Task Lighting Solutions: Their Economic and Ergonomic Benefits

Supported by human factors research and driven by demand for energy savings, task lighting is a critical component of efficient and effective workplace lighting solutions.

Provided by Humanscale
By Karin Tetlow

It was not so many years ago, when employees worked mostly with paper documents, that lighting, like other building systems, was designed around the belief that more is better. Workspaces of the 1960s and 1970s provided more light than the job required with little or no flexibility for the user. The result was wasted energy and a variety of human factors issues, such as eyestrain and headaches. Since then, new human factors research and enhanced technologies have provided designers with smarter solutions. Yet, many offices continue to use dated technology to illuminate workspaces. Moreover, lighting experts report, many designers and consultants pay more attention to the aesthetics of lighting than how it functions for employees.

But as more owners demand energy efficiency or US Green Building Council (USGBC) LEED® certification for their buildings, and a growing number of employers seek productivity measures, the need for functional and efficient office lighting is becoming increasingly critical—as is familiarity with lighting specifications and LEED requirements.

Today’s workplace calls for flexible lighting systems that support the tools of the modern office, such as monitors and notebook computers. This suggests the integration of more appropriate lighting solutions into existing lighting plans, and the selection of the most advanced products for new office construction.

Office lighting design continues to move toward greater energy efficiency, while providing improvements for worker comfort and safety. This move toward environmentally responsible design can be further developed with the incorporation of task lighting into workplace lighting schemes that would typically use just ambient or overhead light sources.

One recent example is the USGBC’s new headquarters in Washington, DC, which achieved a LEED-Commercial Interiors (CI) Platinum certification. One benefit that accrued outside the recently renovated space, which included individual task lights, was a dramatic reduction in watts-per-square foot. Designers accomplished this by removing excess lighting fixtures, which resulted in energy savings for the building owner.

Recent research into the use of task lighting has provided evidence that incorporating positionable light sources into individual workspaces provides many benefits with regard to energy consumption. Additionally, it provides individual workers the freedom to position their light sources most comfortably. Moreover, reports Kate Charles, Ph.D. and Jennifer Veach, Ph.D. in a presentation at Science Insight 2004, sponsored by the Canadian NRC Institute for Research in Construction, control over physical working conditions contributes to reducing effects of job-related stressors.

CONTINUING EDUCATION

Use the learning objectives below to focus your study as you read Task Lighting Solutions: Their Economic and Ergonomic Benefits. To earn one AIA/CES Learning Unit, including one hour of health safety welfare credit, answer the questions on page XXX, then follow the reporting instructions or go to construction.com/CE/ and follow the reporting instructions.

Learning Objectives
After reading this article, you should be able to:

• Evaluate office lighting design for effective work environments.
• Recognize the importance of incorporating task lighting into an overall lighting plan.
• Identify the environmental, economic and human factor benefits of task lighting.

EARN ONE AIA/CES HSW LEARNING UNIT
In contrast to the assumption that more lighting was better, recent research has shown us that more is not better, and in fact, is not desired by most workers. Providing too much light can lead to the following:

- Energy waste
- Emotional and physical discomfort for the office worker due to improper illumination of the work surface and glare on reflective surfaces (such as the computer monitor)

Using positionable task lighting in addition to low ambient light can lead to the following:

- Improved lighting quality, comfort and control for workers
- Increased energy efficiency

Task lighting can provide illumination where it is most needed—on paper-based documents—more economically than the most energy-efficient ceiling ambient light because task lighting is located closer to what is being lit. In addition, individual workers can gain control over their lighting as appropriate for the task being completed.

**Flux, Illuminance and Luminance**

Total flux, in lumens, is the parameter that bulb manufacturers use when describing the total amount of light given off by a bulb in all directions. Lumens do not, however, tell us how much light will be received where it is needed. Illuminance, on the other hand, tells us how much light will reach a given surface. Illuminance is generally measured in lux, which is a short form for lumens per square meter of surface area, the metric equivalent of footcandles (which represent lumens per square foot). There are 10.76 lux in one footcandle, but the lighting industry typically rounds this factor to 10.0 for the sake of simplicity.

