



# Lighting Design Process

## for the first Optimum Performance Home™

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### synopsis

Gaining an understanding of the clients' lifestyle and the vision they have for their home is foremost in beginning to assess what the lighting solutions will be.

As lighting is more a sensory than a spatial experience, the contrast between light and dark, the transitions and shadows, whether deliberate or accidental, can stir a memory, hint at an emotion—or shout out an invitation for fun and laughter.

There are three main phases in a lighting design process: planning, conceptual, and development, all paralleled by constant communication with the clients.

In order to render the lighting in certain rooms, accurate and realistic surfaces were applied to the interior spaces and exterior structures, including carpeting, slate floors, painted walls, stainless-steel appliances, and wood kitchen cabinets—important elements not only aesthetically, but because their reflectance values would affect the overall illuminance, or light level, in the space.

### Introduction

The moments leading up to a lighting design are exciting and unique to each new project. This past fall, a select group of graduate students from the Lighting Research Center (LRC) at the Rensselaer Polytechnic Institute (RPI) in Troy, New York, was asked to design the lighting for an exemplary home/office complex at The Sea Ranch development in Sonoma County, California. They would place some science behind the art and base their lighting design on research-based evidence. Readers of this magazine are, by now, familiar with the complexity of the Optimum Performance Home™ endeavor. For Sandhya, Nancy, Robert, and Justin, it can be likened to carving into a rough block of marble, so to speak, to chisel out a smooth and timeless statue.

The lighting design process always begins with the clients. Gaining an understanding of their lifestyle and the vision they have for their home is foremost in beginning to assess what the lighting solutions will be. A curious phenomenon is that, many times, the clients do not really know what that vision means in term of lighting. They know the furniture they're using and the location of all the television displays; they know the material their countertops and ceilings are—but lighting is somewhat intangible.

Lighting, if you think about it, is more a sensory than a spatial experience; therefore, not always simple to describe.



(Figure 1) Plan view showing soft exterior lighting from the front parking area, plant beds (left), and garages through the entrance and vestibule to the rear courtyard, where color-changing LEDs illuminate the glass block walls flanking the hot tub. All lighting projects downward, respecting The Sea Ranch zero-light pollution policy.

The contrast between light and dark, the transitions and shadows, whether deliberate or accidental, can stir a memory, hint at an emotion—or shout out an invitation for fun and laughter. Creating a lighting language and communicating it well to all members of the design team is critical to a successful design.

The design, team with whom we collaborated for the Optimum Performance Home, included the owners/clients, architectural designer, lighting consultant, interior designer, and biophilic designer. Our challenge was unique in the sense that this home was to represent all things not only good and sustainable, but technologically leading-edge as well—and it was to accommodate both a family and a work environment. We also did not have the luxury of a site to visit or architectural structure to review. We were in the middle of our fall semester in Troy, and the project was in Sonoma County, California. We were equipped with two-dimensional (2-D) drawings and expectations to integrate great lighting into an environmental model for homes in the future. The components to consider were many: this home

aimed to be sustainable in materials and operation, adhere to universal design principles, respect the biophilic needs of human beings, and comply with Leadership In Energy And Environmental Design (LEED®) For Homes criteria. Energy-efficiency was implicit—but it also had to have a wow! factor. Oh, and did we mention the electronics?

There are three main phases in a lighting design process: planning, conceptual, and development—all paralleled by constant communication with the clients. We would take this project through the conceptual phase. Gary Reber, Editor-In-Chief and Publisher, and Marlene Reber, Executive Publisher, of *Ultimate Home Design* and *Widescreen Review* magazines, and the owners/conceptual designers of the home, have a wonderful team of experts assembled to make this home come to life—and we were privileged to collaborate with them. They provided us with as many architectural details and specifications on materials and furnishings as possible upon request. The planning stage for us began with a phone conference back in September of 2006, since geography precluded an actual meeting.

## Through The Clients' Eyes

The students had to be able to see through the clients' eyes to determine what it was they wished the clients and visitors to see, what message they wanted the lighting to send—where it should be subtle and where it should be bold. They considered the house and grounds holistically, then divided the whole into sections that they each could address. They worked together to make sure the effect was cohesive, yet each area took on a distinct identity.

