LIGHTING FOR UNIVERSAL DESIGN

Patricia Rizzo

(Figure 1) Conceal light source within opaque shade (left) or diffuse glass (below) to protect eyes from glare.

synopsis

- **Lighting is the application of light. What we do with lights, where we place them, how much area we light with them, what color "white" light we choose, what shadows we cast, or which artwork we accent—the effects we create—this is lighting.**
- **As we get older we need more light, but it must be more shielded, balanced, and uniform light.**
- **Lighting that is the most effective for an application while using the least amount of energy can be considered energy-efficient.**
- **Lighting for universal design is lighting that grows and shrinks as we do; it lives with us, and adapts to our needs.**

Light And Lighting

Light touches every part of our lives, from the moment we are born until the moment we die, and maybe beyond. It sustains us; allows us to see; allows us to sense the time of day; to sense the season; and it regulates our 24-hour circadian clock, the sleep/wake cycle that we take for granted. We feel joy when the sun shines, and perhaps romance when the moon shines. Shadows intrigue, or frighten us; bright light protects us, makes us feel safe. Light is a constant companion.

In this article, I intend to talk about lighting, specifically lighting for universal design. You've no doubt read about universal design in previous issues of *Ultimate Home Design*™. Universal design is becoming an increasingly more familiar term in our vernacular. The concept, initiated by Ron Mace in the 1970s, addresses the ability of humans to live comfortably in our built environment. How can we accommodate the needs of a broader segment of our population, in fact, the broadest segment of our population? What types of homes, buildings, and public spaces would allow almost everyone to feel comfortable, to navigate without restriction, despite any physical or sensory impairment? What types of spaces would just make life easier for those of us who are getting older, or even the very young among us?

"Designing lighting that respects energy limits aligns perfectly with lighting that benefits young eyes, aging eyes, and everything in between."

Aging-in-place is a popular phrase used by the National Association of Homebuilders (NAHB) today. An eponymous CBS News segment recently showcased a family of multiple generations, right up to the great grandmother, all living together in close quarters, under one roof. This is becoming more and more common. Remember when we "baby boomers" were growing up in urban neighborhoods as children? Children, parents, grandparents, aunts, uncles, and cousins often lived within a few blocks of each other, if not in the same apartment building across the hall from one another. There wasn't a day that went by when we didn't see each other, at least once. Everyone's door was open at any time to family and neighbors. We didn't need to make special "plans" to visit, no one had to check their calendar; we just walked right in. The coffee pot was always ready and perking on the stove, and some freshly baked cake or biscotti was just coming out of the oven, or homemade tomato sauce bubbling in the pot, ready for that crust of Italian bread to dunk. Life was simple. We took care of each other. "Nursing home" wasn't in our vocabulary.

That culture was lost to most Americans over the past few decades, but now there is a desire to return to that simple life. People resist being placed in "assisted-living facilities"; no one wants to leave their homes. We yearn to have family around to take care of us once again. So, homes are being built for "sandwich" generations. Master bedrooms, as well as bedroom suites for grandparents, are appearing on the first floor. Doorways and hallways are wider to accommodate any peripheral walking or wheelchair devices we may need, or just to allow large pieces of furniture to be moved easily. Front entries are step-free, and thresholds throughout the house are smooth. Door handles are levers, not knobs, and microwaves are low enough that even a not-so-tall person can reach them.

So, physical barriers are being mitigated. Now, how do we navigate these spaces? First of all, if we are sighted, we need to see. Lighting is the key element. If we aren't sighted, we need to orient ourselves.

Light—Or Lighting?

