Field Test DELTA Snapshots

LED ACCENT LIGHTING IN A COMMUNITY ART GALLERY

Demonstration and Evaluation of Lighting Technologies and Applications ▲Lighting Case Studies

Art galleries draw attention to artwork by providing more light on the artwork than in the surroundings. This type of accent lighting should reveal the shape, color, and texture of the art without producing glare, flicker, or distracting shadows to the viewer.[1] The need for accent lighting on art must be balanced with energy codes that limit allowable lighting power density.

Conventional accent lighting for galleries typically consists of aimable track heads with incandescent halogen light sources such as PAR or MR16 lamps. Lately, several manufacturers have developed LED lighting systems for art galleries to provide accent lighting while reducing energy use. The objective of this study was to evaluate an LED track head designed for accent lighting and compare its performance to conventional accent lighting and to the existing diffuse lighting.

Application profile

Mineola Public Library, located in a Long Island suburb of New York City, hosts exhibitions from local artists. The Walter and Joan Hobbs Gallery shows the work of the community artists, typically framed paintings and photographs. The gallery is located in the basement of the library. The displayed artwork changes every month. The gallery space is also used for circulation, connecting several rooms to the elevator, stairs, and restrooms. Adjacent gallery spaces do receive light from large clerestory windows, but the majority of the illumination in this space is contributed electrically.

Objectives

- Provide accent lighting for community art gallery to draw attention to the art
- Evaluate occupant acceptance of LED track heads compared with existing compact fluorescent lamp (CFL) downlights and conventional halogen MR16 track heads
- Compare energy performance of the three lighting systems

Lighting systems

The existing lighting in this 174 ft^2 gallery space consisted of four recessed downlights, 10-inch diameter, each with two, 32-watt, pin-based, triple twin-tube CFLs.

WAC Lighting of Garden City, N.Y., provided two track lighting systems: halogen MR16 and LED (see table at right). A two-circuit track was mounted 24 inches from the wall. The ceiling height is 9 feet-9 inches. The dual circuits enabled changing between light sources for the occupant survey. Track heads operating conventional MR16 lamps were installed temporarily at the gallery to provide an additional comparison for the new LED lighting system.

Gallery area in Mineola Public Library, Mineola, NY

Light Source Comparison

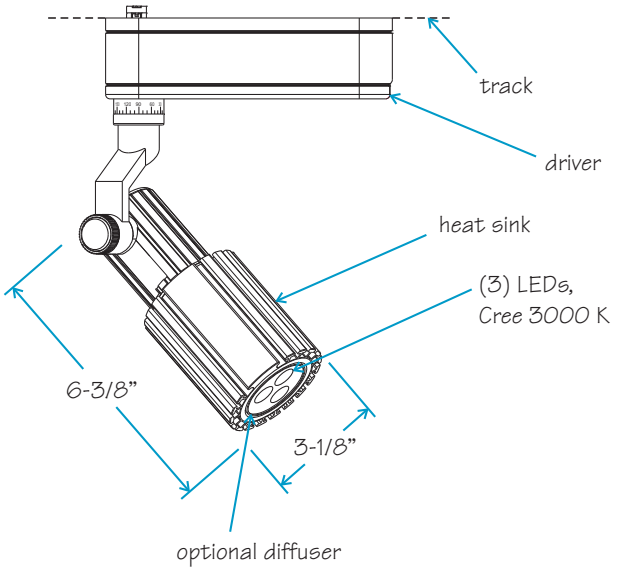
	Existing CFL Downlights	WAC MR-16 Track Heads	WAC LED Track Heads
Light Source	(2) 32 W CFLs	MR-16	White LED
Color Temperature (CCT)	4100 K	3000 K	3014 K
Color Rendering Index (CRI)	80	100	81
Beam Angle	N/A	~15°	~13° *
Maximum Intensity	N/A	5063 cd	6659 cd
Light Source Life	12,000 hrs	3,000 hrs	35,000 hrs
Luminaire System Input Power	71 W	48 W	14 W
Luminaire Quantity	4	11	11
Luminaire Efficacy	N/A	13 lm/W	51 lm/W

N/A = Not available
** Diffusers available for wider beam spreads, reducing efficacy*

[1] While artifact conservation is important in many art galleries, conservation was not relevant in this demonstration and thus was not evaluated.

