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# Designers Light Forum

## Guidelines for Specifying Light Fixtures in WELL projects; What to Consider and What to Avoid

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Director of Lighting Design at **Lightcraft**

March 13th 2018

CONTINUING EDUCATION AIA

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

# Learning Objectives

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

1. Attendees will be able to evaluate intent of lighting features in the WELL building standard.
2. Attendees will be able to understand lighting credits and how to achieve them.
3. Attendees will be able to identify key factors contributing to visual comfort and circadian lighting.
4. Attendees will learn about critical factors needs to be considered, before specifying lighting fixtures.

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# What is WELL V2?

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# WELL Concepts


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# Scoring and Certification Levels

Projects must achieve all preconditions, as well as a certain number of points to earn different levels of certification:

- WELL Core Certification: 40 points.
- WELL Certification **Silver**: 50 points.
- WELL Certification **Gold**: 60 points.
- WELL Certification **Platinum**: 80 points.

Projects must earn a minimum of two points per concept. Projects may earn no more than 12 points per concept.

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# WELL Certification Process

# Why Light matters?


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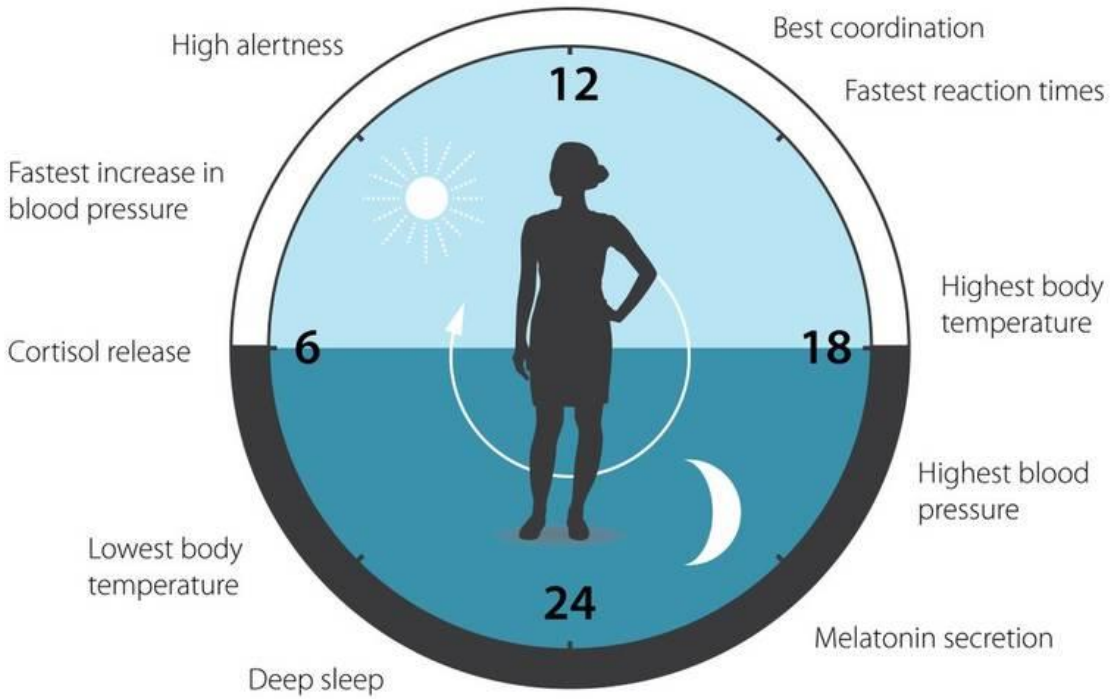
WELL aims to provide a lighting environment that reduces circadian phase disruption, improves sleep quality and positively impacts mood and productivity.

# Circadian Rhythm

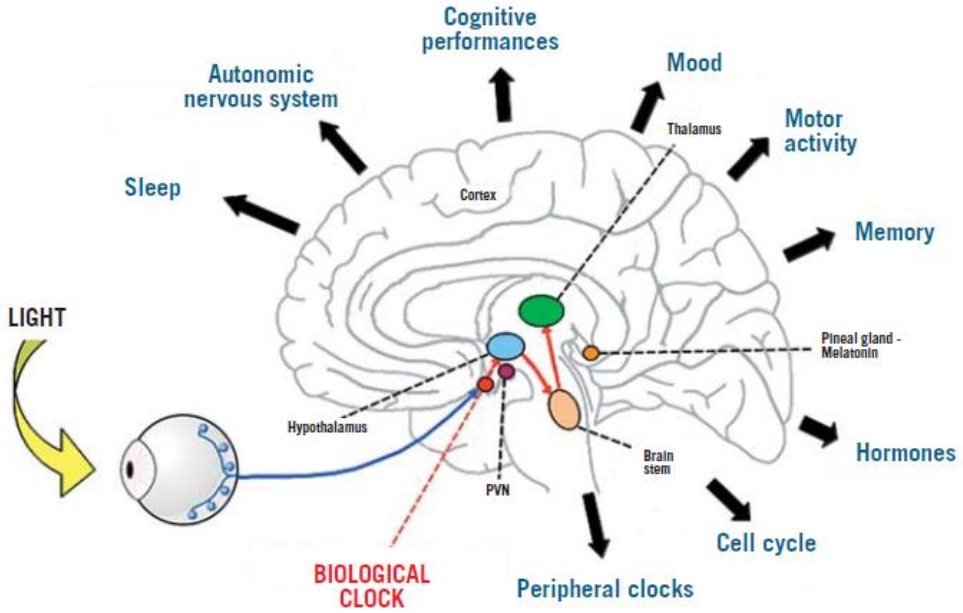
Internal clock that keeps the body's hormones and bodily processes on a roughly 24-hour cycle, even in continuous darkness.

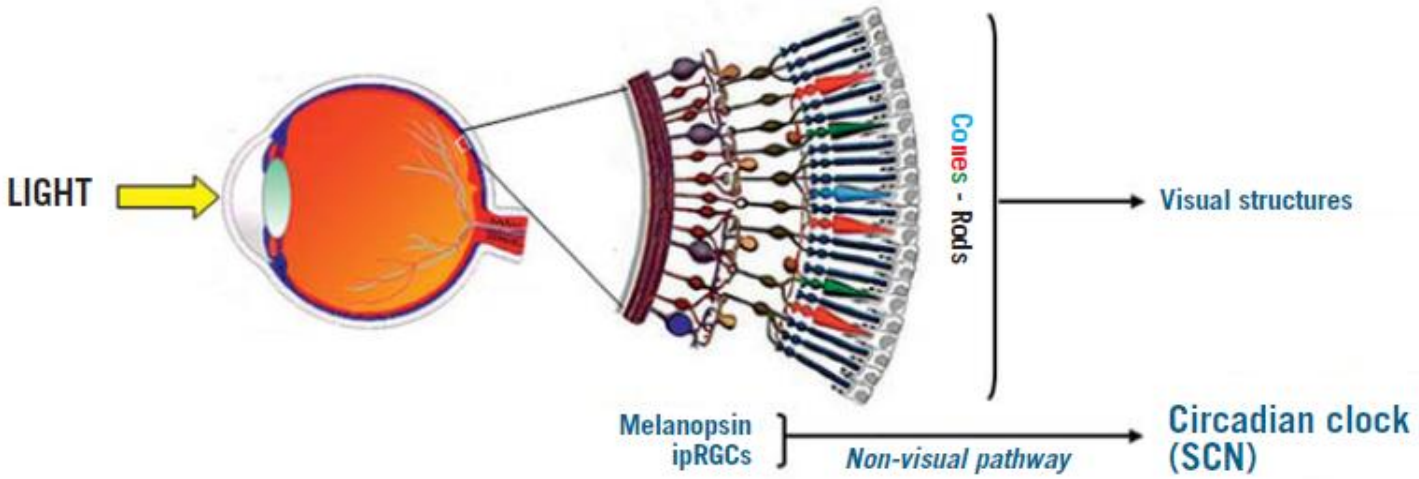
Humans are diurnal, meaning they are innately prone to wakefulness during the day and sleepiness at night. Light exposure stimulates the circadian system, which starts in the brain and regulates physiological rhythms throughout the body’s tissues and organs, such as hormone levels and the sleep-wake cycle.




copyright: © The Nobel Committee for Physiology or Medicine. Illustrator: Mattias Karlén

# IPRGCs and Circadian Clock

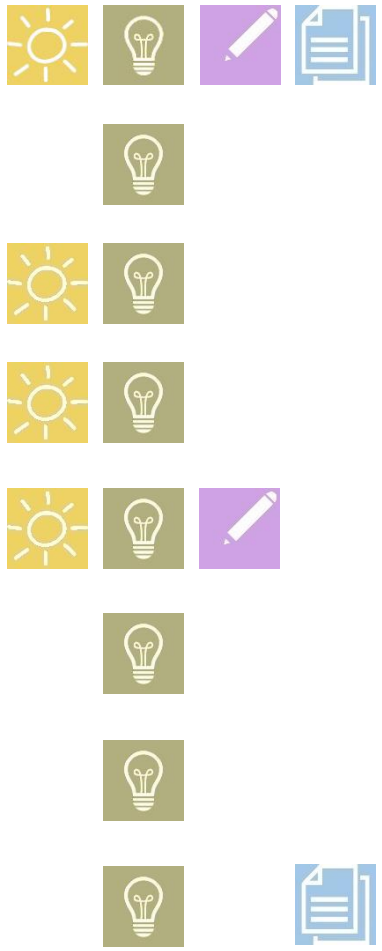



Graphics borrowed from: https://www.pointsdevue.com/

# WELL V2 and Lighting features

| Light Overview | |
|---|---|
| P | L01 Light Exposure and Education |
| P | L02 Visual Lighting Design |
| 3 Pts | L03 Circadian Lighting Design |
| 3 Pts | L04 Glare Control |
| 3 Pts | L05 Enhanced Daylight Access |
| 1 Pt | L06 Visual Balance |
| 2 Pts | L07 Electric Light Quality |
| 2 Pts | L08 Occupant Control of Lighting Environments |



Daylight Design Strategies

Lighting Design Strategies

Architectural Design Strategies

Protocols

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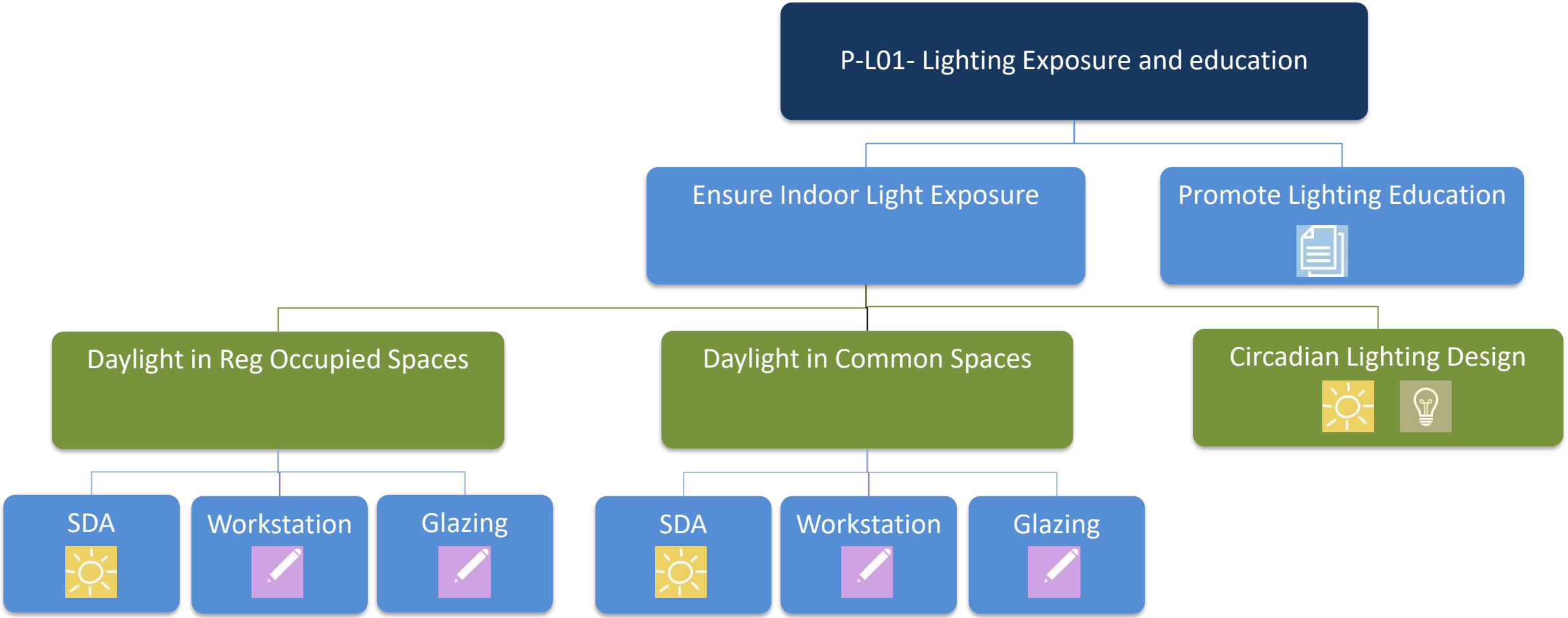
P-L01- Lighting Exposure and education
Ensure Indoor Light Exposure
Promote Lighting Education
Daylight in Reg Occupied Spaces
Daylight in Common Spaces
Circadian Lighting Design
SDA
Workstation
Glazing
SDA
Workstation
Glazing