Have you ever thought about the difference between light and lighting? Lighting is the application of light. We have endless means of creating light these days—windows, for one; then, we have a variety of lightbulbs, thousands of decorative luminaires, and more popular than ever—the return of the candle. What we do with these tools, where we place them, how much area we light with them, what color "white" light we choose, what shadows we cast, or which artwork we accent—the effects we create—this is lighting. As in the theatre, we evoke emotion through lighting. Although we are generally unaware of it, we design our lighting every day. Lighting has an infinite capacity to improve our living environment, visually, aesthetically, and functionally. With energy in high-crisis mode today, lighting responsibly is our duty. And, fortunately, designing lighting that respects energy limits aligns perfectly with lighting that benefits young eyes, aging eyes, and everything in between.

The Aging Eye

With all the good things that come with aging—wisdom, character, personal and professional accomplishments—so come the not-so-good things. Our vision deteriorates dramatically through the normal aging process. Before age 65, we undergo optical changes, and after age 65, neural changes.

Optical Changes

The retina, which is actually part of our brain, is a network of cells that includes photoreceptors, or light detectors, located at the rear lining of the eye. Increasingly less light reaches the retina (reduced retinal luminance) as we age, because our pupils get smaller, a condition known as senile miosis; and our crystalline lens becomes thicker. More and larger protein molecules accumulate and scatter through the crystalline lens, causing increased stray light and disability glare, or glare that prevents us from performing our task. We also experience reduced retinal contrast and color saturation, so we don't see images as clearly. Add to that presbyopia, or loss of accommodation, which means we cannot adapt as

(Figure 2) Linear fluorescent lights above and below cabinets fill in shadows and increase the impression of brightness while producing a glare-free environment.

quickly to sharp changes in brightness, and there you have it: the mandatory optical change package that we are forced to live with. And that's the good news!

Neural Changes

After age 65, our neuron density is reduced. Fewer neurons means limited image enhancement, reduced visual field, and photophobia, or discomfort glare. Diseases such as the following become more common:

- Cataracts—an opacity developing in the lens
- Glaucoma—progressive and visual field loss as the result of a number of diseases that affect the eye
- Macular degeneration—changes to the pigmentation in the macular, a circular yellow-pigmented area of the retina, 2 to 3 millimeters in diameter
- Diabetic retinopathy—results from chronic diabetes mellitus, which effectively destroys parts of the retina through the changes it produces in the vascular system that supplies the retina (Boyce, 2003)

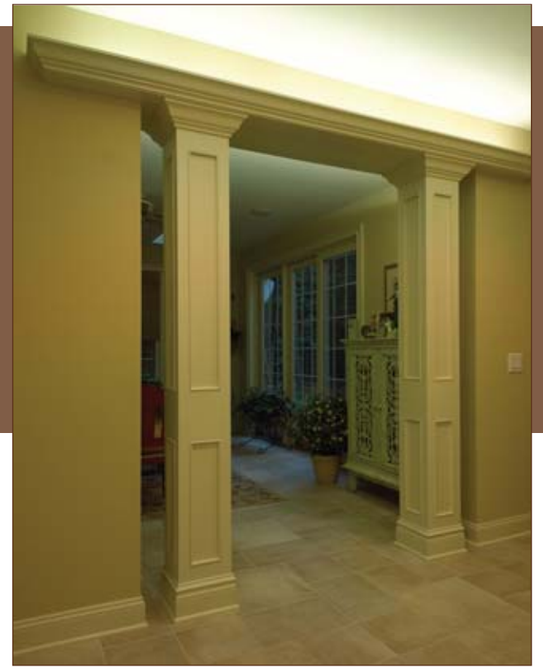
What this all means is that we don't see as well. Less light reaches the retina; there is reduced retinal contrast and color saturation, loss of accommodation, increased sensitivity to glare, and a reduced ability to adapt to large changes in brightness. So what would alleviate these transitions?