From their interview with Gary and the design team, the students developed their design intent, identifying lighting objectives consistent with sustainability, universal design, energy-efficiency, and the zero-light pollution policy of The Sea Ranch. In their words:

The Optimum Performance Home at The Sea Ranch, California has been designed as a place that will promote:

- Aging-in-place
- Comfort for people of diverse physical and sensory abilities
- Sustainability
- Energy-efficiency

It will utilize the best of today's products and building methods to demonstrate how they can make life:

- Safer
- More comfortable
- More enjoyable
- Friendlier to the environment

The science behind the home targets a structure that will not only use less energy but actually:

- Generate energy
- Be quieter
- More comfortable
- Mesh with its natural surroundings

With a set of preliminary architectural plans before us, Gary walked us through the three buildings of the complex, explaining in detail the structural materials selected, and the intended function of each space. Robert, Sandhya, Justin, and Nancy asked Gary specific questions, such as how often he and his wife entertain, a sample of their daily schedules, where they spend most of their time, wall colors, furniture style, height and placement of each piece of furniture, consideration of mechanical shades for daylight control on windows, etc. Basically, how did

they want to feel in their home, and what feeling did they want the home to project?

### Areas Of The Optimum Performance Home Each Student Chose To Design

Gary reinforced that the view from outside the front entry through to the courtyard and vestibule should be transparent, that's why it was designed to be predominantly glass. To conjure up a mental image for the lighting of this area, the students were asked to

Our lighting design is structured around the following principles:

For aging-in-place/universal design we have:

- Used recent discoveries to help make the home safer while using only a minimal amount of energy
- All light levels are controllable by dimmers or motion sensors to accommodate multiple age groups enjoying the home
  - The master bedroom suite and guest bedrooms will use amber LEDs as a way-finding device, to provide enough light to lead the occupants to the bathroom safely without fully waking them or others in the room
  - These lights will switch on via motion sensors located above the bed (at a height not to be activated by the family cats) to prevent fumbling for switches, and consequently trips and falls
    - Blue LED tile located in the master bathroom to enable regulation of circadian rhythms
    - This will allow for healthier sleep patterns
    - It is conveniently located near the Japanese soak tub so doses of blue light can be received during relaxing bath time

For energy-efficiency, we have:

- Complied with strict light pollution rules of The Sea Ranch community and California Title 24 regulations, which dictate lighting energy use
  - Used high-efficacy lamps whenever possible
  - Implemented our design in such a way as to accomplish these things without taking away from the comfort and warmth that one would expect to feel when they are home

answer the following questions:

- Picture yourself standing in the vestibule and looking toward the kitchen, then toward the courtyard, then toward the entry, then walking toward the staircase to the library/home theatre/surround music room. Then picture yourself standing in each of those four areas looking toward the vestibule. What will be the most effective, discrete way to light the vestibule since it acts as such a bridge between these areas?
  - As the lighting designer, if you were driving up the Sonoma County

## Lighting Analyst's AGI32

Lighting Analyst's AGI32 is a visualization program that allows the user to import a 3-D drawing, apply surface textures such as brick or stone or sheet rock; choose colors and patterns from a library of choices; insert windows and doors. You can then choose the exact light sources to be used from manufacturer-provided specifications—incandescent, fluorescent, LED—and position them exactly as they would be in the room. The manufacturer spec sheets supply a photometric, or light measurement, file with values that you can import into the program. This photometric file characterizes the distribution and color of the light source; AGI32 then ray-traces the movement of the light, or number of bounces the light takes before reaching its final destination, and finally renders the effect as closely as possible to how it will look in your space.

floors, painted walls, stainless-steel appliances, and wood kitchen cabinets—important elements not only aesthetically but because their reflectance values would affect the overall illuminance, or light level, in the space. Lighter colors (higher reflectance) result in a brighter appearance than darker colors (lower reflectance). Stickley furniture was re-created in the living room and dining rooms, actual lighting fixtures reproduced, and Armstrong wood-paneled ceilings brought to life in rich honey brown tones. While no electronic program is perfect, these renderings help to effectively portray the intended concepts, making this a valuable tool when trying to convey the vision for lighting to the client, comparing expectations, and making adjustments before equipment is ordered and installation is in progress. Halfway through the students' part of the project, which spanned six weeks, we scheduled another phone conference with Gary and team. During this call the students presented their initial concept by PowerPoint, which was e-mailed to everyone involved ahead of time, allowing them to follow along slide by slide, giving us feedback and prompt discussion before we proceeded with the final design.