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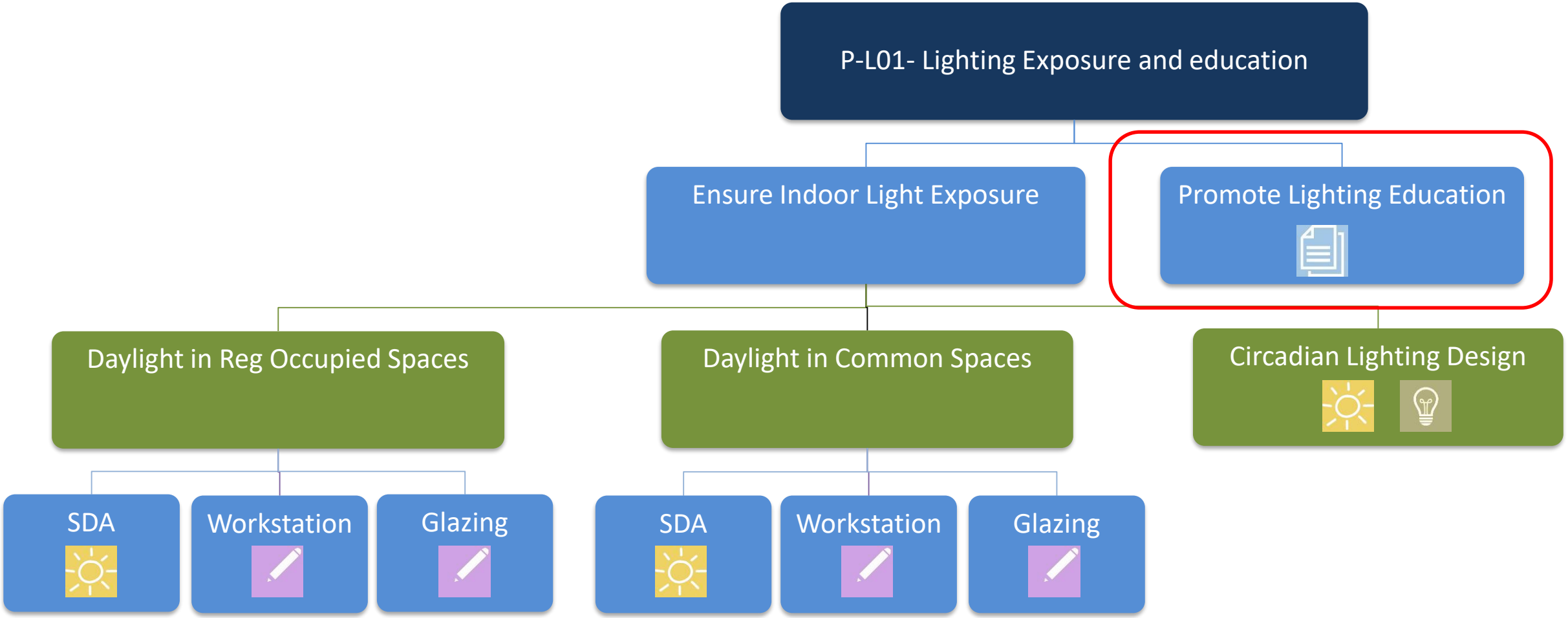
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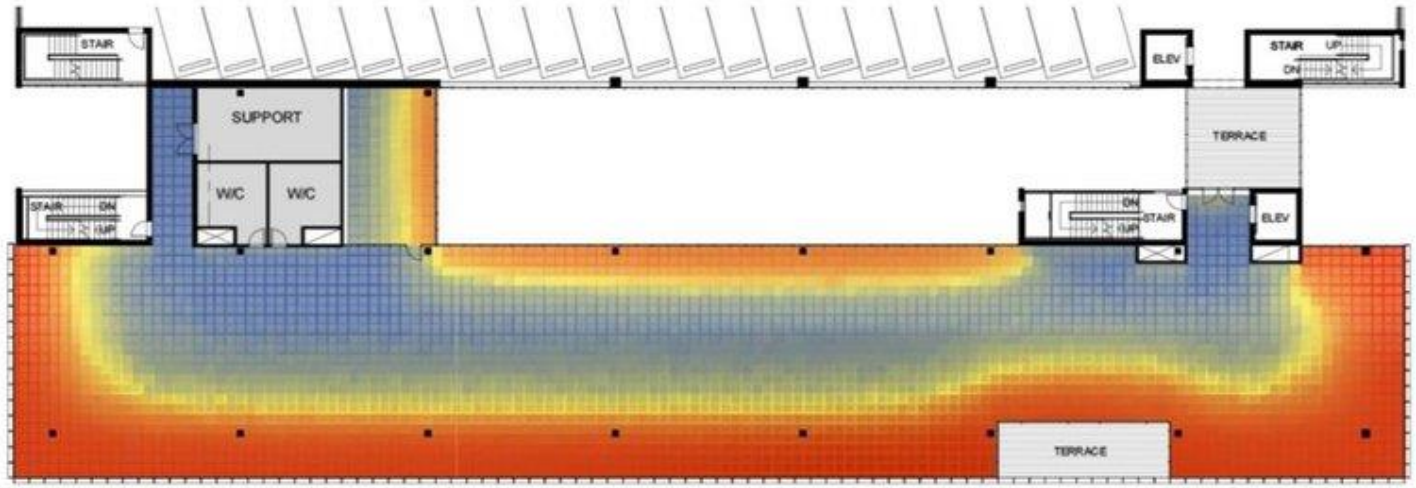
# What is sDA?




$sDA_{300,50}$

48.2%

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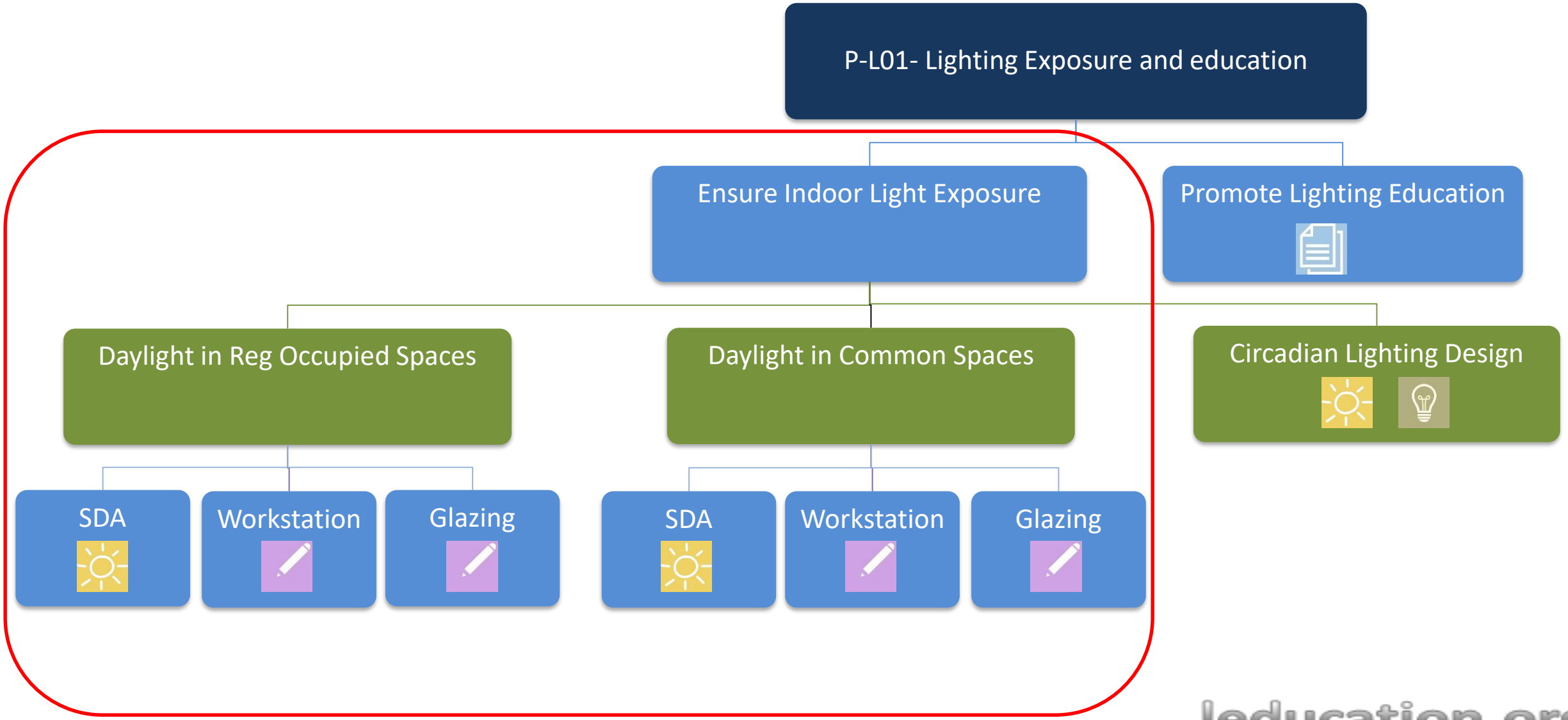
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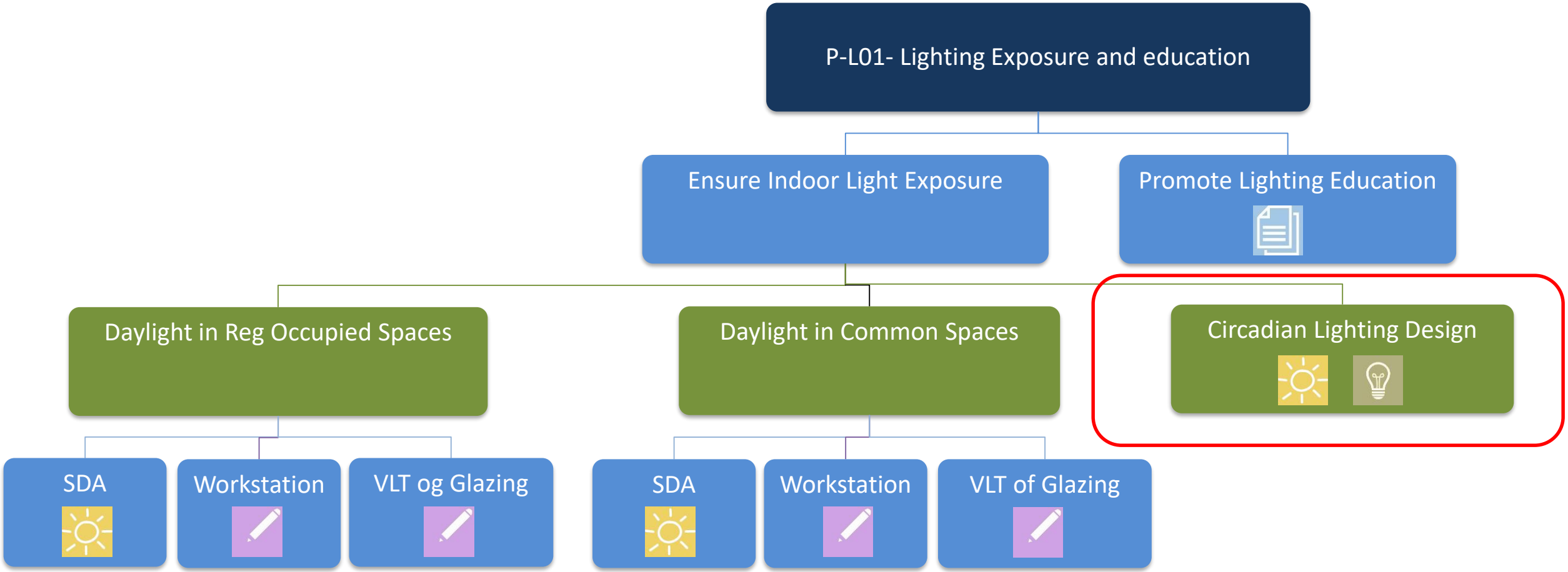
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SDA
Workstation
VLT og Glazing
SDA
Workstation
VLT of Glazing