Lighting Solutions

As we get older, we need more light, but it must be more shielded, balanced, and uniform light. A few tips include:

- Avoid direct glare caused by exposed lightbulbs. Place some kind of translucent material between you and the light source if you can see the lightbulb while standing or sitting. Select luminaires with some type of shade or diffuser (Figure 1).
- Avoid glossy surfaces, especially on floors or countertops; they become mirrors, reflecting the brightness of the light source and increasing the impression of glare.
- Avoid placing bright luminaires against dark ceilings.
- Use indirect lighting whenever possible; it fills in the shadows and creates a soft, glare-free environment while seeming brighter than a directly lit environment (Figure 2).
- Conceal linear fluorescent luminaires behind a decorative fascia, creating a cove or valance. This works especially well when you have nine-foot ceilings or higher, allowing the light to wash the walls and ceilings so your room surfaces become an extension of your light source (Figure 3).
- Use light color finishes on walls and ceilings to soften the effects of bright light sources and to reduce shadows.
- Avoid making the interior of your home too dark compared to the exterior; use dimmers to balance the brightness of your table lamps, floor lamps, and chandeliers. Balancing light levels within spaces and between adjacent spaces is important, since our accommodation is reduced. We can't negotiate sharp transitions from bright to dark spaces and vice versa as easily.
- Provide good contrast between transition areas. For example, around a doorway, lighting horizontally and vertically around a door jamb is a helpful cue for someone who has a hard time focusing clearly. During the day, contrasting paint colors between wall and door jamb will work well, but illuminated delineation is needed at night. Think about waking up in the middle of the night and trying to orient yourself to the room configuration. Light that is just bright enough to enable you to see and guide you to where you want to go, without being so bright as to disturb you, is very helpful—a type of large area night-light.
- Maintain uniform illumination where possible. Oftentimes the way recessed or track lighting is located creates scallops of light on our walls or floors. These patterns, or pools, of light can be confusing and disorienting (Figure 4).
- Place more light close to the task. If you are writing at your desk, place your desk lamp opposite your writing hand to avoid working in your own shadow. This is true with overhead lights as well. In your kitchen, make sure the downlight over your sink or stove is in front of you, not over your shoulder.

(Figure 3 Above) Valance conceals linear fluorescents providing soft ambient light and eliminating the need for downlights. (Figure 3b Right) Cove is designed to extend from columns, blending into architecture, and provides soft, indirect lighting for passage in hallway.



Energy-Efficient Lighting

A frequent misconception is that energy-efficient lighting equals fluorescent lighting. More accurately, lighting that is the most effective for an application while using the least amount of energy can be considered energy-efficient. In certain instances, that may mean that even your basic incandescent bulb is the most "efficient" for your purposes.

Let's define efficiency in absolute terms. Efficiency is a term typically used to describe the performance of a lighting fixture, or luminaire, and is expressed as a percentage. For example, a linear fluorescent pendant used in an office may have an efficiency of 76 percent. This takes into account the efficacy of the light source itself, in this case the fluorescent bulb and the light loss due to absorption or entrapment by the fixture. Luminaire efficiency is the ratio of the light output emitted by a luminaire to the light output emitted by the lamp-ballast combination (Rea, 2000); it indicates how much of the lamp's light output the luminaire's optical system directs out of the luminaire.

How about efficacy? An awkward word, but that is the metric used to describe the number of lumens emitted by a light source for every watt of energy consumed. Think of it the way you would consider miles per gallon (mpg) in the automotive world. Lumens per watt (lm/W) indicate how efficacious a lightbulb is in absolute terms. The incandescent bulb, which has been with us since 1879, is still going strong; it averages 14 lm/W. However, only about 10 percent of the energy consumed by an incandescent lamp results in radiation that is within the visible spectrum, or seen as light, while the other 90 percent is radiated as heat.

Fluorescents

Linear fluorescent sources, the long tubes we're used to seeing in industrial fixtures, and often relegated to the garage and basement, average 80 to 100 lm/W. These sources, such as T5 (5/8 of an inch in diameter) and T8 (8/8 of an inch, or 1 inch in diameter) now use a rare earth tri-phosphor coating in their glass envelopes, vastly improving the color they emit and their ability to render color (such as your skin tone, or your drapery fabric). They operate on electronic ballasts instead of the heavier, noisier, flicker-causing magnetic ballasts we're familiar with, making them even more efficient and less obnoxious. The hum and buzz, and greenish color, so long associated with fluorescents has virtually vanished.