The primary components of the LED track head are shown in the figure below. Lighting Research Center (LRC) staff provided the manufacturer with engineering support in this track head's development. The track head is listed on the ENERGY STAR Solid-State Lighting luminaire program.[2]

Primary components of the LED track head



Illuminance Comparison

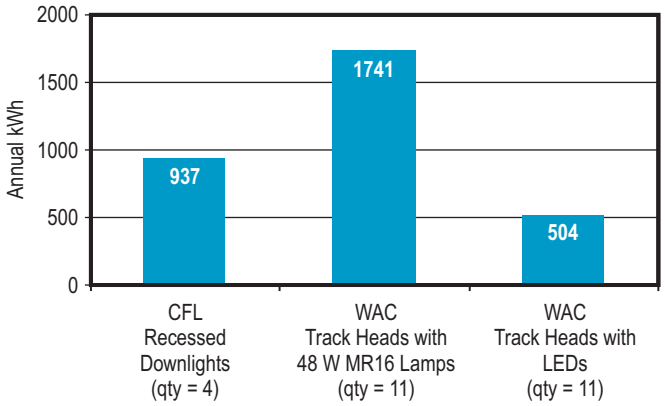
An independent evaluator (KAD Consulting) measured illuminance on the gallery's artwork, on the immediate surroundings, and on the horizontal plane below the artwork (38-inch height). The measurements showed why the existing lighting was not suitable for accent lighting; the existing CFLs provided an illuminance ratio far less than recommended by IESNA[3] for drawing attention to artwork (>2:1). The two accent lighting systems successfully provided the contrast necessary to draw attention to the artwork. The halogen MR16 system demonstrated here provided about 20% lower average illuminance on the artwork compared with the LED system.[4]

Energy and Lighting Power Density

Data from battery-powered monitoring devices indicate that lighting in this gallery space is used 3300 hours per year. To generate energy comparisons, LRC researchers assumed that each of the three conditions would be used for the same amount of time per year. Relative to the existing CFLs, the LRC estimates that the LED system uses 46% less energy. The track heads operating WAC MR16 lamps use considerably more energy than both the existing lighting (+86%) and these LED track heads (+246%).

The power density of both the existing lighting (1.6 W/ft^2) and the MR16 system (3.0 W/ft^2) do not meet the most recent lighting power density code requirements established by the Energy Conservation Construction Code of New York State in 2010. This code establishes a limit of 1.1 W/ft^2 for museum spaces, and 1.3 W/ft^2 for libraries.[5] At 0.9 W/ft^2, the LED track lighting system is the only condition of the three shown here that meets recent energy code requirements.

Annual energy use estimates



Illuminance comparison chart

	Existing CFL Downlights	WAC MR-16 Track Heads	WAC LED Track Heads
Average Illuminance on Art	14 fc	56 fc	70 fc
Average Illuminance, Horizontal Plane	21 fc	18 fc	16 fc
Resulting Illuminance Ratio	0.7 : 1	3.0 : 1	4.5 : 1
Average Illuminance, Surrounding Art	17 fc	27 fc	29 fc
Resulting Illuminance Ratio	1 : 1	2 : 1	2.4 : 1

1 footcandle (fc) = 10.76 lux

[2] Program requirements and qualified products listed at www.energystar.gov.

[3] DiLaura D, Houser K, Mistrick R, Steffy G, editors. *IESNA Lighting Handbook: Reference and Application. 10th ed.* New York: Illuminating Engineering Society of North America. See Table 21.2 "Art Facilities Illuminance Recommendations" and Table 15.2 "Accent Illuminance Ratios." This most recent standard recommends a ratio of (artwork): (horizontal task plane). Previous standards recommended a ratio of (artwork): (immediate surrounding area). Both results are presented here.

[4] Both accent lighting systems were new, with little lumen degradation. The CFL downlights had been operating for approximately 10 years with unknown lamp change or cleaning frequency.

