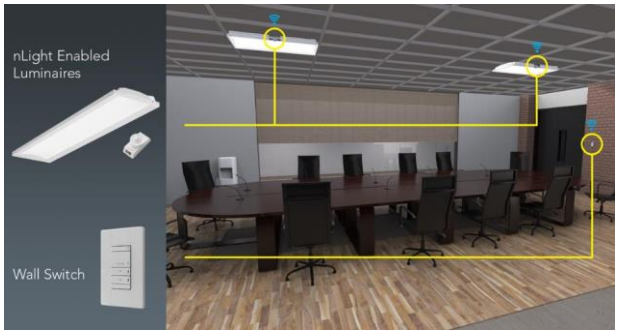
nLight Wired

Delivers distributed intelligence with all lighting control actions carried out locally within each individual lighting zone.



nLight AIR

A simplified wireless lighting control solution that eliminates the need to run wires, resulting in an overall lower cost of install. Developed to penetrate typical obstructions found in commercial buildings



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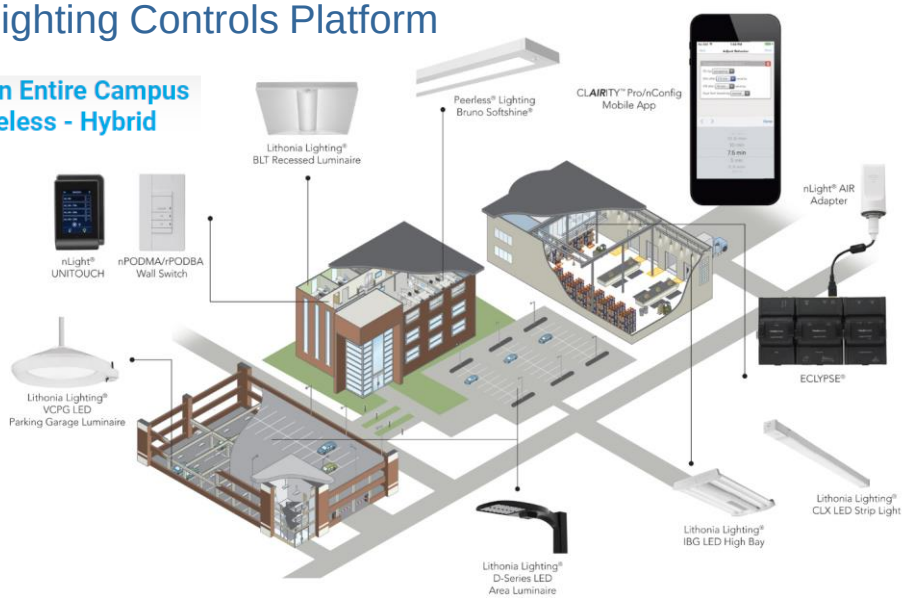
nLight- Lighting Controls Platform

One Room to an Entire Campus
Wired – Wireless - Hybrid



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nLight- Lighting Controls Platform- w/ LLLC

IBG High Bay

I-BEAM® IBG Configurable LED High Bay
by Lithonia Lighting

8,000 to 72,000 lumens

AcuityBrands. Expanding the boundaries of lighting™ | THE LIGHTING GROUP | 206-298-9000 | lighting design lab

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Considerations

- Ease of Operations
- Ease of Maintenance
- Ease of Installation

- Worker Productivity
- Worker Safety
- Worker Well Being

- Energy Savings

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Commissioning

- One of the most often overlooked Commissioning elements….

  Commission the occupants….

- Let them know what to expect from the system and how it operates….and why….

Courtesy: **Metropolitan Warehouse & Delivery Corp**

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Sequence of Operations

Whoever winds up doing it….a sequence of operations is required to tell the contractor, startup technician, and commissioning agent how the system is supposed to function.

- What are the time and astronomic schedules
- Which sensors are vacancy and which are occupancy?
- What is the vacancy timeout?
- What are the target light levels for task tuning?
- What switches or dimmers are tied to which zones?
- What zones are included in each preset and at what levels?
- What are the daylight zone dimming thresholds?
- Are there any specialty programming tasks like rollup door controls?

