



Issues to Consider in Helping Your Customers Make Lighting Selections

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Lighting Design Concepts

- Energy-efficient lighting design focuses on methods and materials that improve both quality and efficiency of lighting.
- Energy-efficient lighting design principles include^[1]
 - More light is not necessarily better. Human visual performance depends on light quality as well as quantity.
 - Match the amount and quality of light to the performed function.
 - Install task lights where needed and reduce ambient light elsewhere.
 - Use energy-efficient lighting components, controls, and systems.
 - Maximize the use of day lighting.

^[1] Efficient Lighting Strategies, Building Technologies Program, Office of Energy Efficiency and Renewable Energy, US Department of Energy, Technology Fact Sheet.

Lighting Equipment Selection

- Choose fixtures (luminaries) that efficiently deliver light and are well suited to the expected tasks.
- Some additional illumination on walls and ceilings may be needed to achieve adequate vertical surface brightness.
 - Especially for parabolic fixtures.
 - Wall and ceiling illumination can be provided with luminaries that deliver some of their light upward, wall-wash sconces, and day lighting.
- Select fluorescent lamps with a high color rendering index (CRI) and color temperature well suited to the space and tasks.
- Install lighting control systems that will dim or turn off lights. Provide manual dimming control, especially in small offices.

Benefits of Helping Customers Do “ Good Lighting ”

- Office worker satisfaction and productivity can be positively affected by well-designed illumination.
- Building owners and managers have the potential to add value, reduce costs and enhance performance through the application of good lighting.
 - People are attracted to well-lighted public facilities, commercial shopping districts and parks.
 - Enhances the mood and desirability of these spaces.
 - Contributes greatly to people's sense of well-being.
- Through cost-control techniques, customers can achieve improved energy efficiency and reduce lighting costs.

Issues for Your Customers to Consider

- Light quantity
- Color rendition and color temperature
- Visual comfort and spectrally enhanced lighting
- Lumen and lamp life
- Maintenance costs
- Aesthetics

Guidelines for Illumination

- Three distinct criteria for lighting:
 - government-mandated minimums,
 - recognized guides for similar areas, objects and tasks
 - utility/function
- Government regulations for lighting come from OSHA and the local and state building codes.
- National standard for lighting levels is the IESNA Table, in the IESNA Handbook. (www.IESNA.org)
- The state building codes mandate compliance with all of NFPA 70, the National Electric Code and parts of NFPA 101, the Life Safety Code.

Light Quality

- Light Output: The total amount of light emitted by a lamp is measured in lumens.
 - Lamps differ in light output.
 - Lamps differ in the rate at which light output decreases as the lamp ages, described as "lamp lumen depreciation."
- Light output rating on a lamp's package is the initial light output rating before the decrease begins.
 - Use lumens to compare the light output of lamps that have similar distributions.

Source:

<http://209.85.173.104/u/lightingresearchcenter?q=cache:KLyCMqKFfE4J:www.lrc.rpi.edu/resources/publications/lpbh/060Lamps.pdf+light+quality&hl=en&ct=clnk&cd=11&gl=us&ie=UTF-8>

Importance of Light Quality

- Too often, lighting is treated as an after thought in facility and design planning.
- Early decisions such as ceiling height, window size, and placement of offices are all critical to the effect lighting will have on a space.
- Surface finish choices also have a significant impact on lighting design.

Source:

<http://www.oneworkplace.com/pdfs/whitepapers/TheImportanceOfQualityLighting.pdf>

Color Temperature

- Defines its whiteness , its yellowness or blueness, its warmth or coolness.
- Does not define how natural or unnatural the colors of objects will appear when lighted by the source.
- Two colors of lamps can have the same Color Temperature, but render colors very differently.
- There is no "best" color lamp nor is there any formal definition of "true" color.

Color Rendering Index

- Warm
(2000-3000K)



- Mid-range
(3000-4000K)

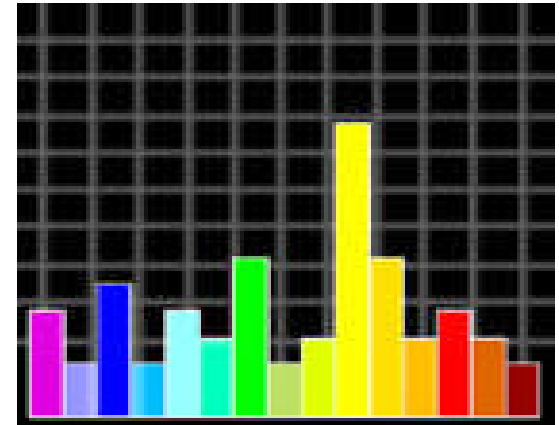


- Cool
(4000K +)



Spectral Distribution

- Each spectral distribution "distorts" object colors compared to whether the light comes from a natural source such as sunshine, north skylight, sunset, or electric sources such as incandescent, fluorescent and HID.
- The "right" color source for a given application depends on personal preferences, custom and, to a very large extent, an evaluation of the tradeoffs in efficiency, cost, and color rendition



Types of Lamps on the Spectral Distribution

- Incandescent Lamps and Natural Daylight produce smooth, continuous spectra.
- High Intensity Discharge Lamps (HID) produce light in discrete lines or bands (used in spectral analysis to identify or fingerprint the material producing the light).
- Fluorescent Lamps produce a combined spectrum -- a continuous or broad spectra from their phosphor, plus the line spectra of the mercury discharge.
- In general, continuous spectra or very full-line spectra produce less distortion of object colors than a few discrete lines.

