



MISSION BLUE DESIGN

Lighting

Interior lighting from simple oil lamps consisting of a saucer filled with fat and a wick remained virtually unchanged for several millennia — from prehistoric primitive lamps about 15,000 years ago until 1783 when a hollow circular wick surrounded by a glass chimney was developed providing brighter light with less smoke. Within the next hundred years came gas and kerosene lighting followed by the electric vacuum light bulb.

Incandescent lighting works by electricity running through a thin filament which offers resistance to the electricity. The resistance turns electrical energy into a glowing heat. The heat makes the filament white hot, and the white part is light.

But the purpose of the light bulb is to light, not produce heat. The problem with incandescent light bulbs is the heating mechanism wastes a lot of electricity (about 95% is used for heat, 5% for the light), making incandescent bulbs very inefficient.

Currently, lighting accounts for 25% of all our electricity and about 45% of the energy consumption in most commercial and institutional buildings. In the U.S., our lighting bill is more than \$100 million a day — much of it wasted in heat.

Fluorescent lights are the most energy saving. A fluorescent lamp is a glass tube, filled with argon, or argon/krypton gas, and mercury. When turned on, the mercury vapors get ionized and emit ultra-violet (UV) radiation, striking the phosphor coating on the tube, causing it to glow — or fluoresce. That is the process that produces light. About 22% of the energy used by the lamp is converted to light.

As with incandescents, there are tradeoffs with fluorescents. For example, all fluorescents contain mercury and require an appropriate ballast. Additionally, it is well known in parts of the medical community that regular exposure to fluorescent lighting can cause or contribute to health problems — especially where there is more flicker and hum.

Effective lighting combines and balances natural light with artificial light. Synergized daylighting strategies have been shown to reduce energy usage.

Lighting techniques differ with age and can be optimized for older adults with aging eyesite using these easy to follow Principles of Lighting for Older Adults.

The use of natural light in buildings has been addressed by building professionals since at least the first century BC, the time when 'De Architectura' was written by the

Roman Architect, Vitruvius. In those days daylighting had to be thoughtfully considered since fire and oil lamps were the only means of artificial lighting.

We know that exposure to natural light is very important to human health. Daylighting helps us maintain our natural bio-rhythms which results in greater well-being. Too much darkness has resulted in a health disorder referred to as SAD (Seasonal Affective Disorder). Too much artificial light has other negative health implications.

The goal of daylighting is the transparency it provides to the natural rhythms of the day, connecting us to the great outdoors — to nature. When given the choice, 75% of people prefer to work in daylit areas. And, we perform better with natural lighting. Effective daylighting combines and balances natural light with artificial light. Synergized daylighting strategies have been shown to reduce energy usage approximately 50 to 80%.

Two main window types used to achieve daylighting are toplighting and sidelighting:

- Toplighting can include roof monitors, skylights and light tubes.
- Sidelighting

7'6" height window placement contributes more to perimeter illumination and views.

Clerestory

7'6" to ceiling height glazing on perimeter walls can illuminate up to 70% of a typical interior

Natural light and outdoor connection influences interior walls and finishes, occupant locations and window placement — all of which should complement one another. Energy usage can be reduced through window selection, placement and glazings, sun control devices, and lighting systems and controls.

For commercial properties, LEED™ Credits are available for Daylighting.

To be eligible for LEED EQ credit number 8, Daylight & Views, a connection to outdoor environment (1 point) and daylighting (1 point) is required. Daylighting is required in 75% of task-occupied space and views are required for 90% of regularly occupied rooms.

Flourescent Light:

Flourescent lights are the most energy saving. A flourescent lamp is a glass tube, filled with argon, or argon/krypton gas, and mercury. When turned on, the mercury vapors get ionized and emit ultra-violet (UV) radiation, striking the phosphor coating on the tube, causing it to glow — or flouresce. That is the process that produces light. About 22% of the energy used by the lamp is converted to light.

Look for the ENERGY STAR label on your CFLs and click to find how to dispose of them when they're finally spent.

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Compact Fluorescent Lights (CFLs) are miniature versions of full-sized fluorescents. Those qualified under the Energy Star program are 3-4 times more energy efficient than standard incandescent bulbs and last up to 10 times longer. Tradeoffs are present with CFLs too. They are a more diffuse light than incandescent and not appropriate for all applications. They do not produce enough light for many reflector fixtures nor for some ambient ceiling lighting applications.

All ballasts generate noise and carry sound level ratings A, B, C, or D. An “A” rated ballast typically hums softly; a “D” rated ballast typically buzzes rather loudly. Electronic ballasts produce less flicker and emit less humming noise — generally quieter than required for an “A” sound rating.