Justin, who is completing his undergraduate work in architecture at RPI, was part of our graduate-level Lighting Design class at the time. His concept for the exterior is as follows:

To create a lantern effect, visible from the approach to the house, and a glow that warms the house from within, Justin concentrated on the front entry, continued through the vestibule, and out to the courtyard. He saw the lighting as very understated, its effect unfolding quietly as one moved from the farthest point on the driveway to the heart of the courtyard (Figure 1).

The lighting objectives he sought to meet for the entrance and courtyard are as follows:

For both the entrance and courtyard, Justin adhered to the zero-light pollution policy of The Sea Ranch—no light directed upward—and provided modest light levels for all outdoor areas. At

coast and entered The Sea Ranch development at night to visit your clients, what overall impression would you want your Optimum Performance Home to give?

• Now answer the same question as if you were the homeowner.

Thinking in these terms led to a clear image of the desired effect; now they had to develop the details that would satisfy the multiple criteria associated with the Optimum Performance Home. They accomplished this through a careful choice of luminaires (recessed, wall-mounted, suspended, track, or custom) light sources (incandescent, including halogen); fluorescent, both linear and compact, or light emitting diodes (LEDs); light source efficacy (lumens per watt); color (warm or cool) and distribution of light sources (narrow or wide beam spread, and everything in between); and available mounting locations and controls (switches in accessible locations, including dimmers and motion sensors). Integration and compatibility with the extensive electronic systems throughout the house had to be considered as well—would the frequency of the lighting components interfere with any of the audio/visual equipment in virtually every room of this house?

The students derived 3-D models from 2-D drawings. Using Lighting Analyst, Inc. AGI32 software to render the lighting in certain rooms, they applied accurate and realistic surfaces to the interior spaces and exterior structures, including carpeting, slate

## Ballast Specification

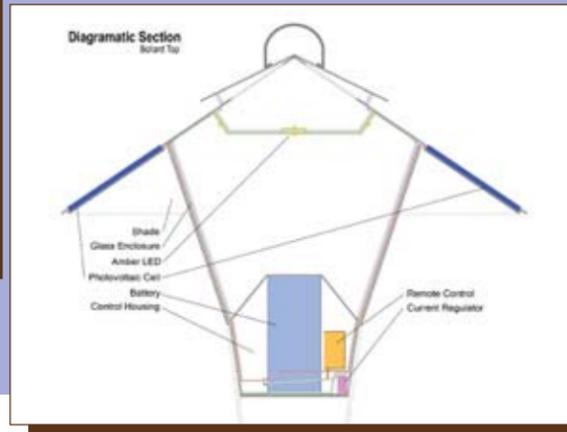
To ensure that dimming these fluorescent luminaires would not interfere with other electronic equipment in the home, I researched ballast options and specified one with these characteristics:

- Programmed Rapid Start Ballast
- Low total harmonic distortion (THD) throughout dimming
- Frequency of operation between 25 kHz and 38 kHz.
- Electromagnetic interference (EMI) will not interfere with infrared (IR) devices
- 63rd Harmonic before entering 2.4 GHz range where most WiFi and other RF products operate. This means EMI is negligible for these devices.
- Ultra Quiet
- Can operate two or three lamps



(Figure 2) Photovoltaic bollard on wheels (left); with canopy detached (top right); light distribution (bottom right)

(Figure 3) Section of bollard canopy, housing battery, PV cell, LEDs, and current regulator, as well as glass enclosure, which can be clear or tinted



the entrance, he added soft illumination around the perimeter to invite guests and visitors, and low-profile accent lighting on the plants in the plant beds. In the courtyard, Justin chose to use natural materials (copper), sustainable materials (LEDs contain no mercury), and low energy in the form of photovoltaic (PV). To create atmosphere, he added color-changing lighting for the glass block surrounding the hot tub, and to provide flexibility for the multiple courtyard activities—such as cooking, gathering, and hot tubbing—he supplied a portable lighting solution.