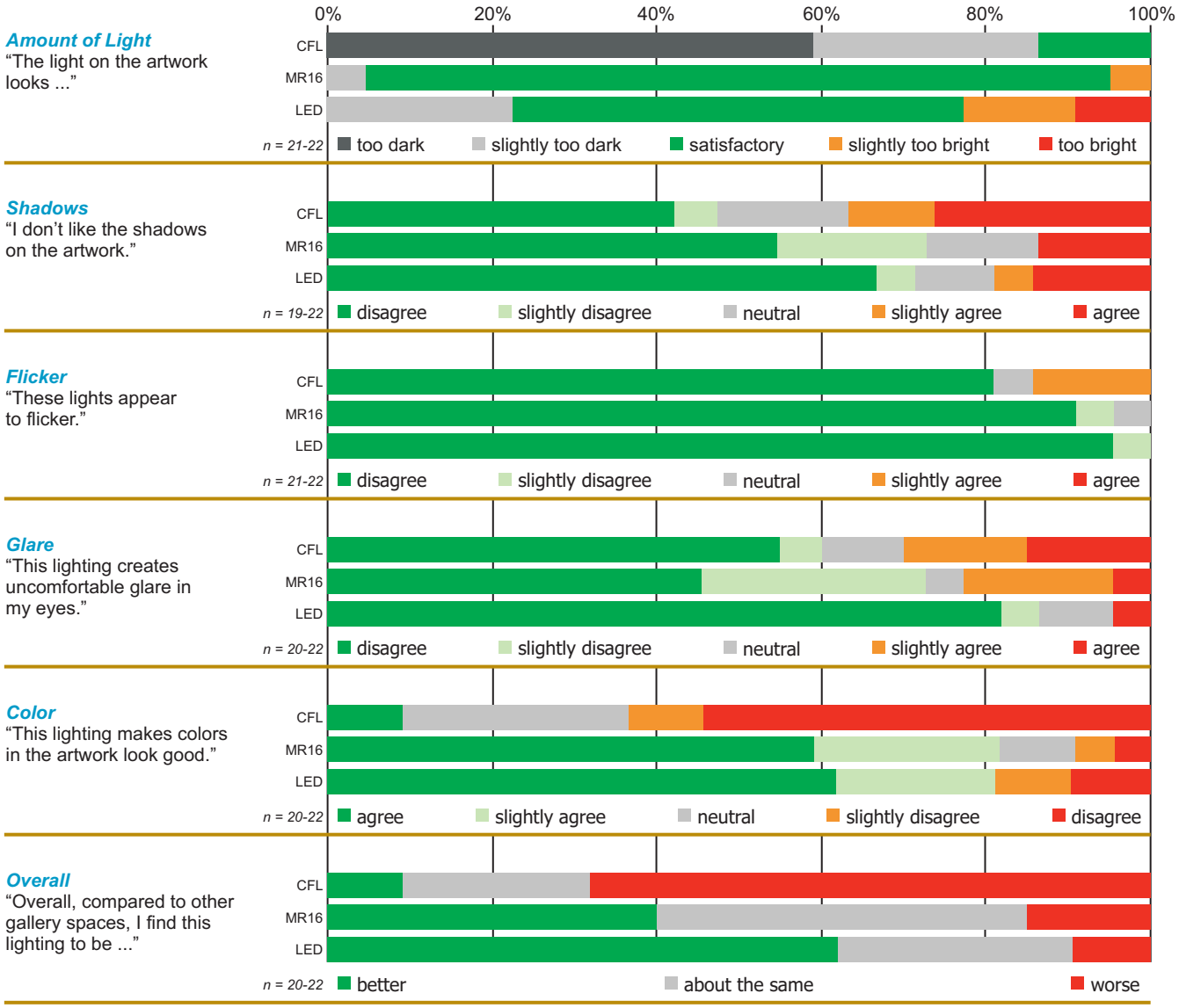
[5] If used in addition to general lighting (thus not applicable at this site), accent lighting in galleries is exempt from power density limits in New York State.

Occupant Feedback

The evaluator presented twenty-two library patrons and staff with the three lighting conditions. Occupants were asked to stand 6 feet from the wall shown in the photograph on page 1, and to answer a set of questions, shown with responses below. Occupant survey ratings for the LED accent lighting system were equal to or better than those for the conventional MR16 lamps for most criteria. The existing CFL downlight system was significantly less preferred than both accent lighting systems in terms of the amount of light, color appearance, and overall appearance.

Other anecdotal comments were also positive. The site evaluator reported library staff believe that artists now want to exhibit their art in this space because they like the LED accent lighting.

Occupant survey results



Other DELTA Comments

Overall, the LED track head size is larger than the conventional MR16 track heads.

The heat generated by conventional MR16s may be an impediment to re-aiming track heads for changing gallery displays; the LED track head remains comfortable to the touch even when operating.

Other gallery sites may require other lighting features. Future development of this LED track head would benefit from not only flexible aiming of lighting, but also flexible intensities (e.g., dimming) and a broad range of beam spreads.

Lessons Learned

- In this community art gallery, occupant survey ratings for the LED accent lighting system were equal to or better than those for the conventional MR16 lamps for most criteria.
- Compared with the existing CFL downlights, both accent lighting systems were preferred for lighting of artwork.
- The LED accent lighting system saved energy compared with both CFL and MR16 lighting systems.
- In this application, the LED accent lighting system met the most recent energy code limits for lighting power density, while the CFL and MR16 systems did not meet code requirements.

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Field Test DELTA evaluates new energy-efficient lighting products to independently verify field performance claims and to suggest improvements. A primary goal of the Field Test DELTA program is to facilitate rapid market acceptance of innovative energy-efficient technologies.

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