If we compare a lighting fixture to a shower head, then the lumen output, or total flux, is the rate of flow of water and illuminance is the amount of water collected in a bucket at a given time. The key point is that the same total flux can give different amounts of water in the bucket, simply by moving the bucket, or by changing the spray pattern or by changing any physical obstructions between the source and the bucket. Total flux doesn’t specify how much illuminance will be provided where it’s needed. This is true, in part, because the luminaire, reflectors, lenses and other optical media can greatly affect the flow of light from the source to the work surface. Failure to remember this is a frequent cause of poor lighting design, especially in retrofit applications.

**IES Illuminance Categories & Values**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LUX</th>
<th>Footcandles</th>
</tr>
</thead>
<tbody>
<tr>
<td>View CRT screen</td>
<td>50 - 100</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Read standard document, photocopy or newspaper</td>
<td>200 - 500</td>
<td>20 - 50</td>
</tr>
<tr>
<td>View photo in moderate detail; reference phone book</td>
<td>500 - 1000</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Perform visual task of low contrast or small size over prolonged periods of time</td>
<td>2000 - 5000</td>
<td>200 - 500</td>
</tr>
</tbody>
</table>

(Illuminating Engineers Society recommended lighting levels for common office tasks.)

The primary reason why Cook + Fox Architects LLP decided to move its office into a former 1902 Beaux-Arts luxury department store on 6th Avenue in New York City, was the extraordinary daylight coming through three walls of 9-ft high windows. The 12,121 sq ft space with its 14-ft high ceiling also helped serve the intention of the firm to feel like an open studio, visible for all walking into the space. To meet another goal of equality, where there are no ‘bad’ workstations, low-partition walls were chosen to let daylight into every workspace. Completed in July 2006, the office is the first LEED® project to receive Platinum certification in New York State.

Included in the many features that earned LEED points—among them: a green roof, zone controls added to HVAC, sustainable materials, low-VOC paint, water-saving toilets—was the controllability and energy efficiency of the lighting.

Supplemental ambient light was provided by uplighting from efficient dimmable metal halide lamps mounted on the building’s columns and connected to daylight sensors. Energy efficient compact fluorescent task lamps were placed on every workstation. “The need for individually controllable task lights was critical,” explains project designer Natalia Martinez, LEED®-AP, “because lighting is dependent on the person’s needs and what he or she is working on.”

Since the workstations are only 48-in high, the task lamps had to meet the technical requirements of durability and of not being seen above the partitions. The selected product has only one hinged arm (the other hinge is at the light source) which, when angled, is not visible.

Lighting consultants Cline Bettridge Bernstein Lighting Design, Inc., created a 3-D computer model of the space to calculate lighting wattage used, color temperature and determine such questions as what color to paint the ceiling.

Visitors are welcome to take a tour of the space and learn about how the lighting strategies helped achieve energy efficiencies.
For lighting designs, we should not assume that two lamps with the same lumen rating will each give the same amount of light where needed.

Thirty years ago, standards of the Illuminating Engineers Society of North America (IESNA) called for general office lighting in the range of 100–150 footcandles (1,000–1,500 lux). Huge, increasingly cubiced floorplates, often without any natural, outside illumination, were lighted, for the most part, by banks of 4-ft, ceiling-mounted fluorescent troffers (recessed fluorescent fixtures) that, in too many cases, resembled stadium floodlights in their intensity.

By 2002, nearly all office tasks were being performed on desktop computers and average ambient light levels in the American workplace declined to one-third of 1970s levels. Today, ambient office lighting is likely to be in the range of 25–45 footcandles (250–450 lux), which is still far more light than is necessary for getting around the office or viewing a computer screen. According to IES, computers are best viewed in an environment where the ambient lighting is 5–10 footcandles (50–100 lux), whereas most reading of documents requires 20–50 footcandles (200–500 lux).