Justin's design is multifunctional. He created a custom luminaire that is flexible, portable, and sustainable—one that would recharge itself both by solar and electric power; and that would literally act as a lantern, able to be placed around the courtyard as needed, with a removable canopy that could sit on a table, hang from a wall via bracket or hook, or sit on a post top to illuminate a parking area. LED sources tucked up into the canopy of the luminaire reflect off the natural copper and cast a sunset hue on pavement or tabletop. (Figures 2-5)

Robert, Nancy, and Sandhya describe their roles as follows:

In Robert's words:

To create a visual environment that provides enough light and flexibility for the multitude of activities that take place, Robert considered the following:

#### Kitchen

For the kitchen, the design challenge was to be flexible with the lighting, while satisfying California's Title 24 energy requirements, and not allowing light to leak through skylights! First and foremost, we must know what our limitations are. Title 24 mandates that we use at least 50 percent high-efficacy lighting in the kitchen. Despite popular opinion, LEDs do not quite fit this description yet. This means 50 percent of the lighting wattage in this kitchen must be fluorescent. This is why most kitchens you see in California have recessed linear fluorescent lamps.

This sounds like a forced, but practical solution, except for one thing. This kitchen has no plenum, meaning that all our luminaires must either be wall-mounted, pendant-mounted, or track-mounted. Track lighting is fine for a

restaurant or a retail store, where specific things need to be highlighted, or for intimacy; but for this home, something a little more traditional is called for. Wall-mounted fixtures can be effective, as well as aesthetically pleasing, but high wall-mounted downlights scream outdoor lighting to me. Again, not something I'd want for a home interior. Thus, pendant lighting seemed to be the appropriate solution, but one that needed to be approached with care. Too few pendants can provide too little light, whereas, too many can appear cluttered and visually unappealing. Also, we had skylights to avoid and varying ceiling planes to manage.

We needed a solution that would provide ample light that could be directed onto the right places (sink, stove, countertop, etc.)—something subtle, that could almost blend with the ceiling. Speaking of the ceiling, I have a riddle. What do you get when you mix a dark, wood ceiling with a bunch of pendant-mounted downlights? An even darker ceiling! This will bring down the apparent height of the ceiling and almost make you feel like you're in

a cave. This is a lighthearted way of strongly suggesting that we need to shed some light on the ceiling as well.

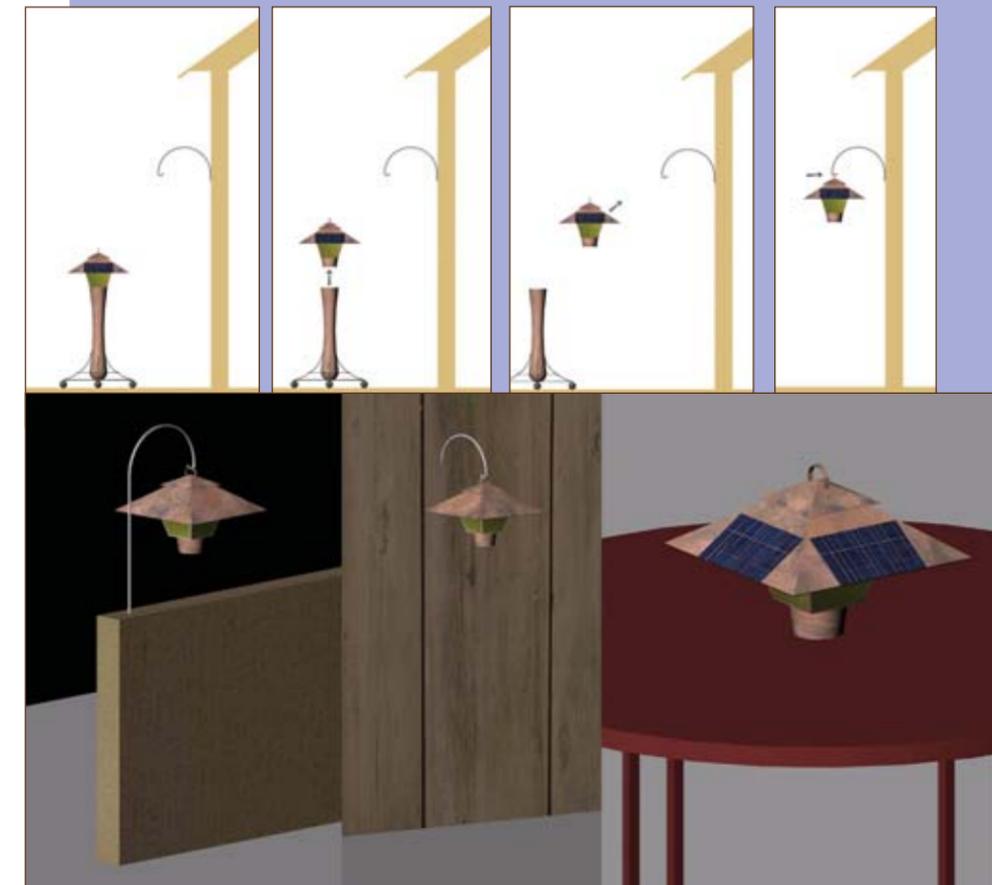
Since this is a unique problem, it requires a unique answer. We developed the design for a custom pendant fixture. This fixture is an H-channel fixture, which gets its name from its shape—from the side view it looks like an "H." This H-channel is 4 inches high and 3 inches deep. It has two sections, one for uplight and the other for downlight, or both uplight and downlight. Both sections are designed to house a T-8 linear fluorescent lamp, strip fixture, and remote ballast. However, not all sections will house all components—some of these sections may be empty, depending on the desired function of the fixture at a given part of the room. From the outside, this fixture will be configured to appear as a continuous unit around the contour of the room, following the run of cabinets and the shape of the kitchen island. It will have a finish to match that of the ceiling. All these details combine to make the fixture as unnoticeable as possible.