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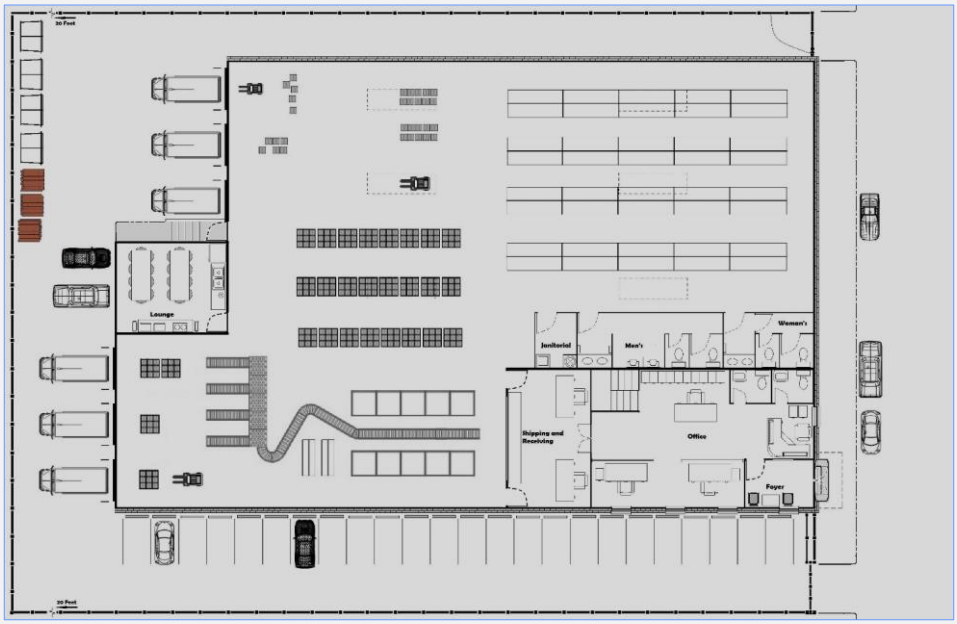
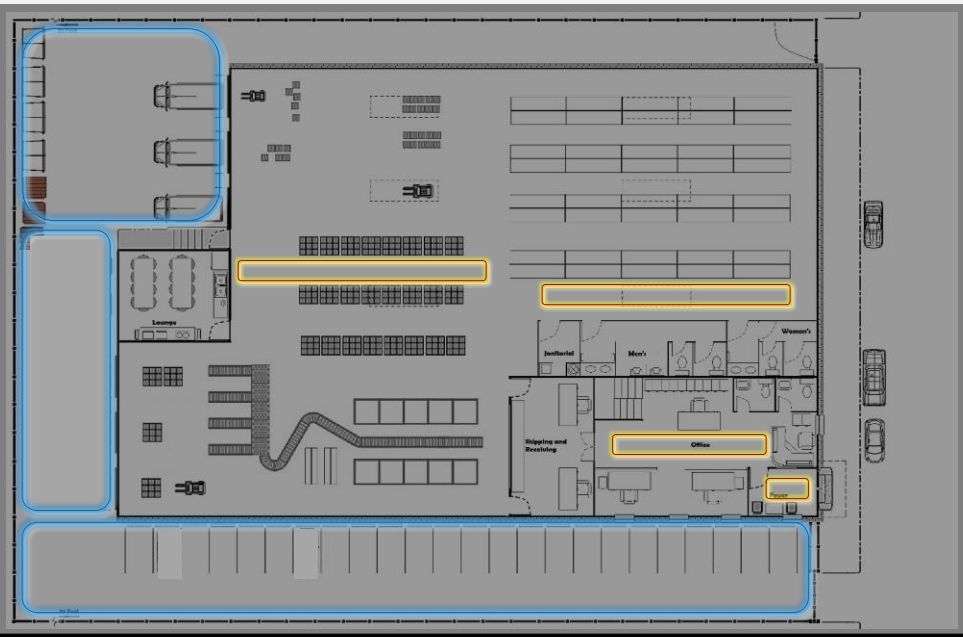
LLLC = High Granularity – Traffic patterns