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# P-L02- Visual Lighting Design

## Light Levels for Visual Acuity

- Compliance With Standard
- Provide Lighting Plan

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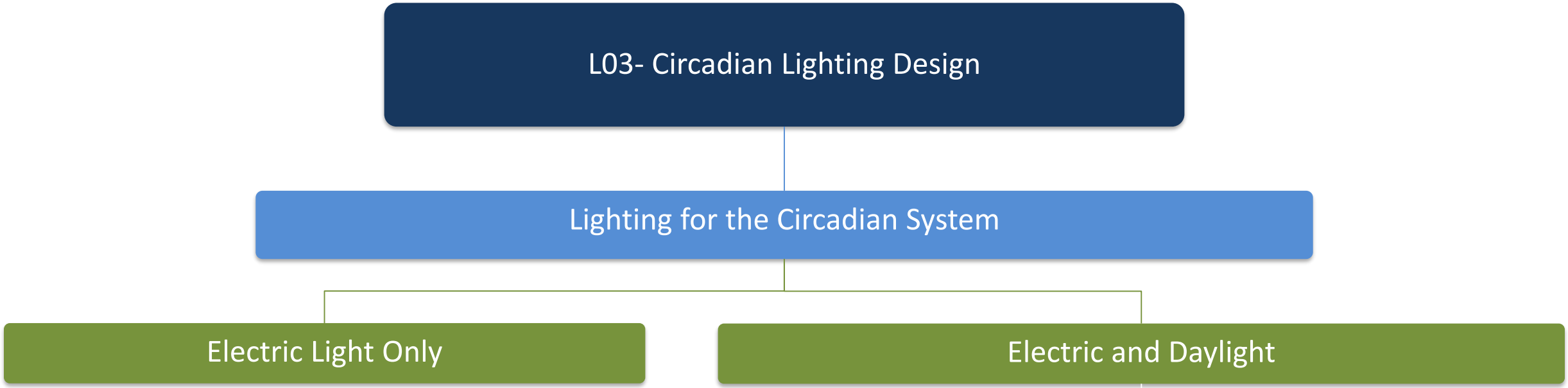
L03- Circadian Lighting Design
Lighting for the Circadian System
Electric Light Only
Electric and Daylight

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# L03- Circadian Lighting Design

## Lighting for the Circadian System

### Electric Light Only

- Solution A (Tunable Lighting)
- Solution B Higher Intensity

### Electric and Daylight

- Solution A Tunable Lighting)
- Solution B Higher Intensity

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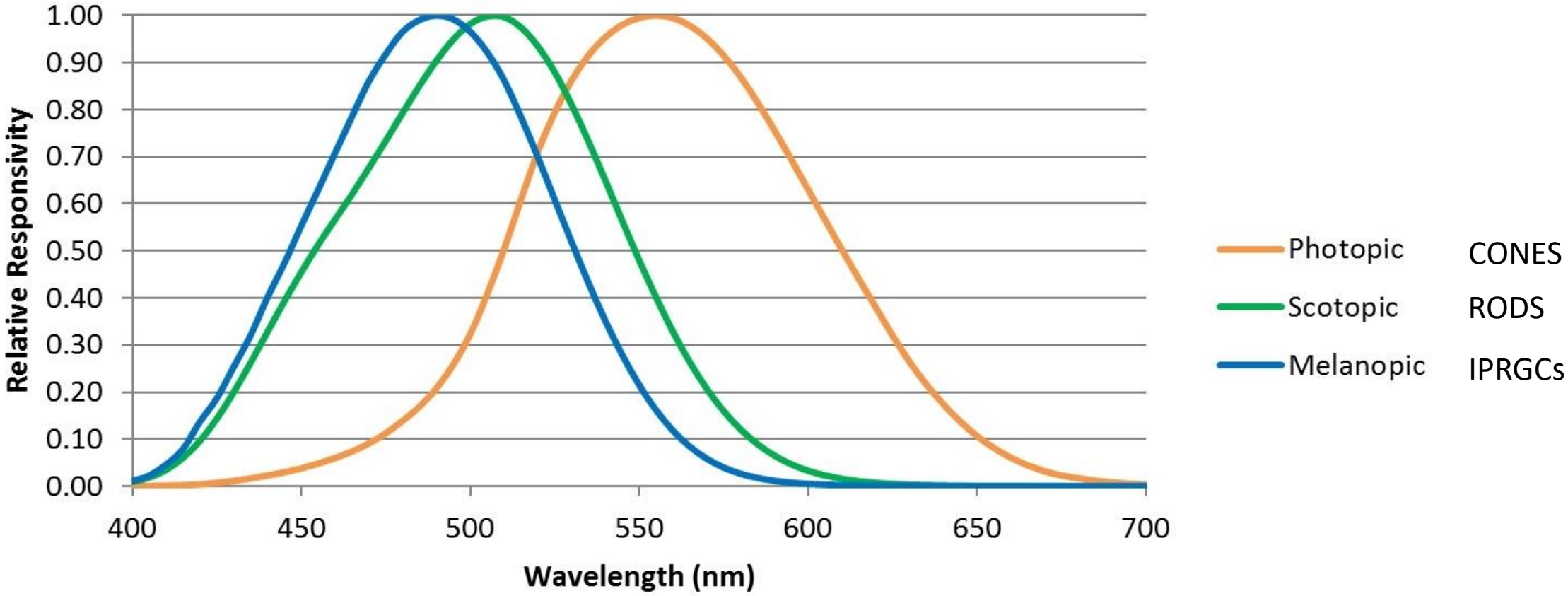
# What is EML?

Equivalent Melanopic Lux = Photopic Lux x Melanopic Ratio




https://lightinganalysts.com/entraining-circadian-rhythms/

# How to Calculate Melanopic Ratio?

USE IWBI spreadsheet published by IWBI (Appendix L1)

| λ (nm) | Lamp data | circadian | visual | lamp*c | lamp*v |
|---|---|---|---|---|---|
| 380 | 0.089 | 0.0009 | 0.0000 | 0.0001 | 3.56E-06 |
| 385 | 0.088 | 0.0017 | 0.0001 | 0.0001 | 5.27E-06 |
| 390 | 0.087 | 0.0031 | 0.0001 | 0.0003 | 1.04E-05 |
| 395 | 0.809 | 0.0059 | 0.0002 | 0.0048 | 0.000176 |
| 400 | 2.477 | 0.0114 | 0.0004 | 0.0283 | 0.000991 |
| 405 | 1.068 | 0.0228 | 0.0006 | 0.0244 | 0.000684 |
| 410 | 0.848 | 0.0462 | 0.0012 | 0.0391 | 0.001026 |
| 415 | 1.449 | 0.0795 | 0.0022 | 0.1151 | 0.003158 |
| 420 | 2.377 | 0.1372 | 0.0040 | 0.3262 | 0.009509 |
| 425 | 11.754 | 0.1871 | 0.0073 | 2.1991 | 0.085804 |
| 430 | 22.863 | 0.2539 | 0.0116 | 5.8042 | 0.265214 |
| 435 | 6.404 | 0.3207 | 0.0168 | 2.0538 | 0.107851 |
| 440 | 4.287 | 0.4016 | 0.0230 | 1.7215 | 0.098595 |
| 445 | 4.122 | 0.4740 | 0.0298 | 1.9537 | 0.122826 |
| 450 | 4.230 | 0.5537 | 0.0380 | 2.3422 | 0.16074 |
| 455 | 3.901 | 0.6297 | 0.0480 | 2.4562 | 0.187239 |
| 460 | 3.572 | 0.7080 | 0.0600 | 2.5289 | 0.214299 |
| 465 | 3.188 | 0.7852 | 0.0739 | 2.5031 | 0.235579 |
| 470 | 3.132 | 0.8603 | 0.0910 | 2.6945 | 0.284952 |
| 475 | 6.117 | 0.9177 | 0.1126 | 5.6133 | 0.688722 |
| 480 | 10.727 | 0.9656 | 0.1390 | 10.3576 | 1.491204 |
| 485 | 9.566 | 0.9906 | 0.1693 | 9.4766 | 1.619582 |
| 490 | 6.190 | 1.0000 | 0.2080 | 6.1900 | 1.287635 |
| 495 | 3.318 | 0.9920 | 0.2586 | 3.2917 | 0.858087 |
| 500 | 1.540 | 0.9660 | 0.3230 | 1.4875 | 0.497402 |
| 505 | 1.211 | 0.9223 | 0.4073 | 1.1167 | 0.493141 |
| 510 | 0.827 | 0.8629 | 0.5030 | 0.7135 | 0.415938 |
| 515 | 0.826 | 0.7852 | 0.6082 | 0.6484 | 0.502252 |
| 520 | 0.934 | 0.6996 | 0.7100 | 0.6535 | 0.663221 |
| 525 | 5.608 | 0.6094 | 0.7932 | 3.4177 | 4.448349 |
| 530 | 29.531 | 0.5193 | 0.8620 | 15.3355 | 25.45544 |
| 535 | 75.415 | 0.4325 | 0.9149 | 32.6196 | 68.99355 |
| 540 | 61.275 | 0.3517 | 0.9540 | 21.5509 | 58.45637 |
| 545 | 13.643 | 0.2791 | 0.9803 | 3.8081 | 13.37375 |
| 550 | 3.533 | 0.2157 | 0.9950 | 0.7621 | 3.514914 |
| 555 | 1.392 | 0.1621 | 1.0000 | 0.2255 | 1.391525 |
| 560 | 1.199 | 0.1185 | 0.9950 | 0.1421 | 1.193033 |
| 565 | 6.378 | 0.0843 | 0.9786 | 0.5380 | 6.241446 |

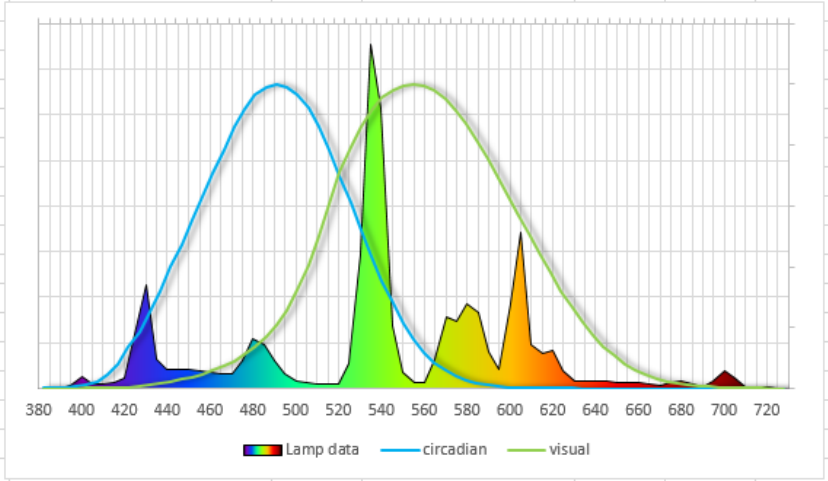
Source: Sample Fluorescent 4000 K

Melanopic Ratio: 0.588

Click here for data input

Instructions

1. Select built-in sample source, or user-entered source (above).
2. For user data, paste lamp spectral power distribution (5 nm increments) into Data sheet.
3. To add more user sources, insert columns to the left of User 2 on the Data sheet.
4. Multiply the Melanopic Ratio by measured or modeled lux to calculate equivalent melanopic lux.

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Paste lamp spectral power distribution ( 5 nm increments into Data sheet)

Multiply the melanopic ratio by measured or modeled lux to calculate melanopic lux

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# How to Calculate Melanopic Ratio?