The Monitor—Document Conflict
“The demands of differing tasks within the workplace create an obvious conflict in lighting requirements,” says researcher Alan Hedge, PhD, CPE, Director of the Human Factors and Ergonomics Laboratory at the Cornell University Department of Design and Environmental Analysis. The majority of work that most office workers perform today is a combination of viewing a monitor and reading documents or other printed material. Yet these two tasks require significantly different levels of light because monitors are a source of light whereas paper reflects light. In fact, reading documents requires four to five times the amount of light needed for viewing a monitor.

If the ambient lighting level is set at the appropriate level for reading printed documents (20–50 footcandles), the lighting intensity will be much too high for proper monitor viewing (5–10 footcandles required). This leads to glare on the surface of the monitor, substantial energy waste and a variety of worker productivity issues. However, if the ambient lighting level is brought down to a point which is appropriate for monitor viewing and movement throughout the workspace, then there won’t be nearly enough light to read documents and other paper-based reading material.

The only solution to this conflict is to lower the overall ambient lighting levels and provide individuals with positionable task lights to properly illuminate the reading material on the desktop. In this way, both the monitor and documents can be lit to appropriate levels for the tasks being performed.

SmithGroup: Task Lighting Essentials

For Detroit-based SmithGroup, Inc., an A/E firm with its own in-house lighting design group, according to James Luckey, AIA, Senior Design Architect, a main goal with creating a nine-building campus in Van Buren Township, Michigan, for auto parts supplier, Visteon Corporation, was to attain “the absolute minimization” of energy costs. The first consideration was natural light. To allow as much light as possible into interiors, Luckey designed all of the 100,000- to 150,000-sq-ft buildings to be “…extremely narrow, 64 feet in width. We wanted this project to conform to the European standard, in which workers are never more than 10 meters from a window,” he said.

Exposures are large: sills of 15-ft-wide windows are only 2 feet off floors; headers are 10 feet above floor height; ceilings at 1-ft 6-in. We like, whenever possible, to push ceiling height,” says Luckey.

Ambient lighting, via indirect pendants (95 percent upward, 5 percent downward), centered in 20-ft ceiling bays, 30 inches beneath ceilings, is at 25 to 30 footcandles and blends perfectly with the distribution of natural light. The uniformly illuminated ceiling plane increases the sense of openness and maximizes the impact of the high ceilings.

For “sparkle,” SmithGroup used café and track lights. Each 50-sq-ft workstation has one adjustable compact fluorescent task light and one furniture-mounted fluorescent light capable of providing 50 footcandles where it is needed.

“The use of task lighting allows higher intensities only where that level of light is needed, while also providing the benefit of personalized control,” says Luckey. “In a computer environment, the goal is to minimize glare. This project,” he says, “is in keeping with what we try to do with every project. If ceilings are shallower, we have no choice but to put lights in the ceiling plane, but we prefer not to.”

At Visteon’s new corporate campus, which opened in January 2006, workers have personal control over lighting within individual workstations; individual controls allow them to control floor-distributed heating and cooling as well.

“Overall, lighting consumption,” Luckey says, “is one watt per sq ft; lighting and miscellaneous power consumption, 2.25 watts per sq ft—the figure excludes air-handling.

Perhaps more importantly,” Luckey says, “ASHRAE 90.1 sets a standard of 94,842 BTUs (British thermal units) per square foot per year. Visteon Village consumes about 59,000 BTUs per square foot per year—a 37 percent energy reduction from the code allowance. That number includes under-floor heating and cooling consumption.”
Lighting Needs Change As We Age

Equally significant to the fact that different tasks require different amounts of lighting is that actual lighting needs vary among individuals. The older we get, the more light we need to see. Research indicates that the visual performance of those in their 20s is about eight times better than those in their 60s, almost four times better than those in their 50s. In fact, persons in their 60s require 250 percent more contrast than persons in their 20s.

The increased need for light is due to a number of physiological changes in our visual system, which occur as we age. The term presbyopia means “old eye” and is a vision condition involving the loss of the eye’s ability to focus on close objects. An additional symptom is the declining ability of the eye to receive light. Symptoms are usually noticeable by age 45 and continue to develop until the process stabilizes some 10–20 years later.

