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More than 30 years in the lighting industry as an architectural lighting designer, instructor, daylighting and sustainability specialist, lighting control system consultant, and theatrical designer.

Has taught and consulted on sustainability issues, lighting, and daylighting for the Lighting Design Lab and University of Washington Architecture Department

Selected Awards Selected Projects ł

- King Abdullah University of Science and
- Technology Masdar Headquarters Pearl River Tower
- Canyon Ranch Spa Club
- Amgen Helix Campus
- Reebok World Headquarters
- Reno Sparks Convention Center
- Pacific Place Retail Center
- Ala Moana Retail Center
- REI Denver Flagship Store
- Boeing Commercial Airplanes Offices
- Real Networks Headquarters
- Tommy Bahama Headquarters

Microsoft B16/17

San Francisco PUC Headquarters

- ected Awards Amgen Helix Campus Amgen Helix Podestrian Bridge Caryon Ranch Spa Club Harvard Universiti (80 Oxford King Street Station Lighting Design Lab Methodist Hospital Research Institute Microsoft B16/17 Dea Cambridge Center Padific Place Retail Center Reads World Headquarters Reno Sparks Convention Center Real Networks Headquarters SFFUC Headquarters Tommy Bahama Headquarters COTE Too 10 AIA COTE Top 10
- Red Cort Lop 16
 Reg Fighting Store Deriver
 King Advallah University of Science and Technology
 San Francisco PUC Headquarters
 Manitoba Hydro Place



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 healthcare specific spaces.



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- Private Practice Offices
- Small Clinics
- Multi-Care Clinics
- Specialty Clinics
- Hospitals

Other?

- Hospital SystemsResearch Institutions
- Long Term Care
- Annead Annead Annead Annead Annead Annead Annead

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More Specialized

Patient Rooms

- Patient Corridors
- Imaging Centers
- Infusion Therapy
- LDRP
- Pharmacy
- Surgery



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Trends

- Traditional Healthcare Environment
- More Holistic Approach
- Hospitality EnvironmentsPatient Centered
- Tatient Gen
- Wellness





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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



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Luminaire Level Lighting Controls

- Wrap all of the sensors and most of the logic into the luminaire itself
- Simple to specify and install
 Will require commissioning to
- Will require commissioning to function most effectively.May be capable of all control
- strategies
 May be capable of only OS/VS and Daylight harvesting
- Smarter systems will be more capable



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 POE – Power over Ethernet 9. Open Source Standard? 9. Sach device has a unique dates 9. Maximum flexibility 9. Adixon momissioning 9. Alt controls strategies possible 9. Energy management software 9. Lumen Maintenance 9. Scheduling



Courtesy: Cree























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.



- Corridors / Stairwells
- Toilet rooms
- Warehouses
- Parking garages
- Site lighting
- The second s

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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
- Classrooms
- Storage



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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
 - Education
 - Public Spaces
 - Circulation
 - Warehouse / Industrial



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Task Tuning / High Trim

- Setting a high trim tuned to deliver the target illuminance level.
- Can reduce glare
- Can balance brightnessCan 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.
- Public Spaces
- Circulation
- Retail
- Areas in which OS/VS would pose difficulty



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Newer Controls Strategies

- Color selection
- Tunable White
- Circadian Lighting
- Generally based on LED capabilites



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- hardwired
- Zone control wireless
- Luminaire addressable wirelessPOE (Power Over Ethernet)
- POE (Power Over Ethern
 IOT (Internet of Things)





Why use advanced lighting controls?

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



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Specific Concerns Wellness Breast Cancer, by Industry Circadian Systems Health Care and Social Assistance, 43% Other Industries, 17% Shift Workers Manufacturing, 11% Poor sleep quality Mood Accommodation and Food Services, 18% Trade, 11% Metabolism Cardiovascular disease Obesity Cancer 🖫 lighting design lab

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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Duration - Dose

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



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Photobiological History

- The patterns of light exposure during the day and over time matter
- Intensity ranges may be critical over time
- How does this effect shift workers?



Lighting Controls to the Rescue

- Intensity
- Distribution
- Spectral Power Distribution
- Duration Dose
- Timing
- Photobiological History
- If only we had a convenient means of manipulating most of these variables....





UL RP24480

Recommended Practice and Guideline for Promoting Circadian Entrainment with Light for Day Active People

- Currently in final review
- 77 pages long currently
- Largely adopts LRC CS system
- Considers EML
- Many examples



Figure 4.1

Measurin

 Not a consensus document like IES / ANSI standards

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Lobby / Waiting / Patient Intake

- Scheduling
- Daylight Controls
- Task Tuning / High Trim
- Tunable White?
- Scene Based
- Zone based load controllers
- Decorative equipment



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Typical Exam

- Manual Dimming
- Scene Control / Raise Lower
- Occupancy SensorTask Tuning / High Trim
- Tunable White?
- LLLC Opportunity



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Procedure

- Manual Dimming
- Scene Control / Raise Lower
- Task Tuning / High TrimTunable White?
- Low end dimming
- -----3
- LLLC Opportunity



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Operatory

- Manual Dimming
- Scene Control / Raise Lower
- Color Tuning?
- Low end dimming
- They're all different
- Load Controllers



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Imaging

- Manual Dimming
- Scene Control / Raise LowerTask Tuning / High Trim
- Low end dimming
- LLLC Opportunity?



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Imaging

- Manual Dimming
- Scene Control / Raise Lower
- Task Tuning / High TrimTunable White?
- Low end dimming
- Active imagery?
- Zoned Load controllers



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Corridors

- Scheduled
- Occupancy Sensor to Dimmed Level
 Task Tuning / High Trim

Excellent LLLC Opportunity

- Tunable White?



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Patient Corridors

- Scheduled
- Occupancy Sensor to Dimmed Level
- Task Tuning / High Trim
- Tunable White
- Manual dimming at charting and nurse stations

Excellent LLLC Opportunity



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Patient Room

- Manual Dimming
- Integrated patient controller
- Task Tuning / High Trim
- Tunable White
- Manual dimming at charting stationsColor Tuning?
- Night Light
- i light Light
- Zoned Load Controllers



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Considerations

- Simplicity
- Ease of Operations
- Ease of Maintenance
- Ease of Installation
- Patient Outcomes
- Patient Preferences
- Staff Well Being
- Energy Savings



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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 partition controls?

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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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Future of Lighting Controls

Where do we go from here?

What do YOU think?



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



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Upcoming LDL Online Events			
LDL Course	Delivery Date	Time	
Fundamentals of NLC (Side A – Theory & Technology)	Nov 3	10:00 - Noon	
Fundamentals of NLC (Side B – Practical Application)	Nov 4	10:00 - Noon	
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 <u>website</u>			
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 n the U.S. and Europe, 15–20% of all full-time personnel are employed outside of regular working hours, with over 7 million Americans following shift-work schedules. Shift work, especially when it involves rotating and overnight shifts, is associated with increased risks for developing cancer and other diseases. Research in this area has focused on circadian disruption and exposure to light at night (LAN), both of which are involved in melatonin suppression and its associated cancer risks. Scientists at the LRC have been exploring the role of light in these two avenues of research, and investigating how light can be used to improve performance and facilitate healthier outcomes for shift workers.

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