98

Traffic patterns

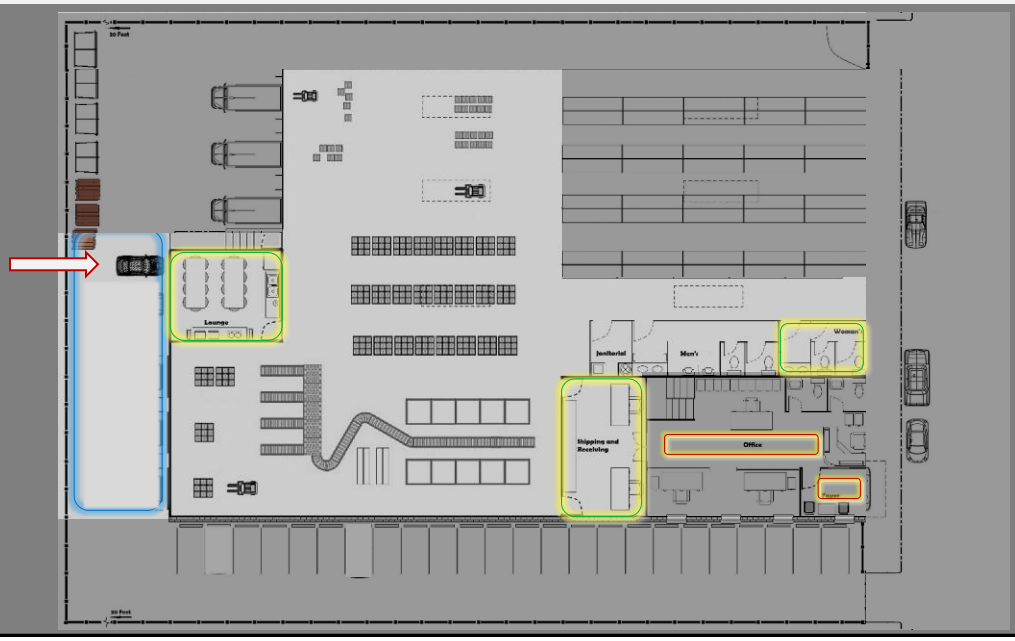
Night- Minimum light for egress at 10%, parking to 30% (Business closed).



99

Traffic patterns

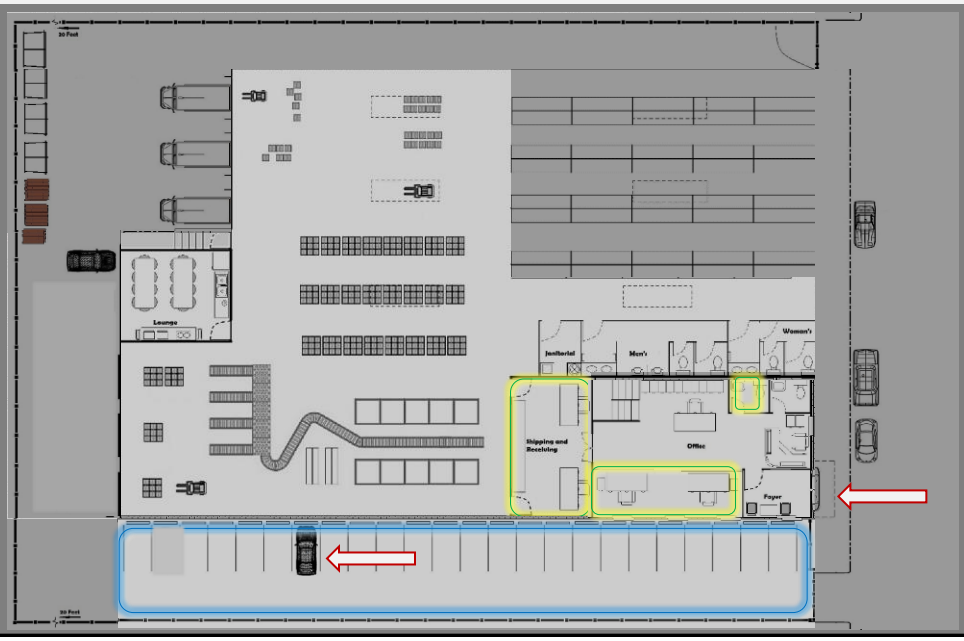
Early entry- ambient to 30%, traffic pattern to 90%, parking to 90% (Business closed).