Source:

http://www.gelighting.com/na/business_lighting/education_resources/learn_about_light/distribution_curves.htm

Visual Comfort

- Important to match light levels with appropriate visual needs.
- Guidelines include:
 - 30-fc (foot candles) is good workplace lighting
 - 5-fc is adequate general lighting for clear walkways
 - 1-fc is the minimum for paths of egress,
 - Precision tasks require 100-150-fc.

Source: Ohio School Design Manual 11-1-97, Ohio School Facilities Commission,
http://www.pdhcenter.com/courses/e114/Commercial_Interior_Lighting_Design.pdf

Lamp/Lumen Life

- Defined as: Rated lamp life is the length of time of a statistically large sample between first use and the point when 50% of the lamps have died.
- “Useful life” of a lamp based on practical considerations involving lumen depreciation and color shift.
- All types of electric light sources experience lumen depreciation.
- Causes of lumen depreciation in incandescent lamps are depletion of the filament over time and the accumulation of evaporated tungsten particles on the bulb wall.
 - Results in 10% to 15% depreciation compared to initial lumen output over the 1,000 hour life of an incandescent lamp.

Maintenance

- Proactive Maintenance for Best Results

Reactive maintenance (i.e., replacing lamps when they fail) may not effectively keep illumination at the designed levels.

- A proactive maintenance program can be important to the success of any lighting system and can include:
 - Regular cleaning of lamps and luminaires
 - Scheduled group relamping of luminaires
 - Regular inspection/repair of lighting equipment
 - Inspection and re-calibration of lighting controls
 - Re-evaluation of lighting system for upgrades
- Fact Sheet from FEMP, DOE

Maintenance Considerations ^[1]

- Turn off lights by 11:00 p.m. unless they are needed for security or safety. In little-used parking areas, illumination may not be needed that late. Consider motion sensors when only brief periods of illumination are needed.
- Design systems to provide for cost-effective maintenance. To reduce maintenance costs, provide long ballast and lamp lives, and provide equipment that is resistant to dirt, animal droppings, birds' nests, vandalism, and water damage.
- Relamp groups of fixtures at the same time to reduce maintenance costs, lamp stocking, and light depreciation toward the end of lamp life.

^[1] GREENING FEDERAL FACILITIES, An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers SECOND EDITION

Aesthetics

- Reinforce an organization's image and culture.
 - Light forms the perception of space and gives visual clues as to what happens there.
- Aesthetic lighting is purely decorative, such as a neon sculpture or a spotlight illuminating a statue or painting.
- This type of lighting must not be used alone, but accompanied by other lighting strategies in your interior design.

Sources:

<http://www.isnare.com/?aid=140083&ca=Home+Management>

<http://www.oneworkplace.com/pdfs/whitepapers/TheImportanceOfQualityLighting.pdf>

Panel Discussion

Tools to Assist in Lighting Design and Product Selection

- Commercially available software tools, including Lumen-Pro, Radiance, and LightScape, are a tremendous help in lighting design.
- Lighting Technology Screening Matrix (LTSM) software evaluates different lighting technologies on a per-fixture basis. The algorithms are based on lumen equivalents, but the user can adjust for areas that are over lit or under lit. The LTSM program is primarily a financial tool that generates a list of potentially cost-effective lighting retrofits.
- Lighting Systems Screening Tool (LSST) software allows managers to evaluate system retrofits on a facility-wide basis. It can either make assumptions about existing lighting for a first cut or allow more precise evaluation using actual data entered for the facility.

Lighting Sources/Resources

- DOE's Building Energy Tools Directory offers information on over 200 software tools covering lighting and other topics. Many of these tools are free or accessible online; www.eren.doe.gov/buildings/tools_directory.
- The National Lighting Product Information Program (NLPIP) of the Lighting Research Center at Rensselaer Polytechnic Institute offers independently evaluated product information, including manufacturer-specific test results on thousands of lamps, fixtures, ballasts, and controls; www.lrc.rpi.edu.
- IESNA Lighting Handbook – 9th Edition, Illuminating Engineering Society of North America, New York, NY, 2000; (212) 248-5000; www.iesna.org.
- Electric Utility Guide to Marketing Efficient Lighting, Western Area Power Administration.
- The Outdoor Lighting Pattern Book, McGraw-Hill, New York, NY, 1996.
- Lighting for Exterior Environments (RP-33-99), Recommended Practice Series, Illuminating Engineering Society of North America, New York, NY, 1999.



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