USE IWBI spreadsheet published by IWBI (Appendix L1)

| Source | | Melanopic Ratio |
|---|---|---|
| User 2 | 2700K LED | 0.469 |

Click here for data input

Instructions

1. Select built-in sample source, or user-entered source (above).
2. For user data, paste lamp spectral power distribution (5 nm increments) into Data sheet.
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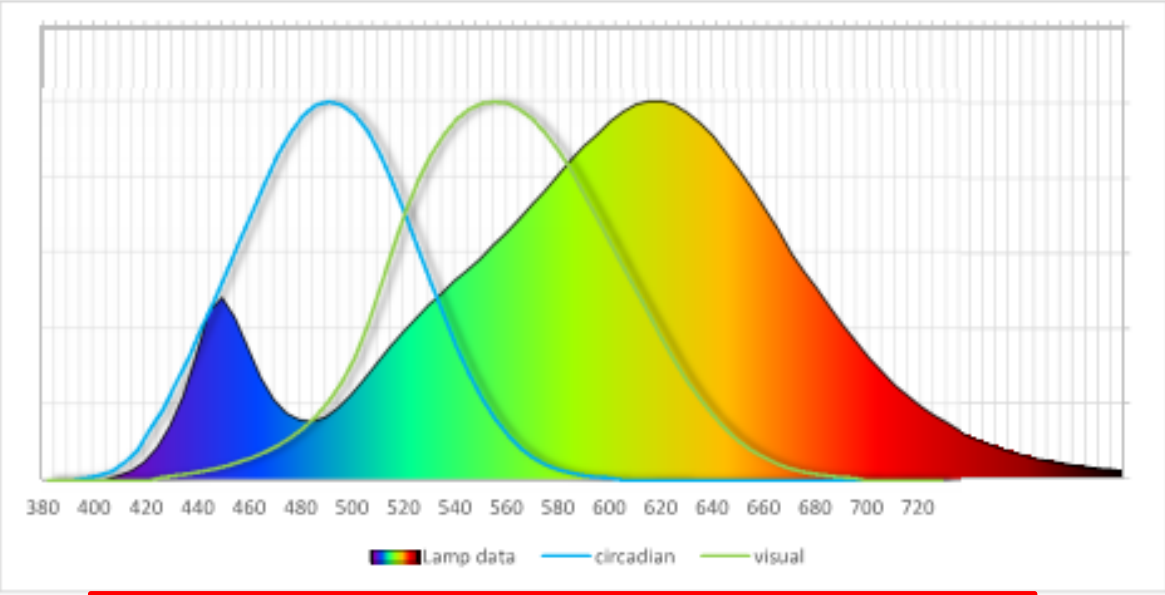


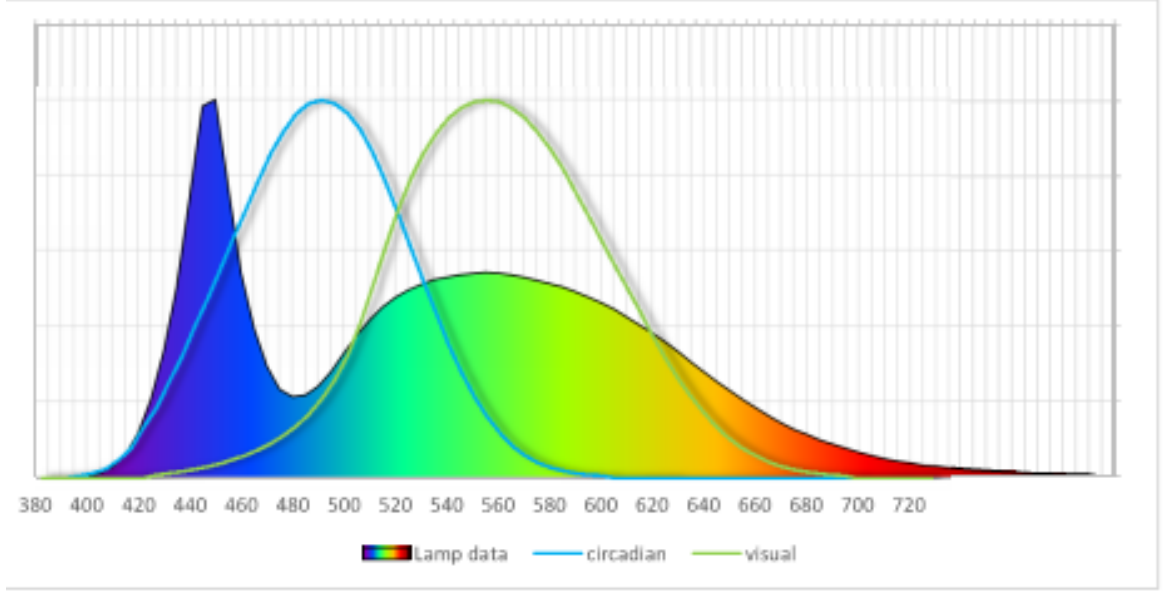

EML assuming getting 350 Lux = 350 x 0.469 = 164 EML

| Source | | Melanopic Ratio |
|---|---|---|
| User 2 | 6000K LED | 0.903 |

Click here for data input

Instructions

1. Select built-in sample source, or user-entered source (above).
2. For user data, paste lamp spectral power distribution (5 nm increments) into Data sheet.
3. To add more user sources, insert columns to the left of User 2 on the Data sheet.
4. Multiply the Melanopic Ratio by measured or modeled lux to calculate equivalent melanopic lux.




EML assuming getting 350 Lux = 350 x 0.469 = 316 EML

leducation.org

# How to Calculate Melanopic Ratio?

USE IWBI spreadsheet published by IWBI (Appendix L1)

| Source | Melanopic Ratio |
|---|---|
| User 2 2700K LED | 0.469 |

Click here for data input

Instructions

1. Select built-in sample source, or user-entered source (above).
2. For user data, paste lamp spectral power distribution (5 nm increments) into Data sheet.
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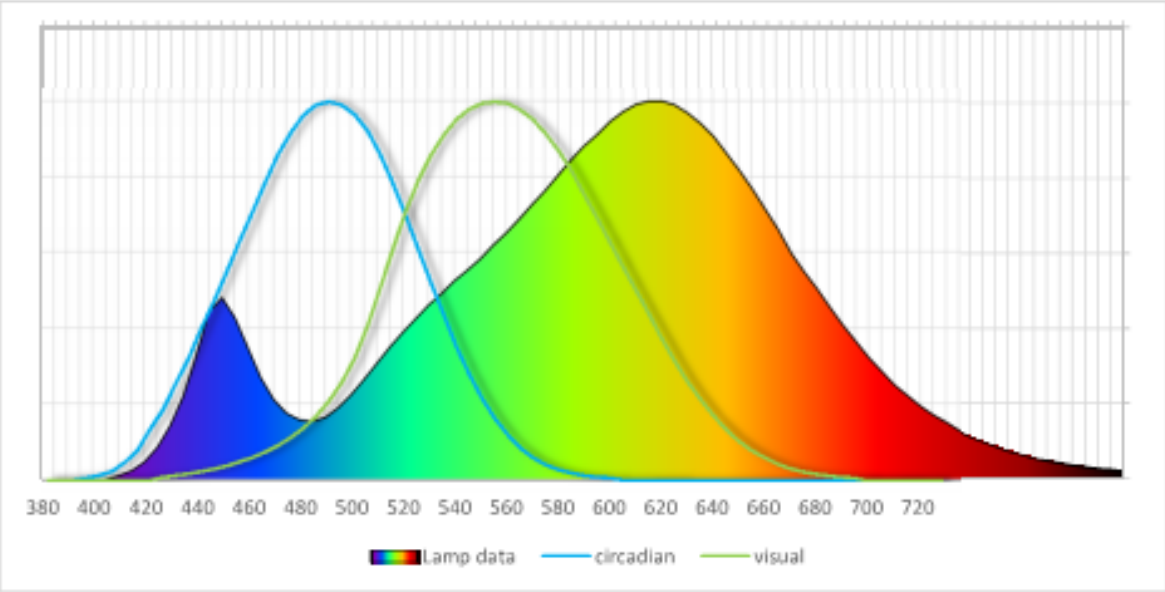


EML assuming getting 350 Lux = 350 x 0.469 = 164 EML

| Source | Melanopic Ratio |
|---|---|
| User 2 6000K LED | 0.903 |

Click here for data input

Instructions

1. Select built-in sample source, or user-entered source (above).
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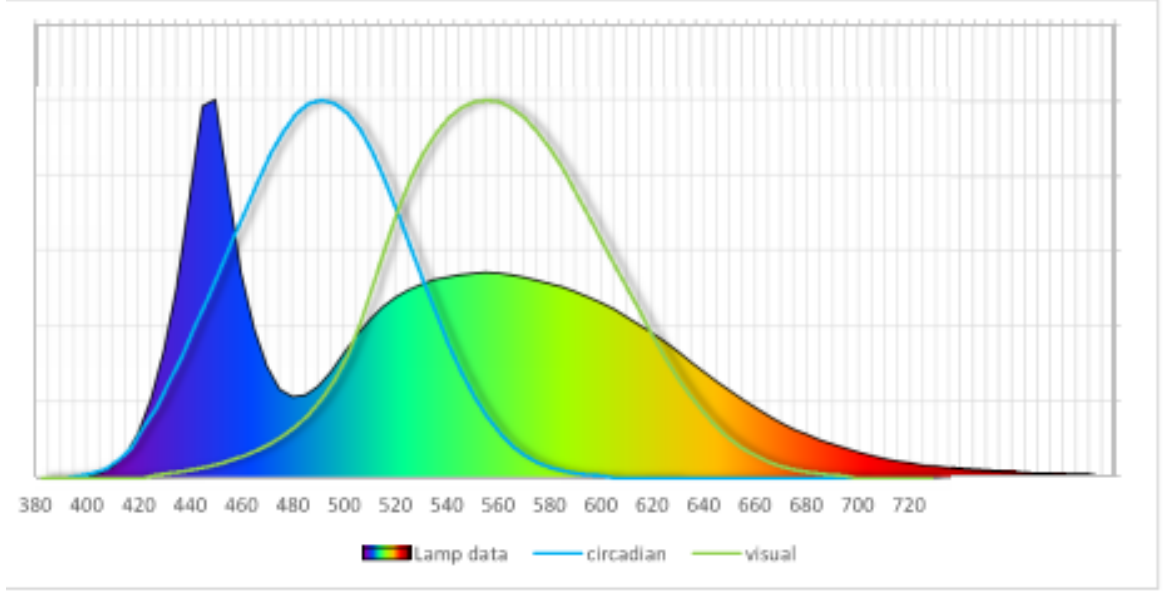


EML assuming getting 350 Lux = 350 x 0.469 = 316 EML

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# FIXTURE SPECIFICATION ALERT!

- Look for the melanopic ratio on the cut sheet (Rarely found! )
- Specify fixtures from manufactures willing to provide their SPD in Excel format in 5nm increments.

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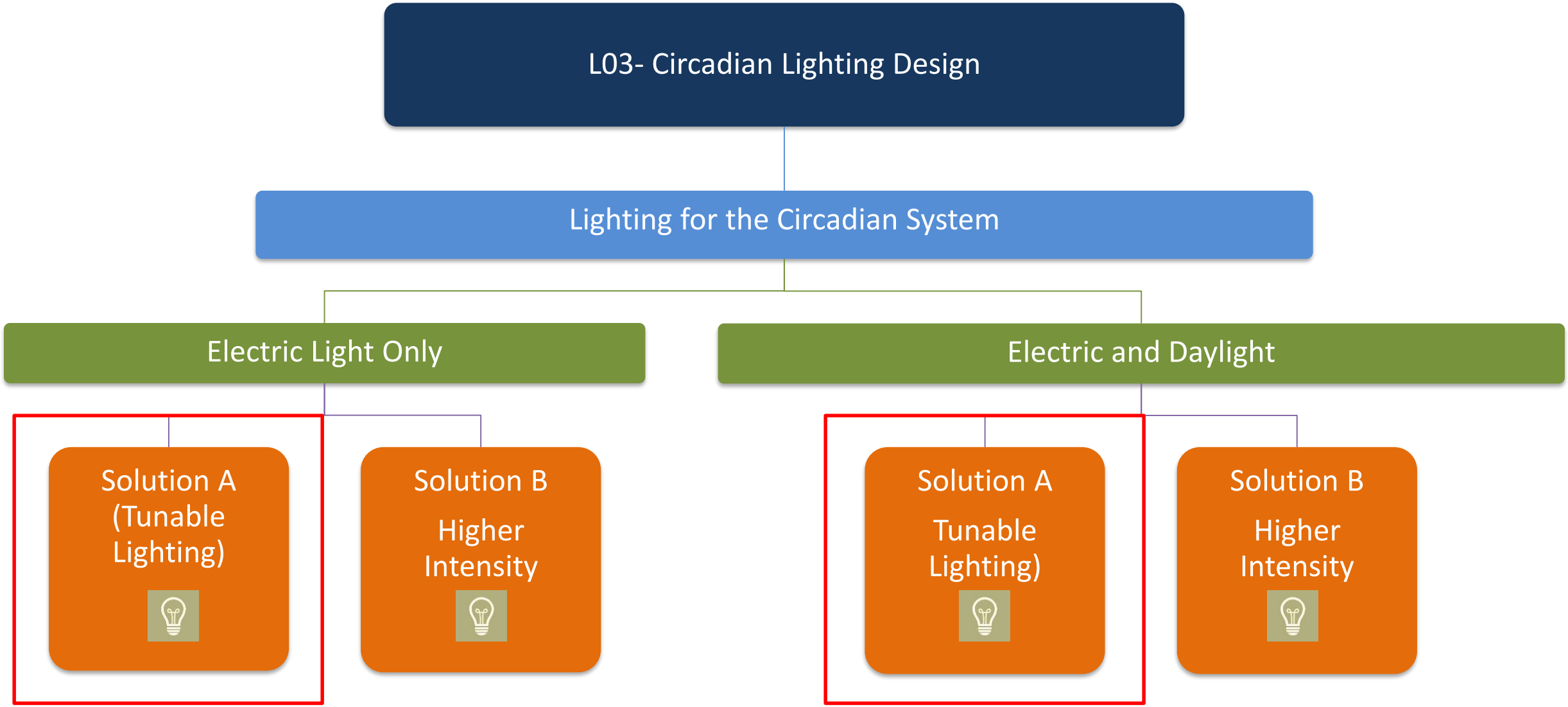