Compact fluorescent lamps (CFLs) are the smaller variety designed to replace incandescent bulbs. They come in shapes resembling ice cream twist cones and short bent tubes. They may have a screw base for standard luminaires or a pin base that requires a dedicated socket. CFLs have

efficacies of 55 to 75 lm/W. Unlike incandescent sources, fluorescent sources are a system, made up of a lamp (bulb) and ballast, which is needed to start them and regulate the current running through them.

Fluorescents are touted as energy-efficient because of their longer life as well as their higher efficacies than incandescent. While incandescent bulbs have a life of 800 to 2,000 hours, fluorescents last from 6,000 to 20,000 hours, reducing replacement and maintenance costs.

The higher efficacy of fluorescents translates to 4x as much light as an incandescent for equal amounts of energy consumed—meaning a 15-watt fluorescent is the equivalent of a 60-watt incandescent in light output. The caution here is that the distribution of light is not always the same, so be careful to match expectations. Take a parabolic aluminized reflector (PAR) lamp, for example. A PAR lamp is often used as the recessed floodlight or spotlight in our homes; it not only has a filament providing center beam candlepower, but also has a built-in reflector. This allows all of the lumens to be directed down where they're needed. A recessed CFL will not perform the same way. It doesn't have a filament to provide that center beam punch. Therefore, to place a lot of light directly on a work surface where it's needed, a halogen PAR or MR16 (2-inch diameter low-voltage multi-faceted reflector bulb) may be the better solution (Figure 5).

Dimming is desirable and recommended in residential applications, and it is easily achieved with incandescent technology. In fact, when dimming an incandescent you can extend its life exponentially, so it's a great energy-savings technique. Be aware though, that an incandescent will become more golden in color when dimmed. While some linear and compact versions of fluorescents have dimming options, it is not always easy or cheap to accomplish. A dimming ballast and sometimes special wiring for the dimmer switch is required. It is important to understand how different light sources behave in order to make good decisions on how to use them for maximum benefit.

Fluorescent is not the only technology being considered as energy-efficient these days. In fact, some may say it's so "20th century." So who's the new kid on the block? Light emitting diodes (LEDs), a type of solid-state lighting, hold promise of becoming the great energy saver of the 21st century.

(Figure 4) Avoid creating pools of light; patterns can be disorienting to the aging eye.

(Figure 5) Different distributions of an A-lamp, a PAR lamp, and an MR 16 lamp

LEDs

LEDs are a solid-state source, so they have no breakable parts, such as a delicate filament or glass envelope. They are robust but small. Their diminutive size allows them to fit in the smallest of spaces. They are easily controllable, so dimming is not an issue as it is with fluorescents. They provide dynamic color changing and so offer endless possibilities to create different moods and atmospheres. Their life is tens of thousands of hours, varying with color and type of LED. Their efficacy (there's that word again!) is eclipsing that of the incandescent and even fluorescent as we speak. U.S. Department of Energy (US DOE) projections are for LEDs to reach at least 150 lm/W by the year 2012. Products are emerging in the market faster than metrics and standards can be developed. Previously confined to the electronics industry for backlighting digital clocks, radios, computers, and cell phones, the LED's merits have propelled it forth into prime time. While the LED is not new by any means—it has been around since the 60s—the invention of the blue LED about a decade ago enabled the creation of the white LED—and this ushered in the feasibility of using LEDs as a source of general illumination.

Like fluorescent sources, LEDs operate as a system, which includes electrical, optical, and thermal components. Unlike fluorescents, they behave well in cold environments such as outdoors or inside refrigerated cases.