Eyestrain and accompanying headaches, which can result from working under inadequate illumination, are aggravated by aging. Eye fatigue may result in blurry vision and dim lighting aggravates the problem. Task lighting allows us to achieve the correct levels of illumination, regardless of the task or vision requirements, by changing the distance between the light source and the lit object—closer for more light, further away for less. It also allows us to correctly position the angle of light to eliminate glare and veiling reflections.

Bulb Options and Energy Efficiency

Today’s task lights utilize one of four types of lighting source: incandescent, halogen, compact fluorescent or light-emitting diode (LED or solid-state lighting), which works by running electricity through a chemical chip, causing the chip to glow. Compact fluorescents burn cooler and have proven to be more energy efficient than any other available task light source. A regular incandescent or halogen bulb works by heating a metal wire to a temperature at which it glows. This requires high temperatures, relatively large amounts of energy and creates a hot bulb surface. In fact, halogen bulbs can reach temperatures of 1800 degrees F and have, therefore, been banned from many university dormitories because of their risk as a fire hazard.

A compact fluorescent bulb is a low-pressure mercury, electric-discharge lamp in which phosphor coating transforms ultraviolet energy, created by electric discharge, into visible light. The fluorescent bulb remains much cooler and uses less energy than the other two, while providing the same amount of light.

The first practical electric lamp, developed by Thomas Edison in 1879, converted less than one percent of electricity into light. Today’s household incandescent bulbs convert 6–7 percent of their electrical input into light. The rest is wasted as heat. Classic 4-ft fluorescent systems convert approximately 19% of their energy into light.

Today’s compact fluorescent lamps, five inches in length, or less, can be 50 times more efficient than Edison’s original lamp and far more efficient than an incandescent light source capable of the same light output. For example, a 13-watt compact fluorescent task light will produce the same light output as a 60-watt incandescent light, burn cooler and consume only one-quarter of the electricity.

LED Lighting

The next generation light source to make headlines is solid-state LED lighting. Around since the 1960s, it has only relatively recently been marketed for commercial interiors because of its apparent energy efficiency and other features. Approximately one-quarter-inch in diameter, each diode uses about one-tenth of a watt to operate and can be assembled together to deliver higher intensity light. LED fixtures require a plug-in transformer or a driver—typically built-in—which is comparable to the ballast in fluorescent fixtures. The plug-in transformer used for portable fixtures, enables the lamp to use 120 volt AC.

LED lights are more rugged and damage-resistant than compact fluorescents and incandescent bulbs. They do not flicker, are low maintenance, are dimmable and, what makes them especially attractive to those seeking LEED certification, have the potential of low energy consumption. Since they operate at 3,300 to 5,000 Kelvin (sunlight at
sunrise is 1800K, overcast sky is 6500K) they have a “cool” color that ranges from blue to daylight fluorescent.

Many designers are now specifying LED lighting believing that it is the most energy efficient lighting solution available. Unfortunately, there is much misunderstanding surrounding this new technology. While there are considerable potential advantages to solid-state lighting, the technology is not sufficiently advanced to make it an energy efficient choice at present.

The major cause of misunderstanding results from there being no standard testing criteria. In their product literature, manufacturers use different evaluation criteria to compare their LED products with traditional fluorescent or incandescent lighting. Another difficulty in testing existing LED luminaires is their susceptibility to color shift and inadequate performance when subject to high heat (some manufacturers have added fans and diffusers to disperse heat.)

After a pilot round of testing several LED products, the U.S. Department of Energy released its conclusions in December 2006. It found that products fell short of manufacturers claims and implied that claims are based on how much light is produced rather than how much light an LED fixture actually delivers. The study concluded that “solid-state based luminaires (lighting lamps or fixtures) have the potential to provide high-quality light which consumes far less energy than more traditional lighting technologies, but recent testing of commercially available products show that some being sold today actually provide less light output than traditional light sources and are less efficacious than products using fluorescent light sources.”