The kitchen island, shown in Figure 6, will have a glass surface around the outer edge for casual dining. We wanted to provide a lighting solution that would highlight the glass, as well as provide a warm and intimate dining experience, a situation in which fluorescent wouldn't work as well as incandescent. Taking into consideration the stainless-steel appliances, we chose stainless-steel incandescent pendants. This solution will match the theme, suit our mood-lighting needs, AND satisfy California Title 24 total wattage requirements. Figure 7 shows an overall view of the kitchen and master bedroom areas. (Did we mention that there are very few walls in this house?)

#### Master Bedroom Suite

The LRC has recently completed studies identifying lighting techniques that might make nighttime safer as well

(Figure 4) Progression from rolling base to free standing lantern



(Figure 5) Versatility of portable bollard; arm-mounted on parking area wall (left), on courtyard wall or outside garages (center), and with canopy removed from base to act as lantern on table top (right).



(Figure 6) View from dining room of kitchen and island featuring a universal design wraparound thick glass eating surface. The lighting fixtures complement the all-stainless-steel appliances.



(Figure 7) Plan view of kitchen area on the left and master bedroom on the right, with lighting zones highlighted in yellow.

out this has a lot to do with the amount of light our eyes get. I'm not going to go into the scientific details behind it all, but if you would like to learn more please visit: [www.lrc.rpi.edu/programs/lightHealth/overview.asp](http://www.lrc.rpi.edu/programs/lightHealth/overview.asp) (numerous fascinating articles can be found here on the subject). It was discovered that we can help regulate our sleep/wake patterns (and other daily patterns, for that matter) by adjusting light levels and exposure time. Another study revealed that blue light is up to 30 times more effective at achieving circadian response than white light (Figueiro, 2005). For these reasons, we specified an artistic LED light fixture that will be programmed to use only blue LEDs. Since the doses of blue light should not be given at bedtime, but hours before, we decided that locating

it on the Japanese soak tub wall would be a soothing and effective way to receive blue light therapy.

#### "Fitting Room"

Have you ever bought an article of clothing from a store because you fell in love with the color, only to find that it just wasn't the same when you took it home? This is not your eyes playing tricks on you. Different light sources provide different spectra, meaning that colors may appear different as you move them from one place to another. Although this next lighting idea isn't scientific or profound, it seems to make sense. Outside the master bedroom closet, there is a fitting area where three mirrored doors fold out to create a fitting room similar to ones you'd find in high-end



(Figure 8) In an area that acts as a fitting room, providing multiple lighting conditions allow the homeowners to see how they would look in different environments. Here, both high-color rendering and cool-color temperature fluorescent track heads contrast with warm halogen track heads. The track system accommodates both, so either or both can be used at one time; track heads shown are by Lightolier ([www.lightolier.com](http://www.lightolier.com)).

as help regulate sleep patterns. What better place to put these ideas to work than in the master bedroom suite? (I'll further explain what these lighting techniques are in a minute.) Thus, the lighting design concept for this room was to incorporate these techniques, plus a fun one, without diminishing any of the style the homeowners would expect from their bedroom.