As with all light sources, we must use LEDs wisely, or we may be disappointed, and they will never fully reach their potential.

The Color Of Light

There are two metrics associated with the color of light sources. One refers to the appearance of the color the sources emit—correlated color temperature (CCT); and the other refers to the way they render color in objects, including skin tones, their color rendering index (CRI). While incandescent or halogens emit a gold or yellowish color, fluorescents offer degrees of "white" light from yellow, or gold (warm), to bluish white (cool). Each color is associated with a CCT and expressed in degrees Kelvin (K). The yellower the CCT, the lower is the number on a scale of 0 to 10,000. Approximate ranges for each source are as follows:

- Incandescent and halogen sources—2700K to 3000K
- CFLs—2700K to 6500K
- Linear fluorescents—3000K to 7500K

CRI is based on a scale of 0 to 100, with 100 being the best. Incandescents typically are rated with a high CRI, close to 100. CFLs and linear fluorescents can range from the low 50s to the high 80s. It's important to read the package label when looking for the CCT and CRI of fluorescent sources. ENERGY STAR® products guarantee a good CRI, since ENERGY STAR requires CFLs to have a CRI greater than 80 and linear fluorescents to have a CRI greater than 75.

Energy-Efficient Lighting, The Aging Eye, And Universal Design

Revisiting the issues that characterize our visual needs as we get older, we know we must respect glare, accommodation, orientation, and way-finding; and we must minimize equipment replacement in order to avoid climbing ladders, thus inviting accidents. Here are some ways fluorescent and LED sources comply:

Fluorescent Sources

Linear fluorescents make wonderful indirect sources, addressing many of the aging eye issues. They cover a greater area than incandescent sources; linear fluorescents lend themselves to architectural applications such as coves and valances. They can provide soft indirect lighting that fills in shadows, minimizes glare, and utilizes the room surfaces as light sources, while being easily concealed behind decorative moldings. Both linear fluorescents and CFLs have a higher efficacy than incandescents, emitting approximately 4x as much light for equal wattage consumed, which translates to one-fourth of the operating cost. They live approximately 10x as long as incandescents, so they require less frequent replacement, which saves money while reducing the risk of falls. CFLs are extremely well suited to table and floor lamps, as well as sconces if housed within a diffuse or colored shade.

LED Sources

LEDs have a unique benefit to the aging eye. As we age, our circadian system, which responds to light differently than our visual system, weakens. Our sleep patterns become irregular. Exposure to the right amount and intensity of light at the right time of day can help regulate our circadian rhythm.

The wavelength of the blue LED, peaking at 470 nanometers (nm) happens to be the perfect color and intensity of light to activate our circadian system much more quickly than white light sources. Humans are blue sky detectors; light entrains our 24-hour sleep/wake cycle to the solar day. The amount of light reaching the retina is a key to melatonin suppression, which occurs during the night while we sleep. We can consolidate the amount of our light exposure to help regulate our night-time schedule.

In addition, colored as well as white LEDs can provide sufficient light to help in navigation and orientation from one room to another, and can do so at levels that do not disturb the homeowner.

Rather than be confined in a single lightbulb, LEDs can be distributed, so they can run linearly in the narrowest of places. Under counters and toe kicks—to delineate edges; around door jambs for contrast; behind grab bars for night guidance; for handrails and step lighting, indoors and out, for safety.