U.S. Department of Energy testing found that LED bulbs with a temperature of 3300K are about half as energy efficient as standard compact fluorescents (17-34 lumens/watt versus 35-60 lumens/watt for compact fluorescents). Higher temperature LED bulbs (5000K) were somewhat more efficient, but still well below the efficiency of CFLs. Moreover, LED bulbs are not ideal for task lighting because the color is too cool (blue) for most users. In other words, LED products now on the market use more energy and provide less light than their compact fluorescent counterparts.

Meanwhile, researchers are addressing the issue of testing criteria and comparison methods. “We have developed technology-neutral, fixture-based testing methods that allow fixtures of the same type but with different light sources to be compared appropriately,” says N. Narendran, Ph.D. of the Lighting Research Center at Rensselaer Polytechnic Institute and director of research and organizer of the Alliance for Solid-State Illumination Systems and Technologies (ASSIST).

At some point, perhaps in another two to three years, LEDs will overtake CFLs in efficiency because LED technology is improving. But for now, CFLs are clearly the best solution in terms of energy efficiency.

### Task Lighting Saves Eyes

Because they are closer to the work surface, positionable task lights are a considerably more effective means of lighting a desktop than are overhead fixtures, which are costly and inefficient. They can be directed to light documents or moved to avoid screen glare.

“The most common design error, clearly, is the mismatch between where light is being delivered and where people are utilizing that light,” says Alan Hedge. “All too often we put light into a building without knowing the ultimate layout. Even if the layout is known, things can happen that are not foreseen. Offices may be partitioned differently by new tenants, for instance, and the new layout can result in a feast or famine situation, so far as light is concerned. Some workers may complain of glare and headaches; some may be in the dark.”

In a study conducted in 1990, Cornell researchers drew on an American Society of Interior Designers survey in which 68 percent of employees complained about the light in their offices and 79 percent of VDT users wanted better lighting. The Cornell study came to the conclusion that eyestrain was the number one health hazard in the workplace—ahead of radiation, asbestos, or exposure to AIDS.

Hedge says eyestrain remains the number one complaint in the office environment, and the degree of dissatisfaction is difficult to ignore. It confirms the need to identify the best available methods of lighting. “Combined ambient-task lighting is likely to be the most effective solution in any environment in which workers are doing both paperwork and computer work,” says Hedge.

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**Light Source** | **Efficacy Range in lm/W**
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| Incandescent | 10-18 |
| Halogen incandescent | 15-20 |
| White LED 3300K | 17-34 |
| White LED 5000K | 25-43 |
| Compact fluorescent (CFL) | 35-60 |

*Source: U.S. Department of Energy 2006*

Recent U.S. Department of Energy research found compact fluorescent bulbs 50% to 100% more energy-efficient than LED bulbs.

Under-bin lights are not a suitable alternative to task lighting. Depending on workstation layout, they may put more light on the monitor than on documents and typically don’t put light where paper-based work is being performed. They can also be a major source of glare.
Program title: “Task Lighting Solutions: Their Economic and Ergonomic Benefits” (11/07, page XXX). AIA/CES Credit: This article will earn you one AIA/CES LU hour of health, safety, and welfare credit. (Valid for credit through November 2009). Directions: Refer to the Learning Objectives for this program. Select one answer for each question in the exam and fill in the box by the appropriate letter. A minimum score of 80% is required to earn credit. To take this test online, go to construction.com/CE/

Learning Objectives

After reading this article, you should be able to:
• Evaluate office lighting design for effective work environments.
• Recognize the importance of incorporating task lighting into an overall lighting plan.
• Identify the environmental, economic and human factor benefits of task lighting.

Questions

1. Using positionable task lighting in addition to low ambient light can lead to:
   - a. improved comfort and control for workers.
   - b. energy waste.
   - c. emotional and physical discomfort for office workers.
   - d. increased glare on computer screens.