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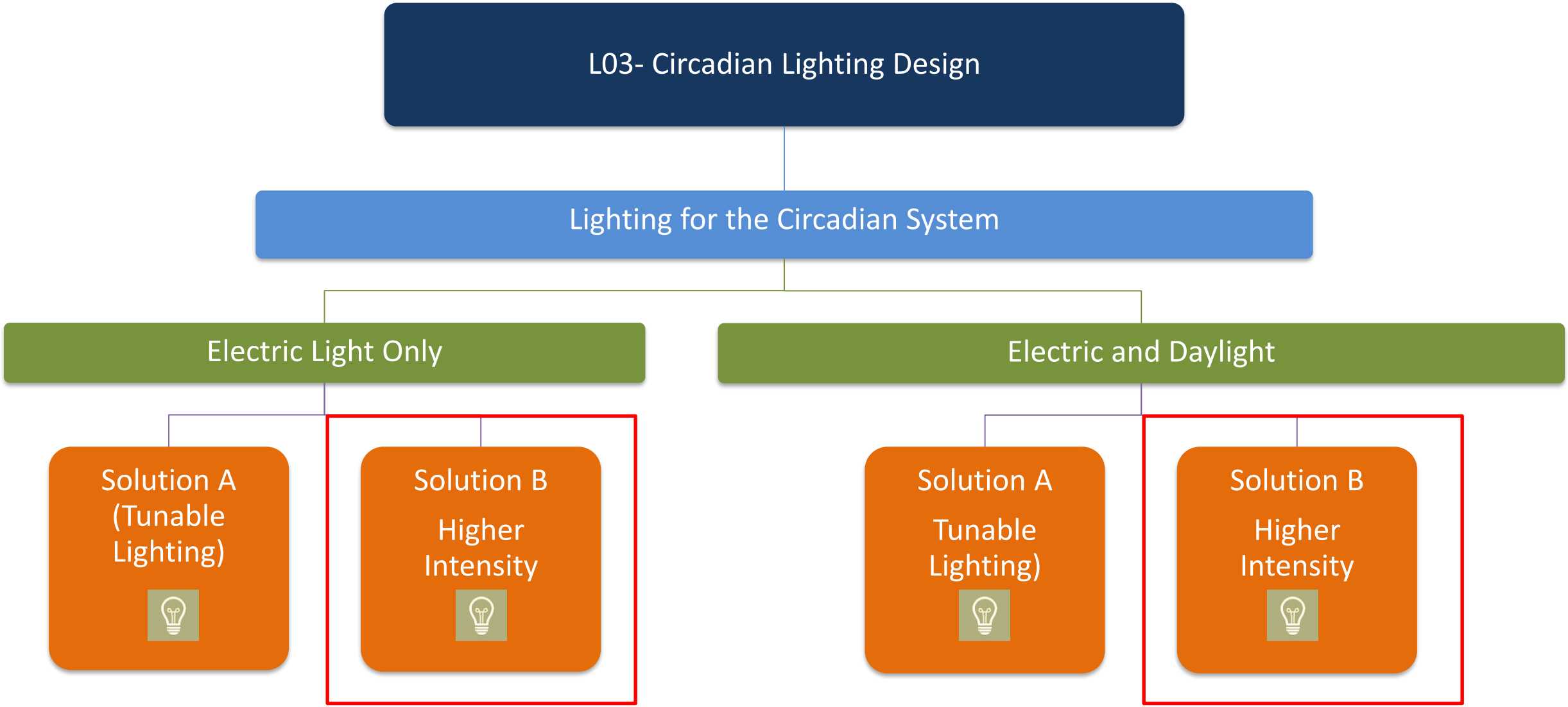


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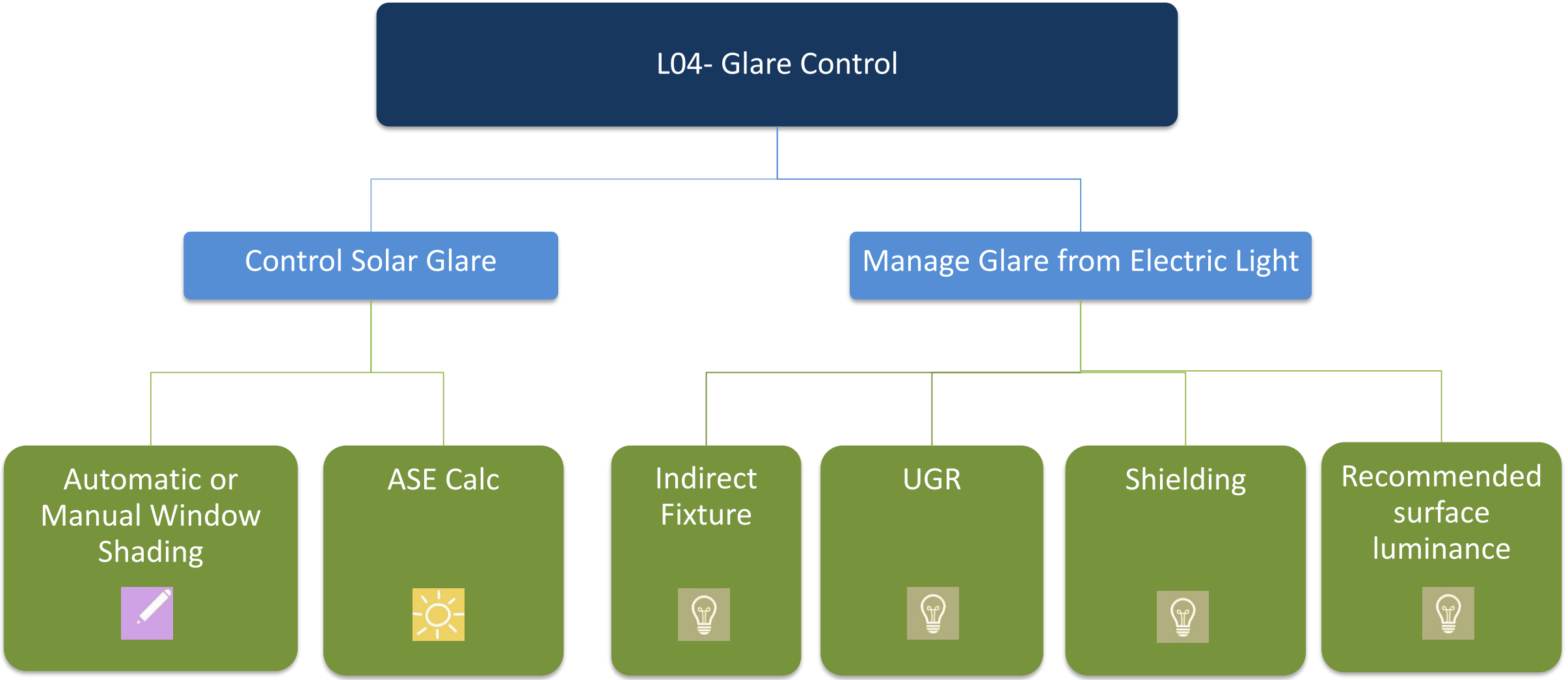
L04- Glare Control
Control Solar Glare
Manage Glare from Electric Light
Automatic or Manual Window Shading
ASE Calc
Indirect Fixture
UGR
Shielding
Recommended surface luminance

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# L04- Glare Control

## Control Solar Glare

- Automatic or Manual Window Shading
- ASE Calc

## Manage Glare from Electric Light

- Indirect Fixture
- UGR
- Shielding
- Recommended surface luminance

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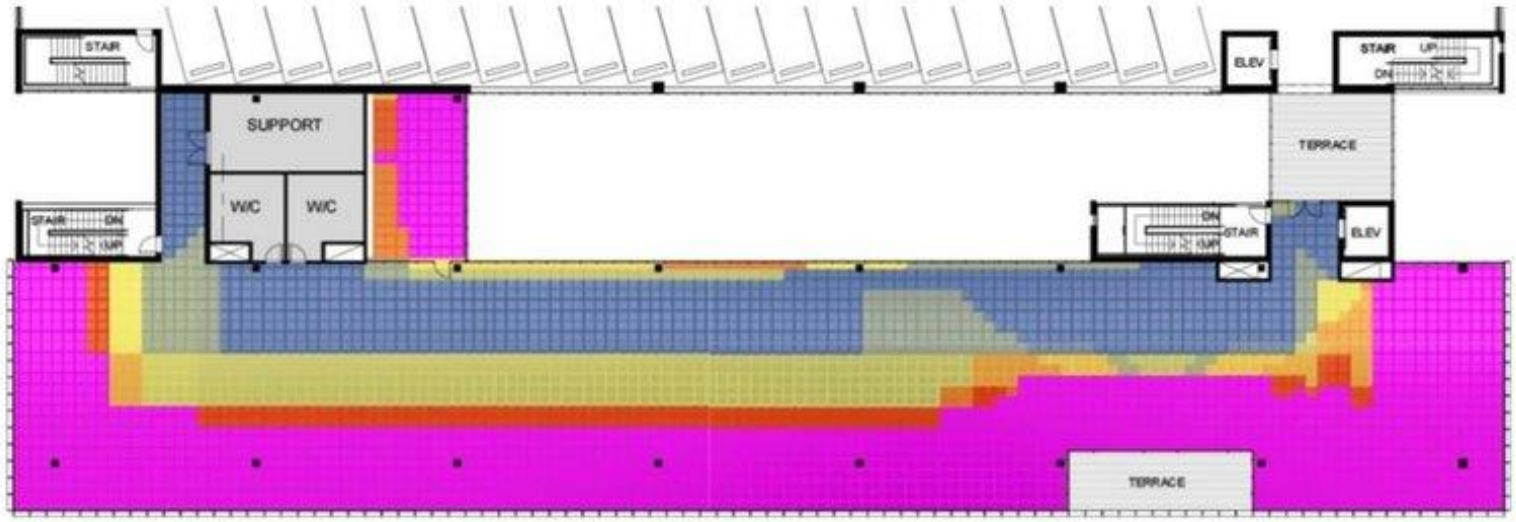
# What is ASE?