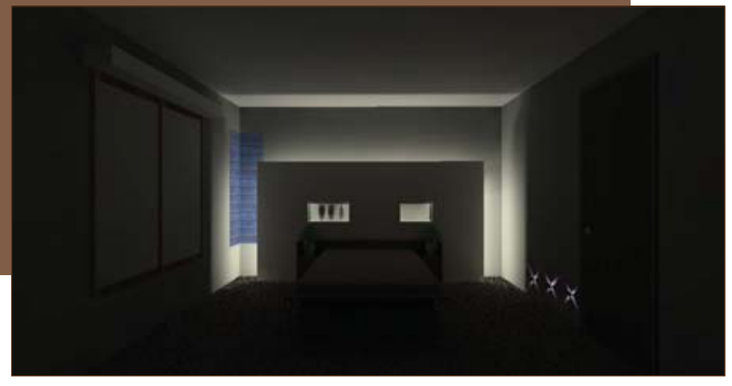
Lighting For Universal Design: A "Universal Design Living Laboratory"

All we've touched on brings us back to our main topic, lighting for universal design. Since universal design covers such a broad range of life situations, we can apply the considerable lighting knowledge we've gathered regarding the diverse phases of life: newborns, teenagers, older adults, those with sleep disorders, and those with compromised vision; those with mobility issues, or those that are in general good health with no disabilities to speak of. The following example is a good illustration.

In the spring semester of 2006, the graduate students of the Lighting Research Center, part of Rensselaer Polytechnic Institute in Troy, New York, worked closely with

(Figure 6) Great Room
Color-changing LED system is concealed in cove along each side of great room to uplight vaulted ceiling, and provide mood and circadian benefits; blue light has been found to be effective in activating the circadian system.

(Figure 7) Grandparents' Bedroom
Linear fluorescents provide emanating light from false wall behind bed; and puck lights located along lower wall help in way finding from bed to bathroom.



a client to design the lighting for her universal design home, a home that is to become a "living laboratory" for conceptual and technological advances in universal design. The students spent several hours interviewing the homeowner in person and becoming familiar with her needs (she is 4-feet 2-inches seated in a wheelchair), those of her husband (he is 6-feet 4-inches standing), the lifestyle they wished to sustain, and the objectives of the living laboratory. The homeowner intends to open the home to the public and showcase the spatial and lighting design solutions integrated into the architecture and landscape by holding instructional tours and seminars.

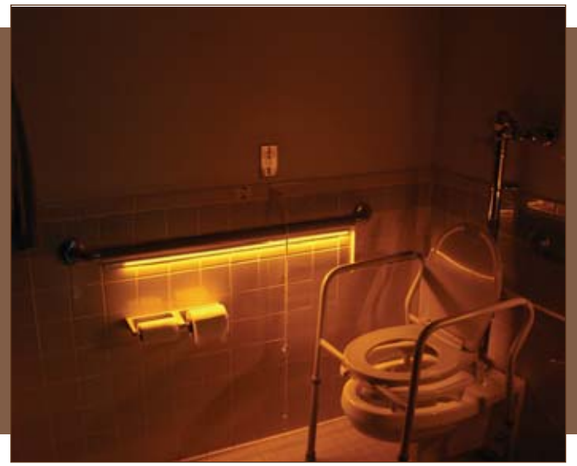
Having already studied light and health issues, and therefore, being well versed in the aging eye, circadian system, sleep phase disorders, and Alzheimer's disease, these students were armed with more than enough knowledge to attempt a "universal" lighting design. Vision science, lighting technology, and artistic sensitivity came together in their solutions.

Their design intent for the project states: "…our design attempts to serve the needs of four broad and disparate segments of the population: the elderly, those suffering from circadian disorder, those who need response with minimal interaction, and the wheelchair-bound."

The students also state that their lighting exemplifies responsiveness to the following needs:

• For the elderly, they focused on the needs of the aging eye by minimizing glare and attempting to create a diffuse and even glow throughout the space.

• For those with circadian disorders, they provided a space, under the color-changing lights in the great room, where those suffering from Seasonal Affective Disorder (SAD), Advance Sleep Phase Syndrome (ASPS), Delayed Sleep Phase Syndrome (DSPS), and various forms of Alzheimer's disease could be suffused with the sky-blue glow known to be particularly effective at affecting the circadian system and dealing with such disorders (Figure 6).



(Figure 8) Amber LEDs light below grab bars to provide sufficient light for navigating at night, but not too much to startle you from sleep.