The first lighting technique is being used more and more commonly in senior living facilities and is based on the fact that most accidents in these residences happen at night when people wake up to go to the restroom. Whether from walking to the restroom in the dark or searching for the switch in the dark, accidents are more likely to occur at this time. What we installed was a set of amber LED pathway lights leading people from the bed to the restroom. Why LED? This application is a perfect fit for them. They provide a moderate amount of light without consuming much energy. Why amber? There is a certain familiarity and warmth within the color amber. It provides a soothing and non-intrusive light that can guide you to the restroom without really waking you, like brighter or other colored lights might, and they will allow you fall back to sleep faster.

The next lighting technique deals with what is called your circadian rhythms. Your circadian rhythm is your daily 24-hour cycle. A general problem among older people is that they go to bed very early and they get up even earlier. Also, has anyone noticed how you feel more chipper during the spring and summer versus the winter? It turns



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clothing stores. What we did with this is provide a track-lighting system that offers light from the two most popular light sources: fluorescent and halogen incandescent (Figure 8). Ridding yourself of the "oh-so-familiar guessing game," you'll know just how you'll look under each lighting condition.

We also used a couple of lighting design techniques to add that touch of class that I previously said we shouldn't be without. The master bedroom suite has a set of French doors leading to the courtyard. We designed a valance above these doors to give a plentiful amount of high-color rendering fluorescent downlight that will make the colors in the room jump out at you. Also, to add to the character of the room, and in keeping with the sustainability theme, we specified energy-efficient Japanese cedar wall sconces to flank the wall-mounted widescreen flat panel HDTV. They will mount just above the in-wall loudspeakers.

Do you remember the answer to the riddle from the kitchen design? If you do, you might be wondering why we don't have uplighting in this room, despite the fact that there is a pitched ceiling. That is because directly above the bed is a large skylight that will allow people to view the stars while lying in bed. This adds a tremendous amount of character and romance to the room, and we didn't want to take away from that. We feel that all of these lighting ideas will make this room safe, fun, and elegant, all at once.

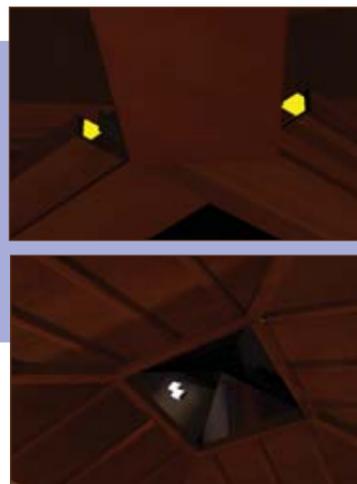
Nancy describes her concept:

Walking along the vestibule on the first floor, we reach another part of this house, which consists of the guest bedrooms on the second floor, and a library/home theatre/surround music room on the third floor, in addition to a guest bathroom, laundry room, and workshop on the first floor.

(Figure 9) Diffuse glass indirect pendant; style is compatible with other decorative luminaires throughout the home, and screwbase CFLs of appropriate size and color can easily replace the incandescent lamps specified. Note, however, that if the lamps aren't pin-based, they wouldn't qualify as high-efficacy under California Title 24, in which case the luminaire should be on a dimmer, requiring dimmable Compact Fluorescent Lamps (CFLs); a sloped ceiling adaptor for mounting is also necessary; pendant shown is by Arroyo Craftsman ([www.arroyocraftsman.com](http://www.arroyocraftsman.com)).



(Figure 10) Cove conceals LED strips, aimed to accentuate ceiling detail with an amber wash



### Guest Bedrooms

The homeowners naturally want to provide their guests with a feeling of warm hospitality by creating a pleasant guest bedroom that will accommodate visiting friends, relatives, business associates, and, possibly, future caregivers. The lighting should be welcoming, comfortable, and easy to control; and, it should be healthy and suited to all ages, as per universal design.