100

Traffic patterns

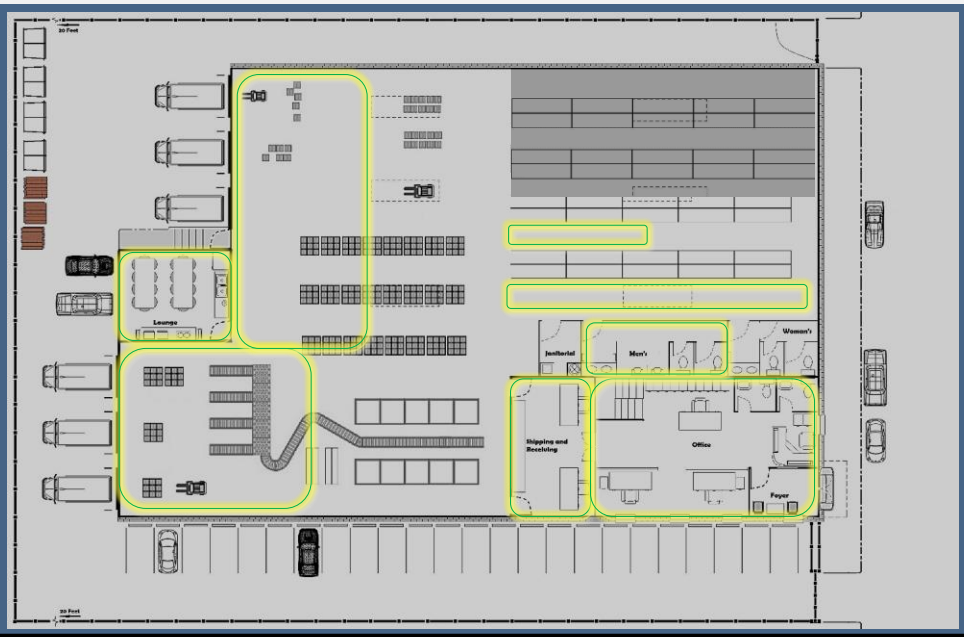
Second Early entry- ambient to 30%, traffic pattern to 90%, new parking to 90% (Note racking off).



101

Traffic patterns

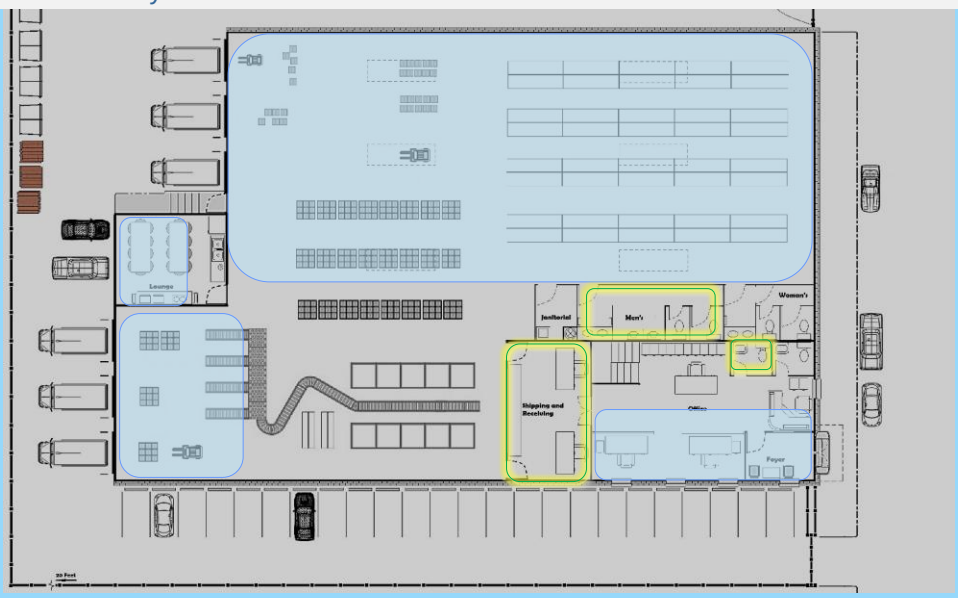
Early morning (cloudy) ambient to 50%, occupied to 90%, exterior off. (open hours.)



102

Traffic patterns

Midday – Ambient off in daylit areas, ambient to 50% in secondary daylit zones, occupied to 90% in non daylit zones



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Wireless Communications

- Zigbee
- Bluetooth
- BLE
- Enocean
- Zwave
- WiFi
- IEEE 802 Networks
- Proprietary
- Others