(Figure 9a) Delineation of transitions zones. Horizontal and vertical lighting provides perceptual cues to help older adults orient themselves when awaking from sleep. These amber LEDs are photosensor and motion controlled. Amber was selected because it gives enough light to see and is closest in color to the familiar incandescent.

• For those needing response with minimal interaction, they provided the lighting automation laboratory in the dressing room, where various lighting control schemes, simulating lighting environments from restaurants to offices to daylight, could be implemented and tested, in the true spirit of a lighting laboratory.

• For those who are wheelchair-bound, they located all lighting controls at locations where no inbuilt structure blocks access; and they specified all control mounting heights as 40 inches from the floor.

• For those who are wheelchair-bound or of shorter stature, they provided well-shielded, lensed luminaires to avoid glare when looking up into an under-cabinet light or pendant.

• In addition, for all occupants, they added elements intended to improve the general lighting; they added way-finding elements, such as subtle "puck" night-lights, which bracket the paths to the bathrooms, and amber LEDs lighting the wall below grab bars to provide sufficient light to find your way into the bathroom but not so much that it startles you during the night (Figures 7 and 8).

• Although not part of this design, delineation of transition zones aids in orientation and helps prevent trips and falls [Figueiro, 2006 (Figure 9)].

• Since the garages were the homeowners' principal point of entry, the students wanted to make them interesting and inviting, so they added artistic illumination in the multiple garages.

• They also added dramatic external lighting, intended to bathe the outside walls of the Universal Design Living Laboratory (UDLL) with a warm, suffuse, inviting glow, thus drawing those of all visual capabilities toward and into the UDLL.

Design, by definition, implies a deliberate, thoughtful solution to a problem/situation. Since each home presents unique situations, when an individual cannot get to an exterior mail box or post office, for example, what's the alternative? A personal, interior drop box—lighted, of course. A door switch activated LED provides a simple solution (Figure 10). This solution sprang from collaboration with a fellow panelist as we

Simple Lighting Tips For Universal Design

• While "baby boomers," the fastest growing segment of our population today, have additional visual needs, i.e., higher light levels, better shielding—universal design occupants may also need to avoid increased glare from pendants or under-cabinet luminaires, due to the lower vantage point of user

• Since countertop and cooktop heights may be adjustable, task lighting must be flexible

• Provide bright, interesting lighting in the garage since that may be the main point of entry

• Provide contrast by illuminating edges under counters, cabinet toe kicks, and around doorways

• Under-cabinet lighting: linear T5 fluorescent, low-profile so as not to protrude below cabinet trim, well shielded (diffuse lens), good CRI and good distribution; locate luminaire at front of cabinet with lens facing backsplash

Controls:

• Light switches—use lighted, rocker switches; height should be between 36 and 42 inches from floor and be located within easy reach of user (not back wall!)

• Use adjustable controls, i.e. dimmer switches, to enable you to balance brightness levels and create atmosphere

• Consider a preset control system option; this allows you to set varying light levels and scenes according to room or task and eliminates the need to turn lights on or off when you enter or leave your home or individual room; or when you forget to turn that one light off on the other side of the house after you get into bed at night

• Occupancy sensors—automatic or manual on (required in California under Title 24 for sources that are not high efficacy, i.e., incandescent)

• Lighting must be beautiful and seamlessly integrated!

Figure 9b: Change in grade is marked by linear LEDs under step

prepared to speak at the National Association of Home Builders (NAHB) Boomers & Beyond Conference in Phoenix, Arizona this past April. And, in the spirit of being truly universal, who wouldn't benefit from such a feature in their home? The only person left to convince would be the mail carrier!