Bedroom lighting typically consists of some combination of pendants, table lamps, and swing-arm wall sconces. We chose the following for this home:

- Craftsman style, consistent with the classic tone of the whole house
- Diffuse yellowish shades to provide warm, soft ambient light
- A diffuse glass pendant that provides indirect uplight to protect eyes from the glare of the light source and enhance the lines of the sloped wood ceiling (Figure 9)

In addition:

- Way-finding light

Again, stemming from universal design principles, navigating the room safely is important. Imagine waking up, leaving the bed and walking to the bathroom during the night; the lighting should prevent you from falling or bumping into objects on your way. In other words, the lighting should guide you around the room without startling you, as turning on a typical light would do.

To achieve this, diminutive coin-sized, motion-sensor-activated LEDs are installed along the lower wall from bedroom to bathroom, providing an amber glow and turning on automatically when guests wake up and their feet touch the floor. The

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## Recommended Light Levels

The Illuminating Engineering Society of North America (IESNA) includes recommendations for various tasks within a home. For serious reading while seated in a chair, for example, the IESNA recommends 50 horizontal foot-candles (hfc) and 10 vertical foot-candles (vfc); for casual reading, they recommend 30 hfc and 5 vfc (Rea, 2000). This would determine the amount of light you provide for a chair in the library, for example, compared to a swing-arm lamp by the bed.

amber color is selected because it is closest to traditional incandescent, a familiar and comfortable source. In general, LEDs are easily controllable; they require a small profile driver, which controls the current supplied to the LED units, and in this instance their power supplies can be concealed in the guest room closets.

- Energy-efficient light sources

In the absence of a suitable ENERGY STAR® luminaire that uses pin-based Compact Fluorescent Lamps (CFLs), warm-toned CFLs, with a correlated color temperature (CCT) of about 2800 kelvin (K), replace incandescent lamps in luminaires whenever possible.

## Deck

A covered deck extends across both guest bedrooms. To accommodate the zero-light pollution policy—no light aimed upward—light is contained within the deck. Wall sconces with opal glass shades provide a warm, diffuse light. The four wall sconces, two outside each guest bedroom door, can be controlled either independently or all together by guests in each bedroom.

## Library/Home Theatre/Surround Music Room

Books can spark ideas, and good lighting is the best tool in that regard. Since your eyes play such an important role, the lighting in the library must be sufficient for reading. The library's area is not large, but seems so because of its high pyramid-shaped ceiling capped by a skylight. We chose to use:

- Floor lamps—shaded floor lamps are ideal since they shield readers' eyes from the light source while directing the light where it's needed for reading

- Bookshelf lighting—two-headed luminaires that provide indirect uplight and wall washing at the same time; books on the shelves are illuminated, and the ceiling is also accented indirectly

- Wall sconces—wall sconces emitting soft, warm light enhance the ambience of the library

- Ceiling—the skylight, admitting abundant daylight during the day, becomes dark at night, as does the ceiling around it. From an aesthetic point of view, the ceiling should be softly lit. Amber lighting is designed to wash down from the four sides of the skylight along the ceiling surface and present a gradient of brightness, enhancing the sophisticated structure of the warm wood ceiling

To respect The Sea Ranch policy on light pollution, a narrow wood cove is located at the seam where skylight meets ceiling. Low-profile, high-output amber LED strips are concealed within the cove to shield a direct view of the light source and to prevent light from escaping through the skylight (Figure 10).

## Library Gallery And Library Staircase

The library staircase is a prominent link between the guest bedrooms and the library; therefore, it needs to be safe, attractive, and carry the theme from one room to the next. For older adults, providing contrast at transition points is essential. Ambient light alone can project disturbing shadows on the floor, so LED strips emitting diffuse amber lights are mounted under the nose of each step. The amber glow is consistent with the LED coin lights in the guest bedroom and the cove light illuminating the library ceiling, providing a subtle continuity between the living area and the study area (Figure 11).

The wall along the staircase from the ground floor to the library acts as a gallery where art pieces are exhibited. Traditional artwork lighting applies warm (low CCT) halogen MR16s to accent the artwork. Here, to create a deliberate contrast between the lighting on the artwork and the warm lines of light at each step up to the library, cool LED MR16s (high CCT) accent the artwork (Figure 12).