2. Illuminance:
   - a. tells us how much light will reach a given surface.
   - b. describes the total amount of light given off by a bulb.
   - c. is measured in lumens.
   - d. is a representation of the amount of light seen by the eye.

3. Optimal illuminance for computer use is:
   - a. 25 to 45 footcandles
   - b. 5 to 10 footcandles
   - c. 20 to 50 footcandles.
   - d. 10 to 20 footcandles.

4. Visual performance of persons in their 20s is how many times better than those in their 50s?
   - a. Eight
   - b. Four
   - c. Three
   - d. Six

5. Today’s household incandescent bulbs convert what percentage of their electrical input into light?
   - a. 6 to 7 percent
   - b. 3 percent
   - c. 19 percent
   - d. 28 percent

6. A 13-watt compact fluorescent task light will produce the same light output as a:
   - a. 100-watt incandescent bulb.
   - b. single solid-state LED light.
   - c. 60-watt incandescent light.
   - d. 150-watt halogen bulb.

7. Which task lighting bulbs on the market are the most energy efficient?
   - a. Incandescent
   - b. Solid-state LED
   - c. Compact fluorescent bulbs
   - d. Halogen

8. Solid-state LED products:
   - a. have undergone a standard means of performance testing.
   - b. are not subject to change under high heat.
   - c. tested by the U. S. Department of Energy used far less energy and provided more light than traditional light sources.
   - d. tested by the U.S. Department of Energy used far more energy and provided less light than traditional light sources.

9. Lighting may contribute to LEED® points by:
   - a. meeting energy use requirements for varying percentages below ASHRAE 90.1–2004 standards.
   - b. specification of recyclable products.
   - c. providing task lighting to 90 percent of employees.
   - d. All of the above

10. Color Rendering Index (CRI) of a bulb:
   - a. should always be 100.
   - b. refers to its cool or warm appearance.
   - c. refers to how colored objects appear.
   - d. is the first consideration before selecting a bulb.

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Material resources used: Article: This article addresses issues concerning health and safety.

I hereby certify that the above information is true and accurate to the best of my knowledge and that I have complied with the AIA Continuing Education Guidelines for the reported period.

Signature Date

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**Task Lighting Saves Energy**

A task light using a 26-watt compact fluorescent lamp will consume far less energy to illuminate a work area than will a typical overhead lighting fixture. A work environment can maintain lower levels of overhead lighting by illuminating desktops with energy-efficient task lights. In addition, maintenance and bulb replacement costs are less with task lighting. An Ernest Orlando Lawrence Berkeley National Laboratory 2003 study for the U.S. Department of Energy on Task Ambient Office Lighting concluded that “comparative analyses indicate significant energy and cost savings through separation of ambient and task lighting systems, as high as 60 percent for energy and almost 50 percent for life cycle cost.”

According to the California Energy Commission, lighting accounts for 23 percent of the electricity used in the state. The actual figure may be considerably higher, say other sources. Five percent of electricity used for air conditioning, for example, goes to eliminate heat generated by lighting. In general, however, the EPA estimates that lighting accounts for 20–25 percent of the electricity used annually in the United States. This suggests that overall energy use can be reduced by more than 10 percent with the introduction of an energy-efficient task-ambient lighting scheme featuring fluorescent technology. One encouraging sign is a recently introduced U.S. Senate bill that proposes a phase-out of incandescent lamps by 2012.

**Task Lighting and LEED®**

With clients’ growing requirements for energy efficiency and the 2,000 percent explosion in USGBC membership, expertise in lighting systems and how they can impact LEED®-CI certification has become a competitive edge.

There are several categories where task lighting can help achieve points. They include:

**Indoor Environmental Quality.** Providing task lighting for 90 percent of employees may earn a point for controllability of systems.

**Materials and Resources.** Recycled content of lights and fixtures can contribute significantly to one or two points in the category.