$ASE_{1000,250}$

42.7%

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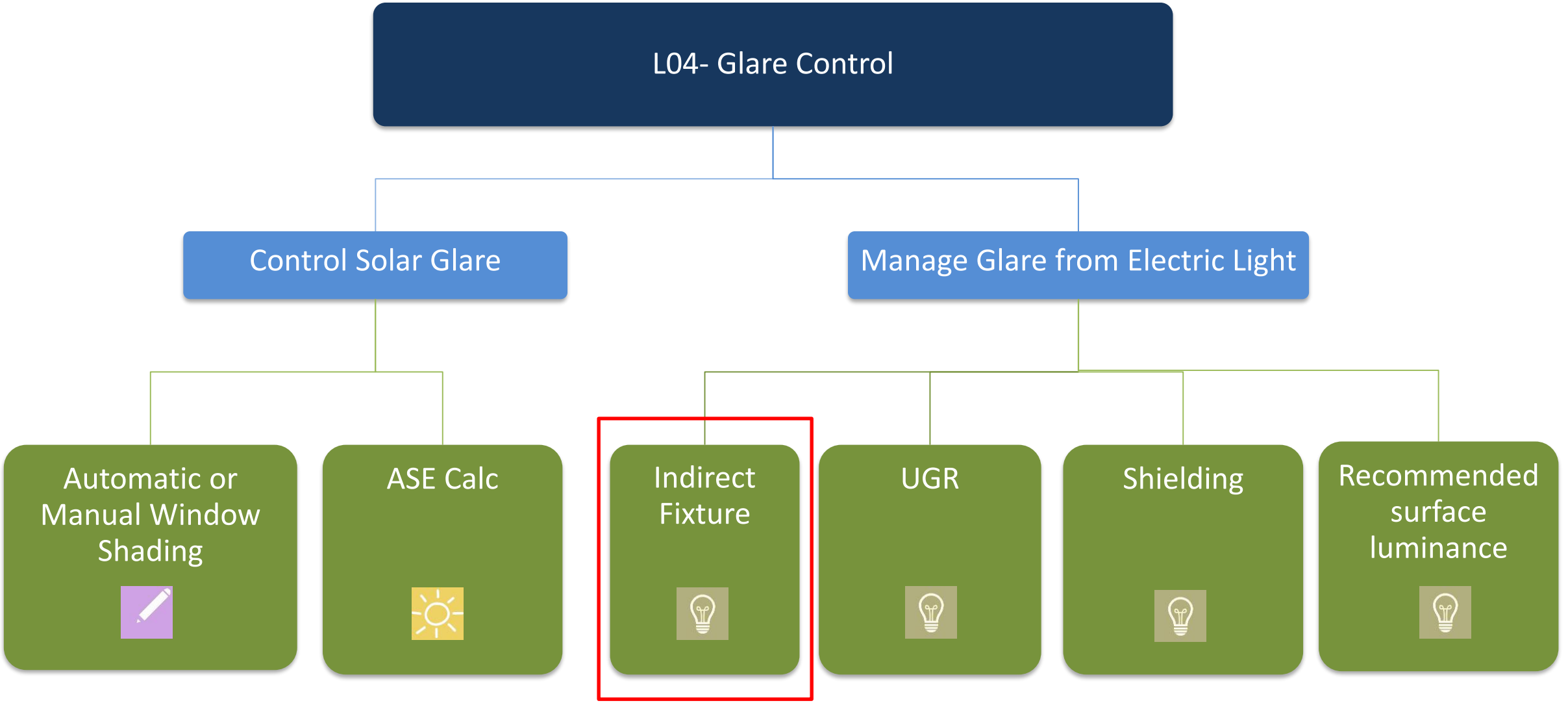
L04- Glare Control
Control Solar Glare
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# L04- Glare Control

## Control Solar Glare

- Automatic or Manual Window Shading
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## Manage Glare from Electric Light

- Indirect Fixture
- UGR
- Shielding
- Recommended surface luminance

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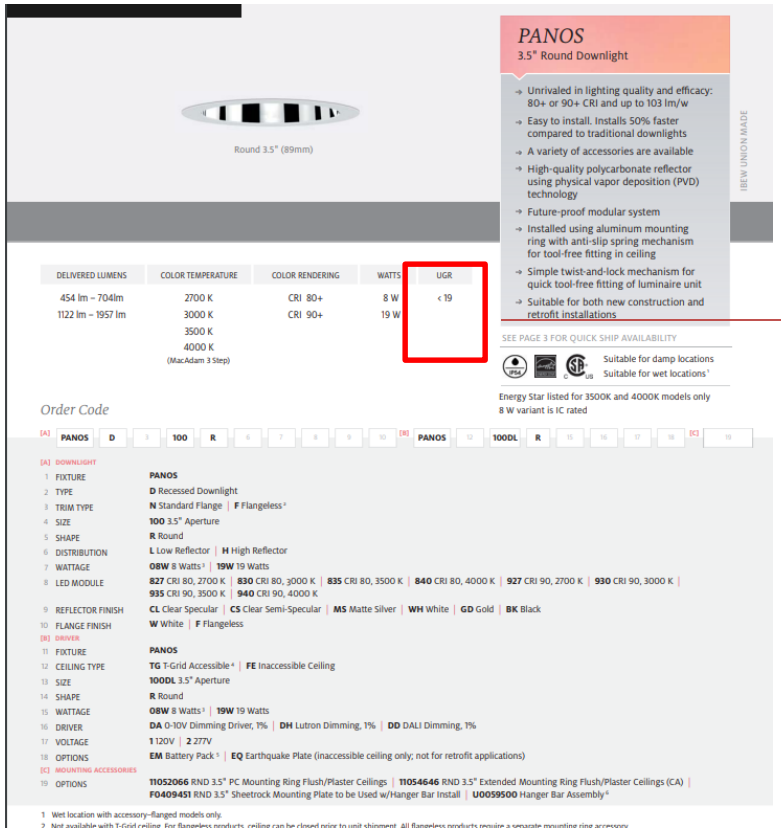
# What is UGR?

The UGR value is a dimensionless parameter which provides information about the degree of psychological glare of a lighting installation in an indoor space. UGR values are defined in steps within a scale of 10 to 30.

$$\mathbf{UGR} = 8 \log \left[ \frac{0.25}{L_b} \sum \left( \frac{L^2 \omega}{p^2} \right) \right]$$

# FIXTURE SPECIFICATION ALERT!

- Look for the UGR on the cut sheet (Mostly found on European manufacturer! )



PANOS
3.5" Round Downlight

- Unrivaled in lighting quality and efficacy: 80+ or 90+ CRI and up to 103 lm/w
- Easy to install. Installs 50% faster compared to traditional downlights
- A variety of accessories are available
- High-quality polycarbonate reflector using physical vapor deposition (PVD) technology
- Future-proof modular system
- Installed using aluminum mounting ring with anti-slip spring mechanism for tool-free fitting in ceiling
- Simple twist-and-lock mechanism for quick tool-free fitting of luminaire unit
- Suitable for both new construction and retrofit installations

Round 3.5" (89mm)

| DELIVERED LUMENS | COLOR TEMPERATURE | COLOR RENDERING | WATTS | UGR |
|---|---|---|---|---|
| 454 lm – 704lm | 2700 K | CRI 80+ | 8 W | < 19 |
| 1122 lm – 1957 lm | 3000 K | CRI 90+ | 19 W | |
| | 3500 K | | | |
| | 4000 K | | | |
| | (MacAdam 3 Step) | | | |

SEE PAGE 3 FOR QUICK SHIP AVAILABILITY

Suitable for damp locations
Suitable for wet locations[1]

Energy Star listed for 3500K and 4000K models only
8 W variant is IC rated

Order Code

| [A] | PANOS | D | | 100 | R | | | | | [B] | PANOS | | 100DL | R | | | [C] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

[A] DOWNLIGHT

| | | |
|---|---|---|
| 1 | FIXTURE | PANOS |
| 2 | TYPE | **D** Recessed Downlight |
| 3 | TRIM TYPE | **N** Standard Flange \| **F** Flangeless[2] |
| 4 | SIZE | **100** 3.5" Aperture |
| 5 | SHAPE | **R** Round |
| 6 | DISTRIBUTION | **L** Low Reflector \| **H** High Reflector |
| 7 | WATTAGE | **08W** 8 Watts[3] \| **19W** 19 Watts |
| 8 | LED MODULE | **827** CRI 80, 2700 K \| **830** CRI 80, 3000 K \| **835** CRI 80, 3500 K \| **840** CRI 80, 4000 K \| **927** CRI 90, 2700 K \| **930** CRI 90, 3000 K \| **935** CRI 90, 3500 K \| **940** CRI 90, 4000 K |
| 9 | REFLECTOR FINISH | **CL** Clear Specular \| **CS** Clear Semi-Specular \| **MS** Matte Silver \| **WH** White \| **GD** Gold \| **BK** Black |
| 10 | FLANGE FINISH | **W** White \| **F** Flangeless |

[B] DRIVER

| | | |
|---|---|---|
| 11 | FIXTURE | PANOS |
| 12 | CEILING TYPE | **TG** T-Grid Accessible[4] \| **FE** Inaccessible Ceiling |
| 13 | SIZE | **100DL** 3.5" Aperture |
| 14 | SHAPE | **R** Round |
| 15 | WATTAGE | **08W** 8 Watts[3] \| **19W** 19 Watts |
| 16 | DRIVER | **DA** 0-10V Dimming Driver, 1% \| **DH** Lutron Dimming, 1% \| **DD** DALI Dimming, 1% |
| 17 | VOLTAGE | **1** 120V \| **2** 277V |
| 18 | OPTIONS | **EM** Battery Pack[5] \| **EQ** Earthquake Plate (inaccessible ceiling only; not for retrofit applications) |

[C] MOUNTING ACCESSORIES

| | | |
|---|---|---|
| 19 | OPTIONS | **11052066** RND 3.5" PC Mounting Ring Flush/Plaster Ceilings \| **11054646** RND 3.5" Extended Mounting Ring Flush/Plaster Ceilings (CA) \| **F0409451** RND 3.5" Sheetrock Mounting Plate to be Used w/Hanger Bar Install \| **U0059500** Hanger Bar Assembly[6] |

1 Wet location with accessory-flanged models only.
2 Not available with T-Grid ceiling. For flangeless products, ceiling can be closed prior to unit shipment. All flangeless products require a separate mounting ring accessory.



## WELL recommendation:

Unified Glare Rating (UGR) values are met as per the below conditions:

Luminaires installed at a height of 5 m [16 ft] or lower meet UGR of 19 or lower.

Luminaires installed at a height greater than 5 m [16 ft] meet UGR of 22 or lower.

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# L04- Glare Control

## Control Solar Glare

- Automatic or Manual Window Shading
- ASE Calc

## Manage Glare from Electric Light

- Indirect Fixture
- UGR
- Shielding
- Recommended surface luminance

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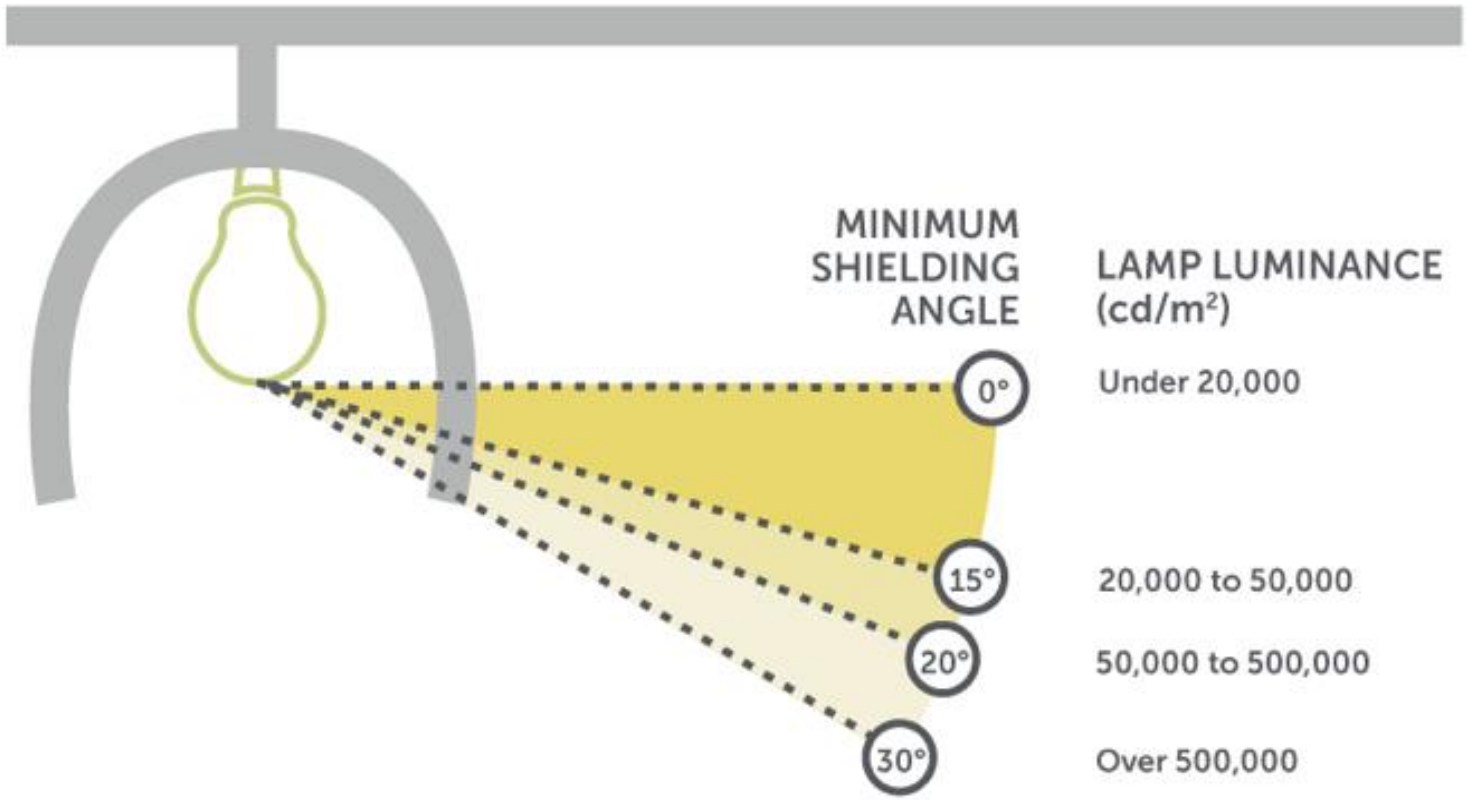
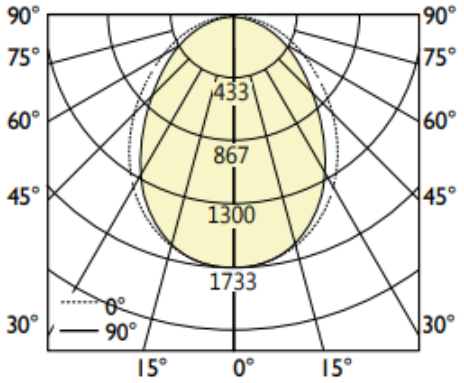
# Shielding recommendation by WELL V2