Courtesy: Leviton

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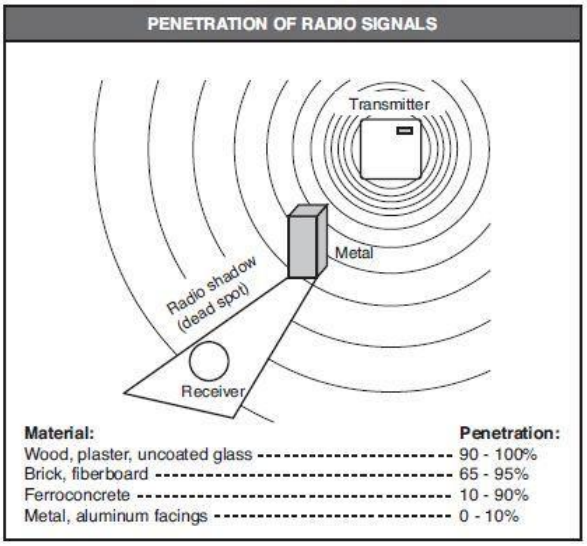
Wireless Communications Considerations

Wireless communications is robust, but there are some considerations:

- Physical obstacles and mass
- Distance between devices
- Number of devices per node or hub
- Other systems on similar frequencies
- E-mag interference
- IOT



Courtesy: Leviton

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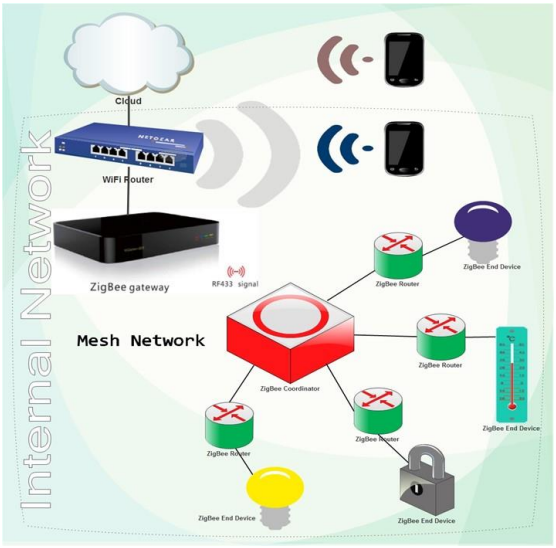
Wireless Communications Considerations

Cybersecurity:

- In an increasingly connected digital realm, lighting may be a gateway to attack just like other building systems.
- Expect this to become a greater issue over time.
- Lighting controls and building automation may be precluded from corporate networks.



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Flicker, or TLA*

- All light sources can flicker under the right circumstances
- LED sources may be particularly susceptible with low quality drivers or in specific cases.
- This may be ok, mildly annoying, hugely annoying, or disastrous.
  - Stroboscopic effects can make rotating machinery appear to be stationary.

Updated on 8 Sep 2020: At the end of 2021, the new Commission Regulation EU 2019 2020 (Ecodesign) enters into force. The specific requirements for LED light sources are changing. Completely new minimum requirements for flicker and the so-called stroboscopic effect are introduced.

* Temporary Lighting Artifacts

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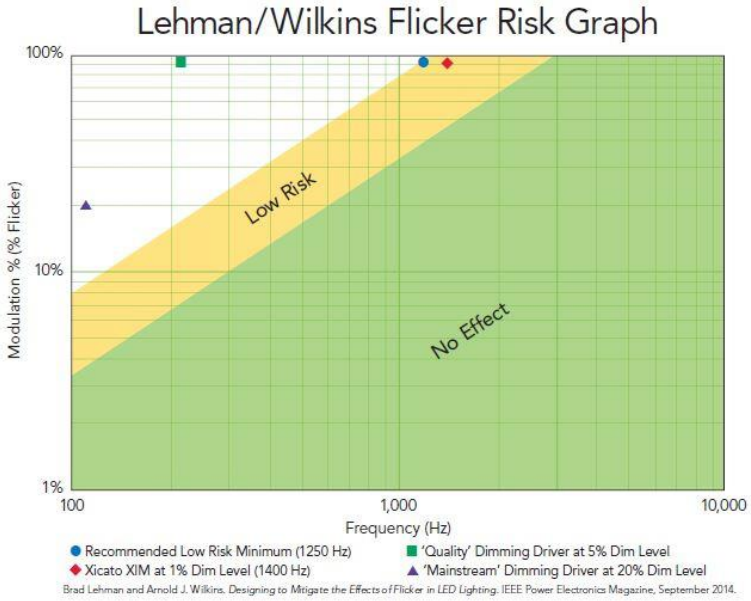
Flicker

- Is it flicker, flutter, shimmer, or other?
- % flicker = amplitude
- Amplitude and frequency both matter.
- Check at multiple dimmed light levels.