Fluorescent Mercury Vapors: When broken, fluorescent lighting can release mercury vapors into the atmosphere, affecting those nearby. Under Federal hazardous waste regulations, businesses can no longer dispose of spent fluorescent light bulbs, lamps, ballasts or other lights containing mercury as unregulated refuse. When specifying fluorescent bulbs, specify low and non-leachable mercury bulbs. When coordinating deconstruction work, reference certified mercury and ballast recyclers

Color Rendering: Fluorescent bulbs emit light in a few narrow bands of color created by the argon and mercury vapors inside, then play off a broader spectrum produced by the phosphors. This affects their color rendering. The perceived white color of a fluorescent is the result of phosphors selected to produce the illusion of white light, causing color distortion. Some claim that our vision corrects for this, and we don't notice a distortion, except in certain color-critical applications. Color rendering of newer CFLs is claimed to be equal to incandescent light bulbs, and able to produce full-spectrum lighting.

How does the human visual system change, as one grows older? What can be done to make lighting more effective for the aging eye? Here are some lighting principles that can help specifiers, builders, facility managers, and homeowners light interior spaces.

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Lighting Principles for Older Adults

As visual capabilities decrease with age, the ability to focus at different distances gets more noticeable — particularly after age 45. This is called presbyopia. As one grows older, less light reaches the back of the eyes because the pupil gets smaller and the

crystalline lens inside the eye becomes thicker, absorbing more light. A 60-year old receives about 1/3 of as much light at the retina as a 20-year old.

The Principles of Green Lighting Design:

More light on task - Older adults need at least 50% more light than younger adults on reading tasks. As much as 10 times more light will be required to see fine details (e.g., reading small points) or low-contrast objects (e.g., black thread on blue cloth). Rather than increasing overall light levels, increase light levels in areas where visual tasks are performed by placing adjustable light fixtures close to the task, or by selecting light bulbs with more lumens (look for lumen rating on the package, not wattage; be careful not to exceed the lamp fixture wattage).

Fluorescent light bulbs are usually a good option because they provide more lumens per watt than incandescent light bulbs, they last 10 times longer than common incandescent light bulbs; they are available with excellent color, plenty of light, no buzz or flicker; they are cooler to touch and, they can be dimmed.

Increase ambient light levels by keeping surface finishes light in color. Light-colored walls, floors, and ceilings will help minimize shadows and increase overall light levels in the living environment. Place light fixtures where visibility is important, such as below kitchen countertop, over kitchen sink, in the shower, closet and laundry spaces.

Less glare - Although more light on the task is required for the older eye to see, care should be taken to avoid glare. Glare is experienced when light sources or bright reflections in the field of view impair vision, or are simply uncomfortable. Hide the light source with a shade, baffles, non-shiny louvers, or a shielding board. Use frosted light bulbs where seeing the light bulb is unavoidable (e.g., fan lights) and avoid clear glass light fixtures. Minimize shiny floor finishes and polished surfaces to reduce reflection of the light bulb.

Balanced light levels - Due to optical, and perhaps neural changes to the eye, older adults cannot completely adapt to dim lighting conditions, so illuminance levels in transitional spaces, such as hallways and entrance foyers should be similar to those of the adjacent spaces. Use balanced ambient light levels in adjacent spaces. Choose multiple switches or dimmers to create intermediate light levels in transitional spaces that lead from bright, outdoor areas, to dim, indoor spaces. Transitional spaces should be dimmer at night and brighter during the day.

Color enhancement - Color discrimination is poorer for older adults because of scattered light in the eye. The aged lens also absorbs relatively more blue light, so it is particularly difficult to discriminate between, say, dark purples and maroons. Use light bulbs with high lumens and good color rendering properties. Choose light bulbs with color rendering indices (CRI) of 80 or greater.

More contrast - Because contrast sensitivity is reduced with age, the visibility of important objects, such as stair edges, curbs, ramps, or doorways, can be greatly improved by increasing their contrast with paint or similar techniques. Use contrasting contrast colors to mark edges, such as doorframes, baseboards, steps, and sharp edges.

How to make lighting more effective for the aging circadian system:

The impact of low light levels on the circadian system and sleep may be further compounded by age-related neurological changes in the circadian system. Moreover, older adults often lead more sedentary lives, less likely to leave indoor living environments which limits their access to daylight.

Lighting can also be used to consolidate sleep patterns. Although there is still some debate about the exact lighting characteristics affecting the circadian system, it is known that relatively higher light levels are needed to activate the circadian system compared to the visual system. For reading, the daytime (photopic) visual response is maximally sensitive to light at 555 nm (yellow-green light), while the circadian system is a “blue-sky detector,” maximally sensitive to wavelengths shorter than

470 nm. Timing and duration of light exposure are important for the circadian system.

But, remember, lighting is only one element of the interior design. Select appropriate surface finishes and enhance relevant information, such as sharp edges, architectural transitions, and doorways so that the visual environment is not cluttered. Lighting techniques associated with appropriate interior finishes will help older adults maintain their independence and stay home longer.