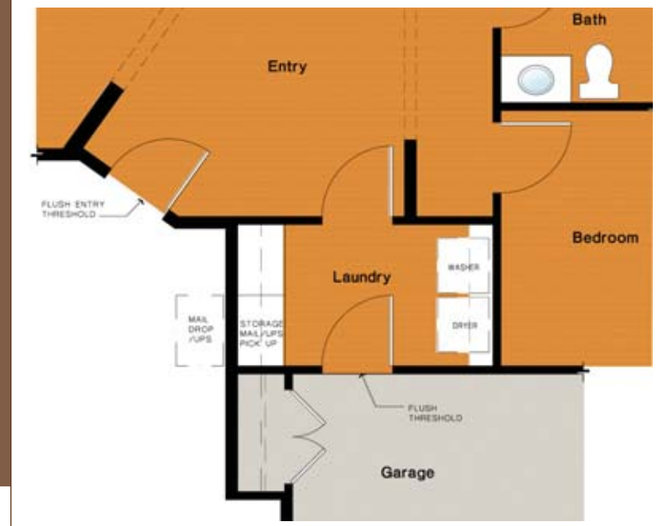
It is safe to say that good lighting is absent from most new construction. Recessed incandescent downlights are rampant and often glaring, and switch locations are often inconvenient. Rare is the case when a building professional calls on the services of a lighting designer to improve their basic construction package. Upgrades are offered for granite countertops and whirlpool bathtubs, and maybe a fancier chandelier. But a chandelier is not lighting—it's furniture.

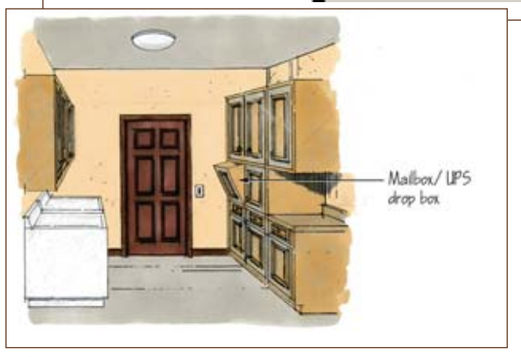
At the very least, hopefully, this article has revealed that lighting answers specific questions. If we are wobbly when waking up to get to the bathroom at night, we need a switch close to our bed to turn on the light, or an occupancy sensor to do it for us. And we don't need to connect to a bright light, but rather a low-level light so we can adapt to the light, and conversely re-adapt to the dark when returning to bed. That's design. If we can't read the same size font we were able to a couple of years ago, then we need more light. But brighter is not better if it causes glare, and discomfort. So we choose a reading light with a decorative shade to shield the brightness but direct the light onto our book or newspaper, or a simple dimmer. That's design—it's being considerate of how we function as humans; such a simple concept, yet so neglected.

If I were to define lighting for universal design, I would say that it is lighting that grows and shrinks as we do; it lives with us, and adapts to our needs. Furniture manufacturers make cribs now that convert into toddler beds. Why not lighting? Then all the elements we mentioned in this article would be incorporated as naturally as Sheetrock™ and windows. It is not only the responsibility of the builder and the manufacturers—it is the homeowner's as well. We are all educating each other at this point. If homes are truly designed to be "universal," then comfort and safety and aesthetics will be a priority, not feared for being an "incremental cost."

When the overlap among our sensory, ambulatory, architectural, and environmental systems is recognized and treated as a unit, not isolated fragments—a lofty goal but achievable—we will be a little closer to longer, happier lives in our own homes, surrounded by our family. UHD

Figure 10a: Floor plan showing location of mail drop/pick-up drawer accessible from laundry room.





(Figure 10b) A special universal design application could be a lighted mail drop—a dedicated pull-down drawer located either alongside the front door or in the laundry room that facilitates sending and retrieving packages for someone unable to go out to mailbox or get to a mail center. A door switch-activated LED could light the interior of the box. Also notice the location of the light switch, no higher than 42 inches from the floor. (Floor plan and rendering courtesy of Rob Williams, KTGY Architects, Los Angeles, 2006)

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