- Do the research upfront to ensure compatibility
- When in doubt ask for samples and test



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Future of Lighting Controls

Where do we go from here?

What do YOU think?

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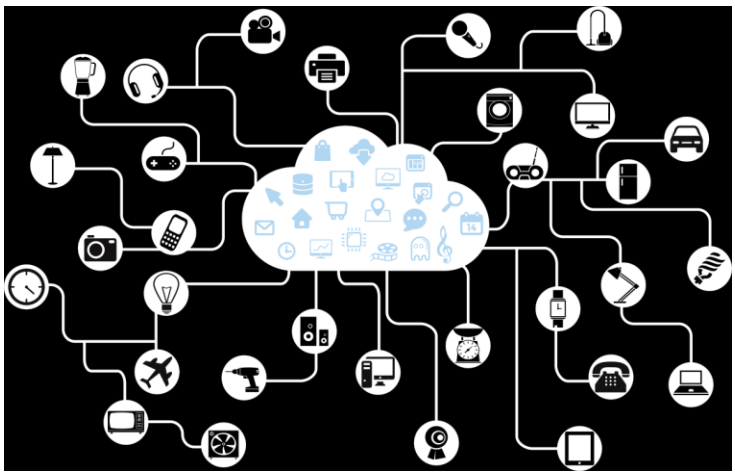
IOT

- HVAC
- Room Scheduling
- Communications
- Tracking
- Security
- Audio
- Video
- Your Refrigerator
- What else?



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Asset Tracking

- How might lighting / lighting controls be used for asset tracking?
- Other functions?

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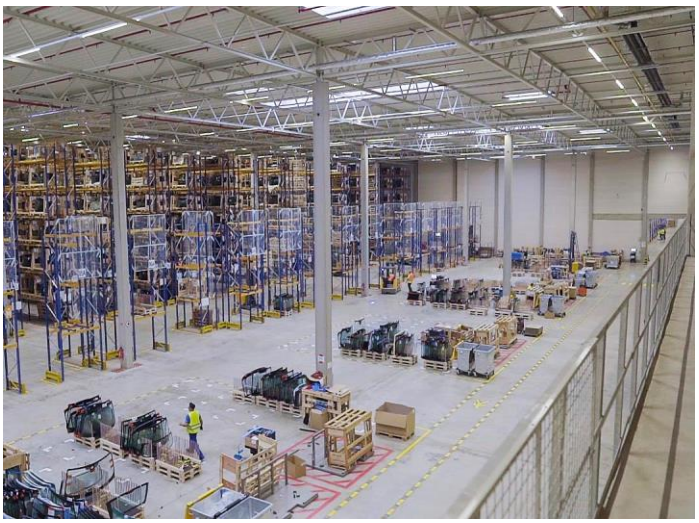
Pilkington Automotive taps smart lights for space analysis

LEDs MAGAZINE

Author — Mark Halper
Dec 2nd, 2019

- In the first known industrial installation of its lighting-based IoT technology, Signify has equipped a Pilkington Automotive warehouse with LED luminaires linked to sensors that gather information and transmit it for data analysis, helping managers improve operations.
- The sensors relay information about warehouse usage and conditions via a Zigbee wireless connection to a Signify-run cloud data system,



signify interact

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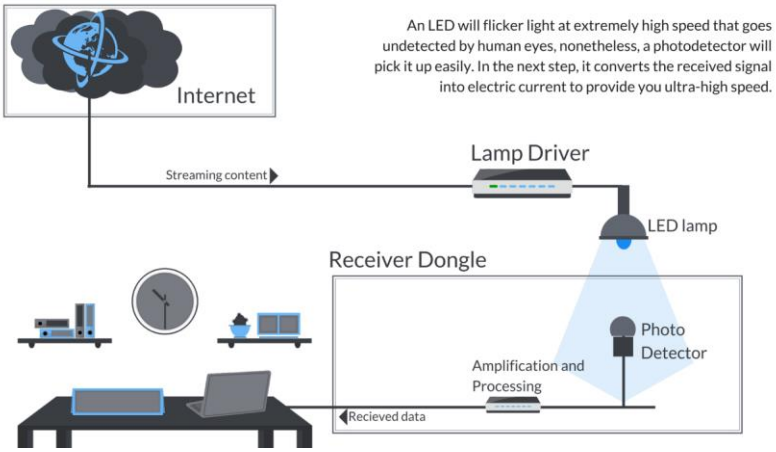
LiFi

- Requires line of sight
- More bandwidth
- Infrared or Visible
- Security
- Health Care
- Schools
- Public Realm



Courtesy: GrayB

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Implementation

- The kind of NLC / LLLC systems we've been discussing are an excellent fit for both new construction and existing building retrofit.
- LLLC in particular – replace existing luminaires one for one with 3 connection points to existing wiring.
- No additional controls wiring or sensors to install.