# Shielding recommendation by WELL V2

**1000 lm/ft**

**PHOTOMETRIC CURVE**




**Luminaire Lumens: 1000 lm/ft**
**Input Watts: 10.4 W/ft**
**Efficacy: 96 lm/W**

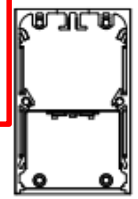
IES FILE: BRLED-1000-80-40-FL.IES
TESTED ACCORDING TO IES LM-79-2008

**LUMINANCE DATA (cd/m²)**

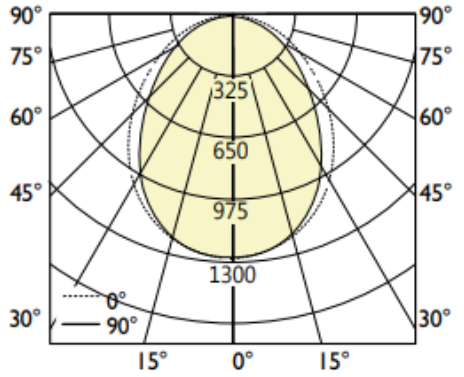
| Vertical Angle | Horizontal Angles 0 | 45 | 90 |
|---|---|---|---|
| 45 | 21381 | 19243 | 17399 |
| 55 | 18360 | 16087 | 14179 |
| 65 | 15173 | 13199 | 11472 |
| 75 | 11683 | 10273 | 8863 |
| 85 | 7776 | 7178 | 6580 |

15 Deg Shielding required

**750 lm/ft**



**PHOTOMETRIC CURVE**




**Luminaire Lumens: 750 lm/ft**
**Input Watts: 7.5 W/ft**
**Efficacy: 100 lm/W**

IES FILE: BRLED-750-80-40-FL.IES
TESTED ACCORDING TO IES LM-79-2008

**LUMINANCE DATA (cd/m²)**

| Vertical Angle | Horizontal Angles 0 | 45 | 90 |
|---|---|---|---|
| 45 | 16035 | 14432 | 13050 |
| 55 | 13770 | 12066 | 10634 |
| 65 | 11380 | 9899 | 8604 |
| 75 | 8762 | 7704 | 6647 |
| 85 | 5832 | 5383 | 4935 |

No Shielding required

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# L04- Glare Control

## Control Solar Glare

- Automatic or Manual Window Shading
- ASE Calc

## Manage Glare from Electric Light

- Indirect Fixture
- UGR
- Shielding
- Recommended surface luminance

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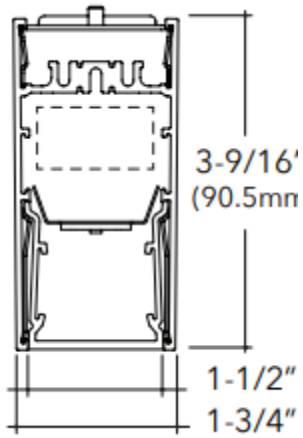
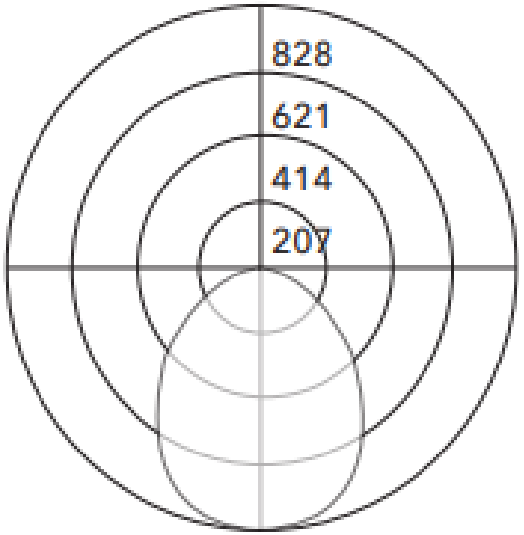



450 Lm/ft

## Photometrics

### High Efficiency Lens

| | |
|---|---|
| Test # | ITL86985 |
| Catalog # | EX1HE-840-4 |
| Lumens | 1726 Lm |
| Watts | 19.9 W |
| Efficacy | 87 LPW |




## Luminance Data (cd/sq.m)

| Angle In Degrees | Average 0-Deg | Average 45-Deg | Average 90-Deg |
|---|---|---|---|
| 45 | 14181 | 11775 | 10034 |
| 55 | 12136 | 9795 | 8273 |
| 65 | 10063 | 8103 | 6991 |
| 75 | 8216 | 6745 | 5967 |
| 85 | 6677 | 5393 | 5136 |

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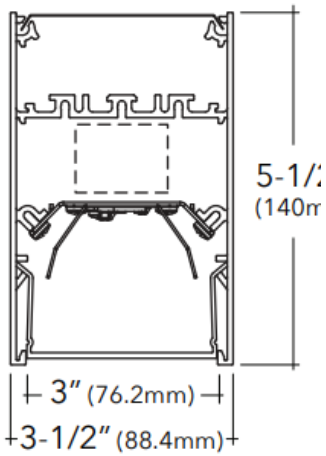
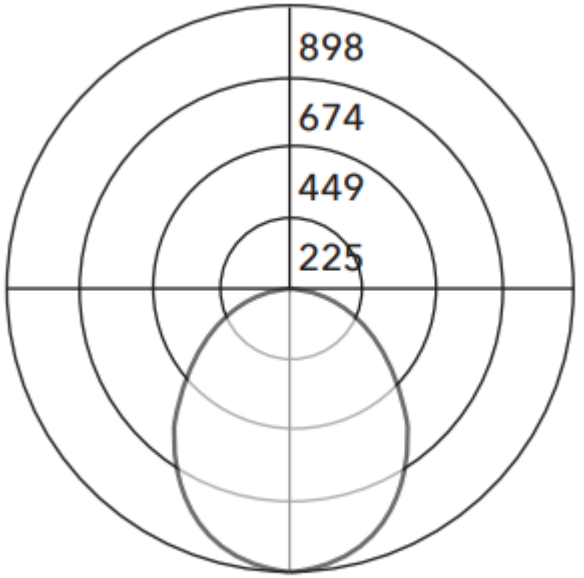



## Satine Lens

| | |
|---|---|
| Test # | ITL89801 |
| Catalog # | EX3D-HE-840-4 |
| Lumens | 1978 lm |
| Watts | 19.3 W |
| Efficacy | 102.5 LPW |

450 Lm/ft




## Luminance Data (cd/sq.m)

| Angle In Degrees | Average 0-Deg | Average 45-Deg | Average 90-Deg |
|---|---|---|---|
| 45 | 7804 | 6836 | 6053 |
| 55 | 6951 | 5928 | 5151 |
| 65 | 6066 | 5064 | 4344 |
| 75 | 4911 | 4071 | 3568 |
| 85 | 3490 | 2867 | 2742 |

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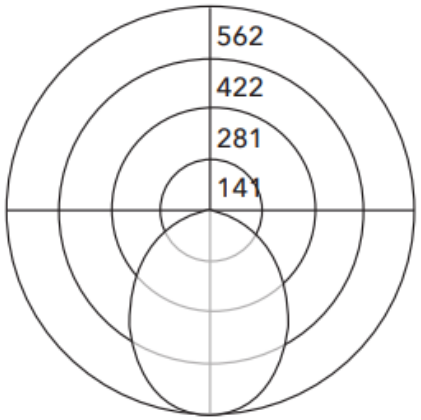
# FIXTURE SPECIFICATION ALERT!

- Look for the fixtures with luminance data report on the cut sheet
- Ask for the luminance data from manufacturer

## Photometrics

### Satine Wet Lens

| | |
|---|---|
| Test # | ITL86499 |
| Catalog # | EV3-WET-N-840-4 |
| Lumens | 1338 lm |
| Watts | 18.8 W |
| Efficacy | 71 LPW |




### Candela Distribution

| Vert Angle | Horizontal Angle | | | | |
|---|---|---|---|---|---|
| | 0 | 22.5 | 45 | 67.5 | 90 |
| 0 | 562 | 562 | 562 | 562 | 562 |
| 5 | 559 | 558 | 558 | 557 | 557 |
| 10 | 547 | 545 | 544 | 541 | 540 |
| 15 | 529 | 525 | 522 | 518 | 514 |
| 20 | 504 | 495 | 491 | 484 | 479 |
| 25 | 471 | 461 | 453 | 444 | 438 |
| 30 | 432 | 423 | 414 | 401 | 395 |
| 35 | 391 | 382 | 371 | 357 | 351 |
| 40 | 347 | 339 | 327 | 313 | 307 |
| 45 | 303 | 296 | 284 | 271 | 265 |
| 50 | 259 | 254 | 243 | 231 | 225 |
| 55 | 216 | 212 | 204 | 194 | 190 |
| 60 | 175 | 173 | 166 | 159 | 156 |
| 65 | 137 | 137 | 132 | 127 | 125 |
| 70 | 101 | 103 | 101 | 98 | 97 |
| 75 | 68 | 72 | 72 | 72 | 73 |
| 80 | 41 | 45 | 49 | 51 | 52 |
| 85 | 18 | 24 | 30 | 34 | 35 |
| 90 | 2 | 8 | 15 | 19 | 21 |

### Luminance Data (cd/sq.m)

| Angle In Degrees | Average 0-Deg | Average 45-Deg | Average 90-Deg |
|---|---|---|---|
| 45 | 3516 | 3122 | 2855 |
| 55 | 3086 | 2690 | 2436 |
| 65 | 2635 | 2277 | 2074 |
| 75 | 2131 | 1863 | 1780 |
| 85 | 1625 | 1615 | 1669 |

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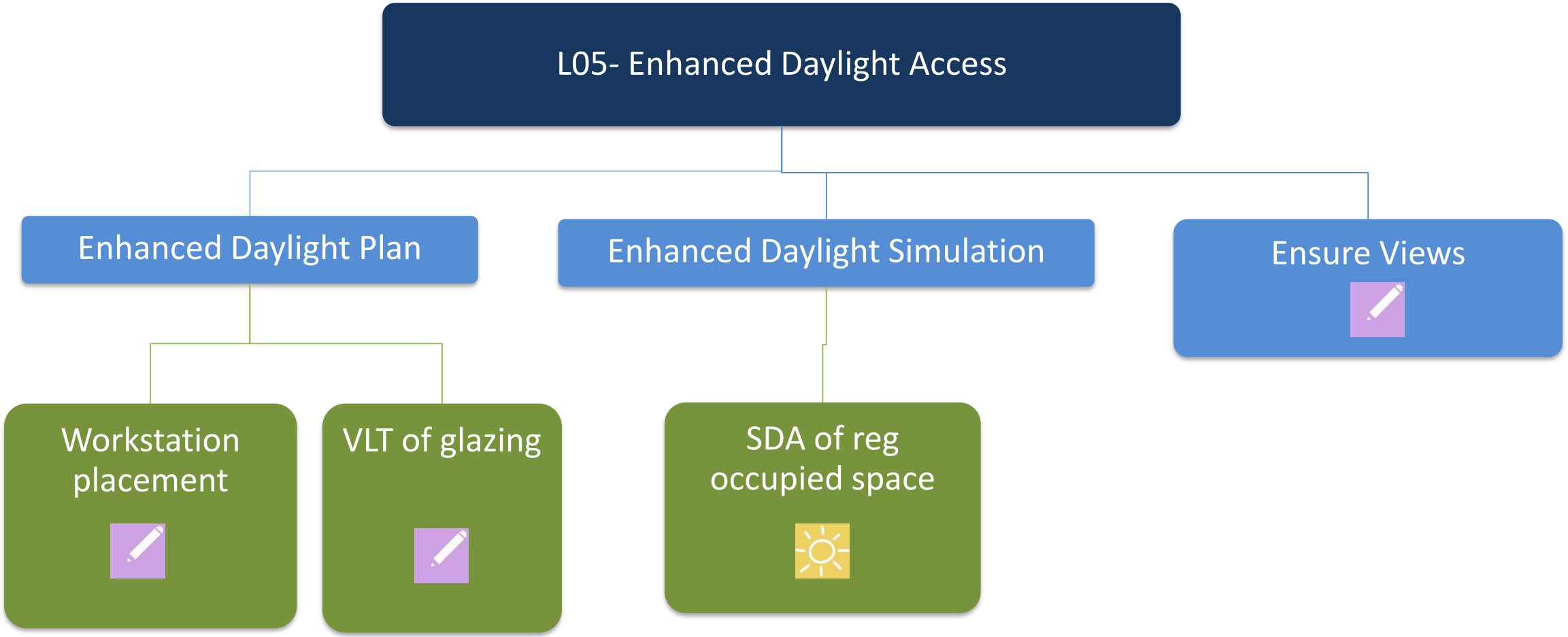
L05- Enhanced Daylight Access
Enhanced Daylight Plan
Enhanced Daylight Simulation
Ensure Views
Workstation placement
VLT of glazing
SDA of reg occupied space