**Energy and Atmosphere.** Energy use of both ambient and task lighting must be calculated to meet LEED requirements for varying percentages below ASHRAE 90.1–2004 standards (under California’s Title 24 Energy Efficiency Standards, the most rigorous in the country, the maximum is one watt per square foot). One challenge in this category is achieving points for a retrofit of an existing building with a traditional overhead fluorescent layout using 1.4 watts per sq ft. Designers have solved the problem by removing overhead fixtures and adding low energy task lights, which will ultimately provide a better lighting solution for the occupants. Francis Rubinstein, Staff Scientist, Lighting Research Group, Lawrence Berkeley National Laboratory, suggests a different approach: Install overhead lighting that uses one watt per sq ft, but build in controls and occupant sensors that turn off lights when not in use (a possible gain of one point in the Energy & Atmosphere category). This will reduce energy use to 0.6 or 0.7 watts per sq ft, thereby leaving an energy allowance for task lights.

**Innovation and Design Process.** This is one LEED category often neglected by designers, who are concentrating on reducing energy and water usage. Task lighting, as part of a comprehensive ergonomics

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**Energy Comparison Chart**

<table>
<thead>
<tr>
<th></th>
<th>Regular Bulb (100 W)</th>
<th>Halogen Bulb 100 W</th>
<th>LED 60 W</th>
<th>Compact Fluorescent 26 W</th>
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</thead>
<tbody>
<tr>
<td>Cost of Bulb</td>
<td>$0.50</td>
<td>$4.00</td>
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<tr>
<td>Bulb Life (on average)</td>
<td>167 Days</td>
<td>416 Days</td>
<td>5000 Days</td>
<td>1500 Days</td>
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<tr>
<td>Bulbs Necessary over 5,000 days</td>
<td>30</td>
<td>12</td>
<td>1</td>
<td>3.3</td>
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<tr>
<td>Annual Energy Cost*</td>
<td>$21.90</td>
<td>$21.90</td>
<td>$13.14</td>
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<tr>
<td>TOTAL COST* for 5,000 days (13.7 years)</td>
<td>$315.50</td>
<td>$348.00</td>
<td>$255.00</td>
<td>$86.30</td>
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</tbody>
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**Possible LEED® Points for Task-Ambient Lighting**

<table>
<thead>
<tr>
<th>LEED for Commercial Interiors v2.0</th>
<th>Points *</th>
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<tbody>
<tr>
<td><strong>ENERGY &amp; ATMOSPHERE</strong></td>
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<tr>
<td>• Reduce lighting power density to 15%, 25% or 35% below standard</td>
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</tr>
<tr>
<td>• Optimize Energy Performance – Lighting Controls</td>
<td>1</td>
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<tr>
<td><strong>MATERIALS &amp; RESOURCES</strong></td>
<td></td>
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<tr>
<td>• Recycled content 10% or 20% (post consumer + ½ pre-consumer)</td>
<td>1-2</td>
</tr>
<tr>
<td>• Regional Materials, 20% Manufactured Regionally</td>
<td>1</td>
</tr>
<tr>
<td>• Regional Materials, 10% Extracted and Manufactured Regionally</td>
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<tr>
<td><strong>INDOOR ENVIRONMENTAL QUALITY</strong></td>
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<tr>
<td>• Controllability of Systems – Lighting</td>
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</tr>
<tr>
<td><strong>INNOVATION &amp; DESIGN PROCESS</strong></td>
<td></td>
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<tr>
<td>• Innovation in Design: Provide Specific Title</td>
<td>1-4</td>
</tr>
<tr>
<td>• LEED Accredited Professional</td>
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</tbody>
</table>

*21 Points LEED  
27 Points LEED Silver  
32 Points LEED Gold  
42 Points LEED Platinum
program, which includes appropriate training for employees, can help a project earn an additional point.

**The Color of Light**

One aspect of lighting that often gets overlooked is bulb color temperature, which describes the color appearance of the bulb, not the object being viewed. Color temperature ranges from 2600 Kelvin for “warm” sources like incandescent lamps, to approximately 6500 Kelvin for “cool” sources like daylight fluorescent. Color temperature data is readily available from lamp manufacturers. The selection of color temperature should be considered relative to the application.