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Connected Lighting Prospectus for Buildings

The 1-9-90 Rule

- 1% Energy & Resources
- 9%: Space & Layout
- 90%: Wellness & Productivity
- +100%: Revenue & Opportunities

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Benefits of plugging in to your Territory Utility

- Investment on innovation and energy efficiency
- Customer and technical support on specific projects
  - Or access to resources for these
- Access to tools and resources
- Access to encyclopedia of implementation knowledge
- Access to impactful programming

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Program Design *Considerations:* **Savings & Incentives**

Example of prescriptive savings in City Light's lighting program

Space Use Type	Networked Lighting Controls	Luminaire Level Lighting Controls
Break Room	40%	50%
Classroom	25%	25%
Hallway	40%	50%
Lobby	40%	50%
The Loo	40%	50%
Warehouse	40%	50%

And so on and so forth…

Regional Technical Forums: Non-Residential Lighting Retrofits protocol

Dictionary

Search for a word

pro·vi·sion·al /prə ˈviZHənl/

1. Arranged or existing for the present, *possible to be changed later*

Simplify Approach:

- prescriptive savings
- prescriptive incentives

Right-Sized Incentive

- $50-75 incentive bonus –

In addition to performance savings!

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NLC / LLLC Best Practice Guides

- LLLC Videos
  - Demonstrate simple primary control strategies
  - Simulates tenant improvement to highlight system flexibility
- https://www.lightingdesignlab.com/resources

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More LDL Resources:

LDL website- Resources- Lighting Guides

LIGHTING LAYOUT GUIDE SERIES

CONTROLS GUIDE 5

WAREHOUSE CONTROLS

KEY TIPS

With a Luminaire Level Lighting Controls (LLLC) solution deployed, the controls can adapt to a change in work flow or a reconfiguring of the inventory.

If upgrading to new fixtures, see if the controls can be installed at the factory. This can ensure a more robust deployment and more reliable performance, and will reduce installation costs.

When a layered control strategy is applied, daylight savings will be minimal in lightly occupied areas because occupancy sensors will have already turned the lights off.

THE OPPORTUNITY

The typical warehouse has areas with predictably high and low activity. However, many areas of a warehouse have intermittent activity that is less predictable. Some warehouses also have daylighting through windows, skylights and/or clerestories that provide an additional light source. There is opportunity for significant energy savings by implementing an appropriate lighting controls solution that takes all of these aspects into account.

THE SOLUTION

To ensure maximum benefit from any control measure, be sure to utilize modern fluorescent or LED fixtures with dimmable ballasts and drivers. Occupancy sensor deployment is the first and best control strategy to apply. This will capture the most savings from sparsely used areas. However, in areas with high activity time-based controls would suffice. If sufficient daylight is present, applying photosensors is a good option.

LLLC that combine occupancy, daylighting, and time clocks on a networked system can be a powerful tool to leverage continued savings.

DESIGN CONSIDERATIONS

Good visibility is a key consideration when speed and accuracy are important. In a warehouse, most of the visual tasks are vertical (e.g., reading side labels on boxes), so special attention needs to be given to high-angle lighting and glare control. Many warehouses have both forklift and foot traffic, therefore safety is a major concern. Modern lighting, particularly LED sources, can come to full brightness rapidly once sensors detect activity in the area. However, sensor placement is critical to ensuring that activity is detected properly. If controls are installed in each fixture, then the system will be responsive to changes in occupancy. Because of the high mounting heights often found in warehouses, be sure to use sensors that have a sufficient range to respond to foot traffic and a narrow enough detection pattern to limit false ON responses.

When LLLCs are combined with an Advanced Lighting Control network, fixtures can be configured to turn ON in groups or zones, not only aiding in productivity and safety, but increasing energy savings. For example, when someone enters an aisle the light nearest to the activity is turned up to 100% and lights in the immediate area will come on to 50%, while lights further away remain OFF. Helping add to energy savings while improving contrast ratios.

