OLED Lighting in the Offices of Aurora Lighting Design, Inc.

DOE Booth
LightFair April 2016

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Aurora Lighting Design, Inc.
OLED Lighting at Aurora Lighting Design, Inc.

Project description
• Arch’l Lighting Design Office in lower levels of residence in Grayslake IL
• Windows onto lake with daylight as principal light source
• Low gypboard ceilings 7’-5” max with 7” recess depth
• Remodeled lighting in September 2014
• First office test site for OLEDs used in general lighting
• Principal, plus 3 design staff in office

Design criteria
• Warm, home-like 3000K color, 80+ CRI, R9 >20
• Smooth dimming down to 10% output
• Soft appearance and shallow profile
• Average 30+ fc (300 lx) on 30” work plane
• Visually comfortable system with little computer screen glare
• Playful, decorative appearance expressing design, suitable for home resale if needed
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Lighting *before* renovation

- Room is 14’-9” x 20’-6”
- 8 recessed medium-base downlights with screwbase 20W LED PAR30 NFL lamps
- 3000K, 80+ CRI
- 8400 initial lamp lumens total
- 156 system Watts, 0.52 W/sf
- Average 291 lx (27 fc), ranging from 26 to 2087 lx (2 to 194 fc)
  - LUMPY LIGHTING!
- Narrow beam lamps produce funky shadows on faces
- Dimmable with phase-cut wall dimmer
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Lighting *after* renovation

- Leslie North and Ashley Mikels designed
- Configuration of Acuity Brands Trilia™ lighting system with OLED panels
  - 4 triangular + 3 straight assemblies, 3000 K
  - 120 OLED panels, 100 mm sq. (4” x 4”)
  - Each OLED panel produces ~70 lumens, draws ~ 1.6W avg.
  - Diffuse light, 3000 cd/m² panel luminance
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Lighting *after* renovation

- 11 remote drivers mounted in adjacent storage space
- 8518 lumens at full, per mfr’s literature
- 0-10V dimming driver controlled with wall dimmer

Remote-mount drivers in adjacent space
Photos courtesy Aurora Lighting Design, Inc.
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- Calculated light levels using AGI32™
- In footcandles (multiply by 10.76 for lux)

Calculated workplane illuminances in fc, 0.85 LLF

Calculation courtesy Aurora Ltg Design, Inc.
Installation issues

- Inaccessible ceiling made it impossible to mount boxy drivers above gypboard between joists. Also hard to fish wires from drivers to assemblies. (This is often a problem with remote drivers or ballasts)
- System used LED drivers requiring running 41 wires to feed points for the 7 different assemblies
- Installation completed September 30, 2014
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Field issues

• A driver fails two months later, leaving half of a triangular section out. Replacement driver is promptly shipped and installed.

• January 2015, one OLED panel failed to light, and the panel exhibited a dark spot, indicated a shorting defect during manufacturing. Replacement panel was shipped out with video instructions, and Aurora staff replaced it.
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Field issues

- Staff almost always uses system in dimmed mode, and had noticed some flicker.
- Tested with flicker top, the OLED system exhibits a pattern suggesting some stroboscopic flicker, likely due to the PWM operation of the dimming driver.
- Acuity’s Horizon Team measured 77% flicker at 261 Hz when dimmed to 80%; 100% flicker at 261 Hz at 50% output. These are within the ranges that some people will find visible. Staff reported no adverse health effects.
- Acuity is changing its drivers as a result.
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Reaction from office occupants

- Staff very pleased with finished appearance and function of the OLED system.
- Comments
- Produces almost shadow-free ambient lighting, similar to indirect.
- Using 100% OLED is not very exciting in a space. Too diffuse. Few shadows or highlighting.
- Works best if supplemented with task lighting and an accent lighting layer
- At full output, the OLED panels are somewhat uncomfortably bright. When dimmed, they are fine.
- They really appreciate the color quality

Soft

Visitors are intrigued

Desirable Uniformity

Visitors want to touch the light

Inspiring
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Color quality of the OLED panels (IES TM-30-15)

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SPECTRAL POWER DISTRIBUTION COMPARISON

COLOR VECTOR GRAPHIC

COLOR DISTORTION GRAPHIC

Reference Illuminant

Test Source
DOE GATEWAY Program field measurements

- Luminances of panels
  - Panels produce a “cosine distribution” so they theoretically have the same luminance from all viewing angles
  - Luminance meter showed panels ranged from 2625 to 3908 cd/m², even though Acuity claimed a 3000 cd/m² maximum for visual comfort.

- Illuminances on workplane
  - Measured workplane illuminances were 20 to 65% higher than calculated (had there been no lumen depreciation, one would expect 18% higher light levels)

- Power draw for system at full output
  - 240 W, assuming a 0.97 PF
  - 0.79 W/sf
  - Expected 192 W per manufacturer’s literature

Polar plot of OLED panel light distribution
Image courtesy Acuity Brands
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DOE GATEWAY Program field measurements

• Why the higher-than-expected values?
  – Talk with Acuity’s Horizon Group suggests mismatch between specified and installed drivers
  – Aurora Lighting Design, Inc. opens driver boxes to find two 35W drivers out of 11, rather than 25W drivers

• Corrected drivers shipped and installed and follow up spot measurements show illuminances, luminances, and power drop to expected levels

• Power draw for system
  – 189 W, assuming a 0.97 PF
  – 0.62 W/sf
  – 45 lm/W
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Summary of project

- OLEDs are a creative light medium for architectural lighting designers
- They have wonderful properties for facial modeling, cheerful wall luminances, and low-glare ambient lighting

Growing pains include
- lower efficacy than LEDs
- higher cost
- lack of standardized connectors and mounts
- limited optical distribution options (at this point in time)
- and drivers borrowed from the LED industry that are less than optimized for OLED use

Try them! Gain experience.
OLED Capabilities, Challenges, Potential

• Exciting design element, especially when panels are easily replaceable
• 20-60 lm/W system efficacy available now. Needs to improve to 100+ to be competitive.
• Panel cost needs to drop precipitously with mass production
• Bendable, foldable, field-cuttable, larger panel options needed for flexibility
• Range of panel luminances and distributions needed
• Drivers! Drivers! Drivers!
  – CCR or hybrid drivers optimized for OLED needs
  – Solve problems of flicker and dimming range
  – Drivers need to be miniaturized to match thinness of panel
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http://energy.gov/eere/ssl/gateway-demonstration-indoor-projects

Thanks for your attention!
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And now for questions????

GATEWAY Demonstrations

Aurora Lighting Design, Inc. Offices
Photos courtesy Acuity Brands