Lamps that are high to very high in color temperature (5000K and above) provide improved visual acuity compared to lower-color temperature lamps (typically 2700K) at the same light level. Visual acuity is generally defined as sharpness of vision, with normal visual acuity rated at 20/20. High color temperature lamps are rich in the blue portion of the color spectrum and have a noticeably “cool” appearance.

The Color Rendering Index (CRI) of a bulb specifies on a scale of 1 to 100 how colored objects appear under that bulb’s light compared to their appearance in daylight. A CRI of 100 means no difference, while a low CRI could mean a big difference. Incandescent lamps typically have CRIs above 90, but that doesn’t mean that they always give suitable results. Suppose, for example, we wish to illuminate white cabinets in a kitchen or a hospital examination room. A design objective might be to enhance the impression of whiteness, cleanliness and sterility. In this case, the color temperature of incandescents would be too low to achieve the desired effect. As a general rule, one should, therefore, select color temperature first, then select the lamp giving the optimum CRI for the application.

**Glossary**

**Color Rendering Index (CRI):** method for describing the effect of a light source on the color appearance of objects being illuminated. A CRI of 100 represents the reference condition of daylight (and thus the maximum CRI possible). In general, low CRI illumination may render some colors unnatural.

**Footcandle:** unit of measurement indicating how much illumination reaches a surface, equal to one lumen striking an area of one square foot.

**Ballast:** a device used with a fluorescent bulb to obtain the necessary circuit conditions (voltage, current and wave form) for starting and operating.

**LED Lighting:** solid-state light-emitting diode.

**Lumen:** the unit of measurement used to describe the output from a light.

**Lux:** unit of illumination closely equivalent to 1/10 of one footcandle.

**Two-Component Lighting:** combination of indirect general (ambient) light and task lighting.

Most fluorescent lamps operate at 3000K to 4100K, with a CRI from the low 50s to 86, but recent technology gains now give us fluorescents with CRIs above 90.

**Ballast Technology**

All fluorescent lamps require ballasts, which stabilize and control the electrical current that gets sent to the lamp. These ballasts are available in two primary types: magnetic and electronic. While magnetic ballasts use long-standing technology and last for 20 years or more, electronic ballasts have the edge in performance and, because they reduce perceptible flicker, health considerations. Virtually all compact fluorescent lamps specified today use electronic ballasts.

**Frequently Asked Questions**

**What is task lighting and why should we use it?**

Task lighting provides workers with total control over where and how much light they need for other tasks, such as reading a document. When utilizing task lighting, energy can be saved by lowering ambient lighting to a level appropriate for monitor viewing.

**Why choose a compact fluorescent (CFL) task light?**

CFL bulbs use less energy than incandescents (about one fourth), output more light and last up to 10 times longer. Compact fluorescent bulbs are also much cooler in operation than regular incandescent bulbs or halogen bulbs and are, thereby, safer and more comfortable to work near. Tests show they are also more energy efficient than LED lighting.

**What Color Rendering Index (CRI) should task light bulbs have?**

CRI describes the effect of a light source on the color appearance of objects. A CRI of 100 represents the reference condition of daylight. In general, low CRI illumination may render some colors unnatural and lamps with a CRI under 60 should not be used. At a certain point, the higher the CRI, the lower the illuminance. A CRI in the 80s is good for all general tasks.

**I don’t like the light given off by fluorescent bulbs. Can they be made to give off a warmer light like incandescents?**

Yes, compact fluorescent bulbs are available in color temperatures ranging from 2700K for warmer light to approximately 4100K for cooler sources like daylight fluorescent.

**Should I specify LED task lighting?**

At present, LED technology is about half as energy efficient as compact fluorescent lights and lacks brightness. But the technology is improving and eventually will overtake that of CFLs.

**Is “full-spectrum lighting” better than regular fluorescent lighting?**

The short answer is “no.” Any bulb with a CRI of over 90 is considered a full spectrum bulb. Full-spectrum lighting is neither better nor worse than any other lamp type. Claims made for its beneficial effects go beyond what scientific literature will support.