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# L06- Visual Balance

## Manage Brightness

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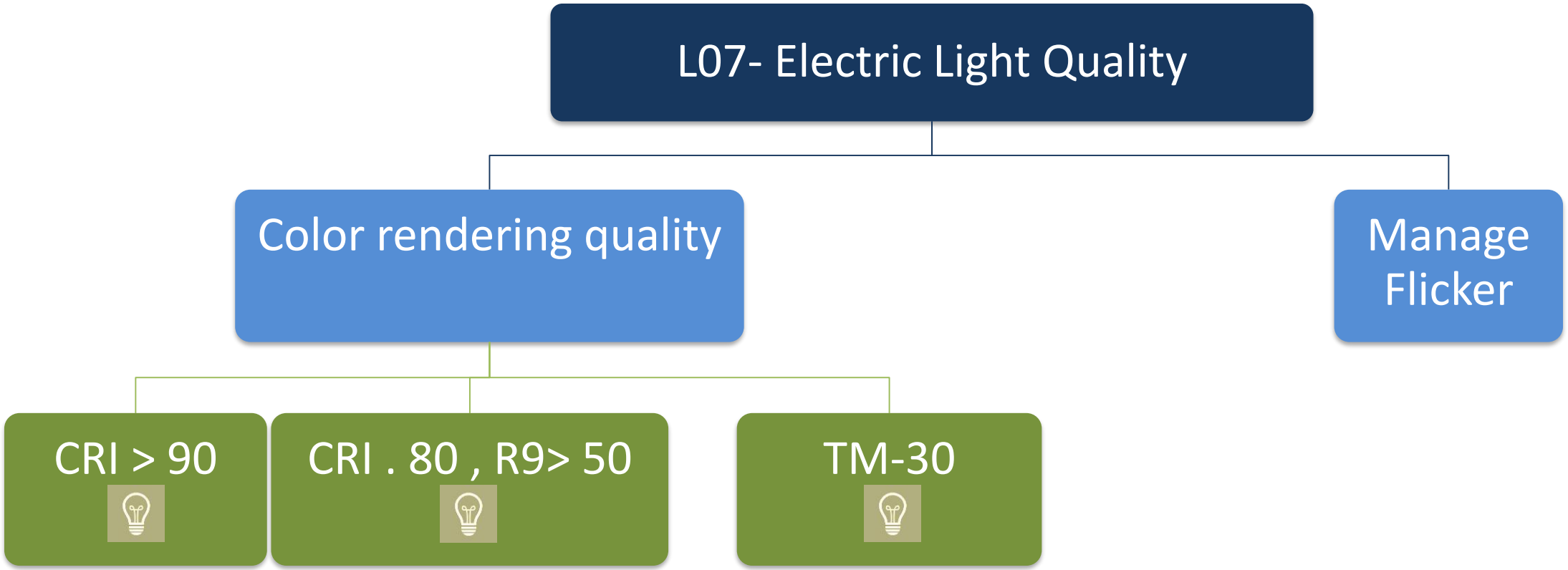
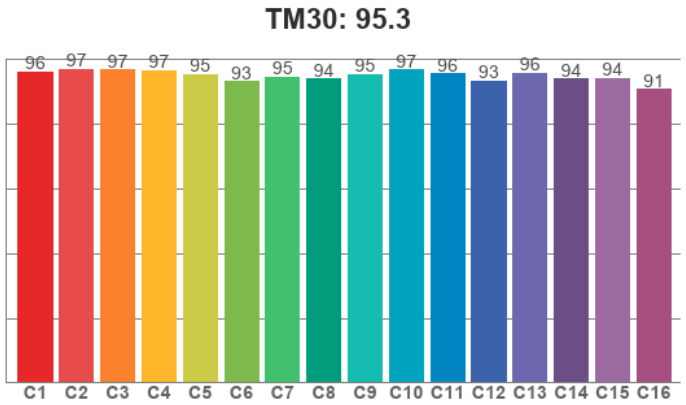
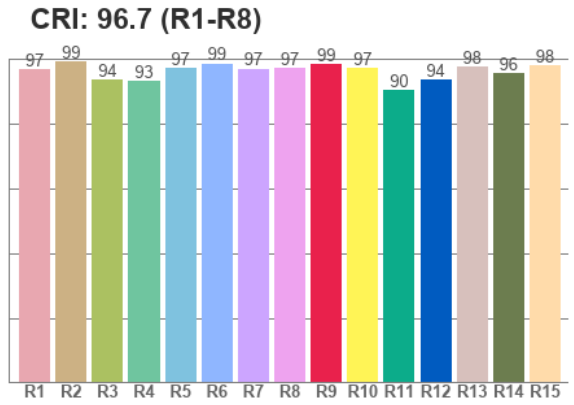

L07- Electric Light Quality
Color rendering quality
Manage Flicker
CRI > 90
CRI . 80 , R9> 50
TM-30

# FIXTURE SPECIFICATION ALERT!

- Look for the fixtures with published CRI or TM-30 report
- Ask for the R9 value from the manufacture if you are planning to specify CRI 80




CRI R values, only R1-R8 are used to calculate final CRI value

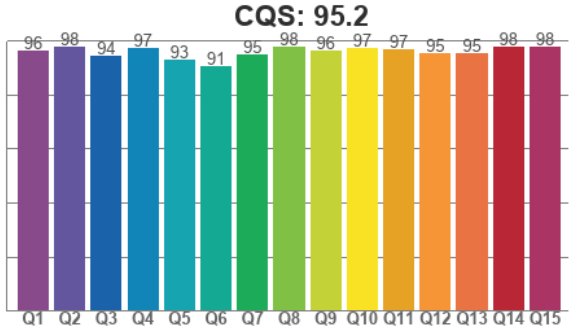
| R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R12 | R13 | R14 | R15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.9 | 99.4 | 93.7 | 93.3 | 97.1 | 98.7 | 97.1 | 97.3 | 98.5 | 97.4 | 90.4 | 93.7 | 97.7 | 95.5 | 98.2 |

TM30 C values, 16 binned values out of total of 99 C values

| C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.2 | 97.1 | 96.8 | 96.7 | 95.3 | 93.2 | 94.5 | 94.0 | 95.5 | 96.9 | 95.5 | 93.3 | 95.8 | 93.9 | 94.2 | 90.8 |

CQS Q values

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.3 | 97.8 | 94.5 | 97.1 | 93.0 | 90.6 | 94.7 | 97.6 | 96.5 | 97.2 | 96.7 | 95.5 | 95.5 | 97.6 | 97.7 |




**Color parameters**

| Color temperature | Color rendering index | Red component | Color fidelity | Color gamut | Color quality scale | Color coordinate cie 1931 | Color coordinate cie 1931 | Color coordinate | Color coordinate | Color diviation from black body |
|---|---|---|---|---|---|---|---|---|---|---|
| CCT | CRI | CRI R9 | TM30 Rf | TM30 Rg | CQS | x | y | u | v | Δuv |
| 3001 K | 96.7 | 98.5 | 95.3 | 103.5 | 95.2 | 0.437 | 0.405 | 0.251 | 0.348 | 0.0003 |

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# L08- Occupant control of lighting environments

## Enhanced Occupant Controllability

## Provide supplemental Lighting

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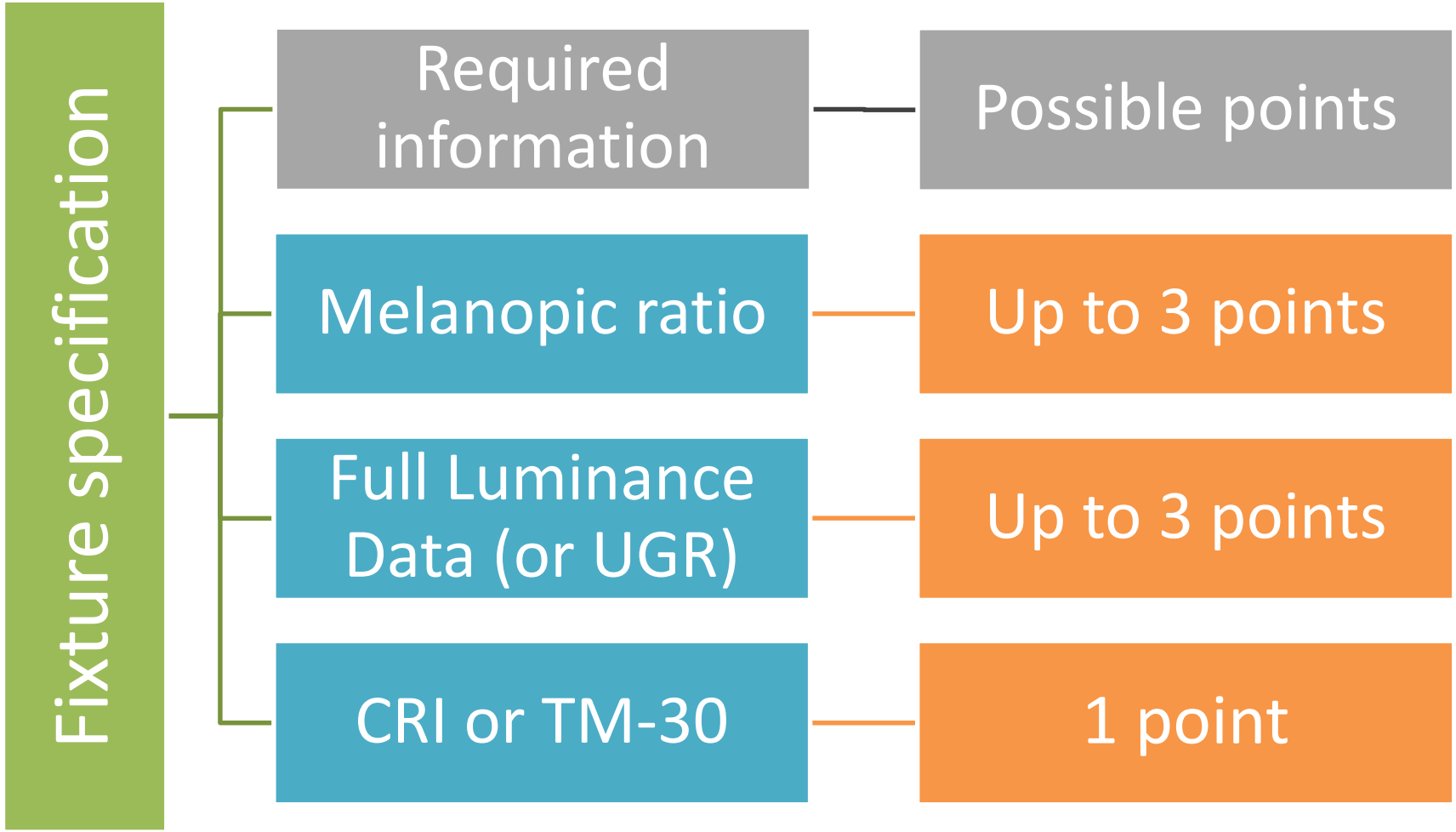
# Conclusion



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QUESTIONS?

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This concludes The American Institute of Architects Continuing Education Systems Course

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