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LIGHTING LAYOUT GUIDE SERIES

CONTROLS GUIDE 2

NETWORKED LIGHTING CONTROL SYSTEMS

KEY TIPS

Education for users, operators, owners and installers about the system is critical to ensure optimal performance, acceptance and persistence of the NLCS.

Many components of a NLCS can be incorporated directly into the luminaires at the factory.

If task lighting and the ambient lighting are controlled separately, there is a potential for deeper savings and higher user acceptance.

LED source luminaires offer a higher degree of control, and therefore provide more energy savings potential than fluorescent and HID lighting.

THE OPPORTUNITY

When multiple control strategies are used together, benefits for energy savings and user productivity can be maximized. Many energy codes require controls to be used in a variety of spaces, but often the controls are from different suppliers and sometimes installed by different contractors. This makes coordination and interoperability a challenge.

Often missing from a lighting project is the post-occupancy follow-up to determine the performance of the system. This can be particularly difficult when evaluating effectiveness of a lighting control system. One of the big advantages of a Networked Lighting Control System (NLCS) is that results can be reported and the system adjusted after installation.

THE SOLUTION

When using a NLCS, the system is networked and highly flexible. It can gather data and report on power use, occupancy patterns, system performance, and operating status for specific fixtures, groups of fixtures (zones), or whole floors with ease. This allows the lighting to be evaluated and adjusted as needed. The network capability enables zones or individual fixtures to adapt to changing conditions in the space.

BENEFITS	ATTRIBUTES
Flexibility	System components have unique digital addresses that can be easily rezoned.
Customization	With wireless systems, new features can be added and reconfigured as needs change.
Reporting	Activity and component performance can be measured and evaluated against expectations.
Graphical User Interface (GUI)	Makes system programming and commissioning more intuitive.
Auto Demand Response	System can receive signals from the local utility to scale back load when stresses to electrical grid are present.

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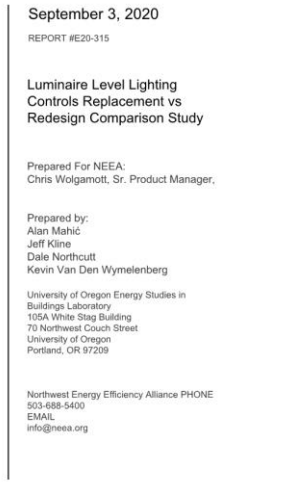
Late Breaking News

- Report commissioned by NEEA on replacement vs redesign with LLLC
- Included in the downloadable handouts
- Also available from NEEA:
- https://neea.org/resources/lllc-replacement-vs-redesign-comparison-study



September 3, 2020

REPORT #E20-315

Luminaire Level Lighting Controls Replacement vs Redesign Comparison Study

Prepared For NEEA:
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EMAIL
info@neea.org

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Additional Resources

Night Shift Work – A Risk Factor for Breast Cancer, 2020
Marta Szkiela, Kusidel, Makoiec-Dabrowska, Durota Kaleta

Disruption of Circadian Rhythms by Light During Day and Night, 2017
Mariana G. Figueiro, PhD

Measuring Light at Night and Melatonin Levels in Shift Workers: A Review of the Literature, 2017
Claudia M. Hunter PhD, Mariana Figueiro PhD

The NICU Lighted Environment, 2016
Mark S Rea PhD, Mariana G Figeuiro PhD

Bright Light Improves Sleep and Psychological Health in Shift Working Nurses 2013
Bjorn Bjorvatn MD, PhD, Siri Waage PhD

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And now – a few words from LDL

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Upcoming LDL Online Events

LDL Course	Delivery Date	Time
NLC for Warehouses	Nov 17	10:00 – Noon
NLC for Schools	Dec 1	10:00 – Noon

Today's slide deck and previous online courses can be found on our website

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Click – Call – Connect

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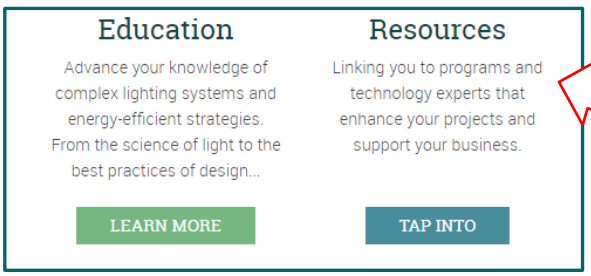
Visit us online



OR

Email Us

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Todays slide deck will be posted here!

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We'll *SEE* you on the next call… ☺

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