## Car Garage And Boat Garage

To illuminate the car garage and boat garage, the idea is to provide uniform lighting that minimizes shadows around the vehicles and allows one to work in the space. So, the lighting in these non-living areas should be simple and efficient. We've chosen fluorescent sources for the two garages, which have higher energy-efficiency and long life; opal lenses conceal glare from the light sources. And, just for fun, we've mounted a whimsical low-voltage nautical-looking lighted "rope" (Boalum by Artemide) to the wall for some boat garage art!

Sandhya says:

When we first started on the project we only had plans, some basic interior elevations, an overall view of the site, and very good input from the clients. So we started by imagining a lot of things and soon we realized that we needed some solid drawings to look at. The pitched ceilings were very difficult to visualize without 3-D drawings. We started the project by creating a 3-D interior view using AutoCAD. Then we used

Lighting Analyst's AGI32 software to test and experiment with our lighting design.

## Living Room And Dining Room

Though the living room, dining room, and kitchen areas are part of a single, big space, all the areas have a character of their own. For example, the living room has a dynamic ceiling, stone fireplace, and Earth Weave wool carpeting, while the dining room has a high ceiling and Kährs wood flooring, and the kitchen has a partially sloped ceiling and Evergreen natural slate flooring. It was necessary to design each space individually, without losing the continuity of the whole area.

To design the lighting for a ceiling with more than five different planes and two big king post ceiling trusses was a challenge in itself. This complicated, yet beautiful, ceiling gave us a very good opportunity to bring out the form and architecture of the building. The seam of the hip and valley beams (where the ceiling changes plane) was highlighted using unobtrusive low-voltage accent lights near the wall plate. The warm color of halogen was used to bring out the richness of the honey brown wood ceiling. The main problem that we faced while selecting luminaires was that the ceiling had no plenum, so we had to select luminaires that are small and could be tucked behind the beams. We grazed the stone texture of the fireplace using discrete, adjustable low-voltage monopoints. In addition to the architectural lighting, we used decorative wall sconces and downlighting to create a magical and warmly lit environment. Prairie-style wall sconces that coordinate with the dining room chandelier within view enhanced the intimacy of the window seats and complemented the overall interior design theme. The wood door that conceals the six-foot wide Stewart Filmscreen® CineWide rear-projection screen, when not in use (not shown in rendering), is washed with soft accent light (Figure 13).

The multi-use living room has a very special place in this house. Sometimes it will be used as a very private and intimate space for reading books; other times it will be used for watching movies on the state-of-the-art performance home theatre system, while sitting on the D-BOX®/Fortress Seating "kinetic" sofa and enjoying a beverage; sometimes it will be used as a family gathering space; and other times it will be used for entertaining guests. So, our challenge was to design lighting for these different scenes or moods.

Most of it can be achieved by dimming the light levels using controls; the rest by simply turning off certain fixtures. For example, for a very private and intimate use of the window seats for reading, the wall sconce for task lighting and the downlight for ambient lighting can be turned on and dimmed. This can save energy without sacrificing functional or aesthetic needs, and also complies with California Title 24.

The same is true for the dining room, where different scene

Figure 11. View from the lower floor up to the library ceiling and skylight.

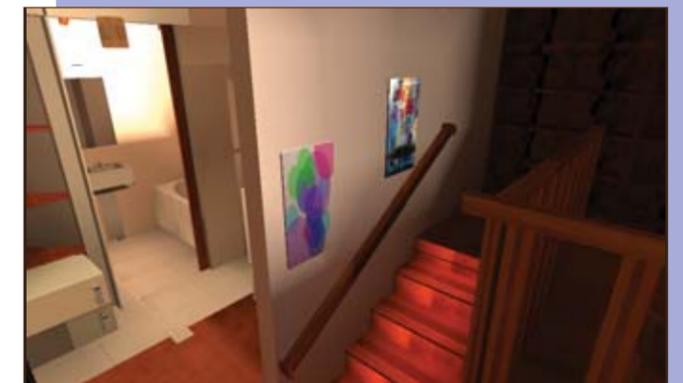
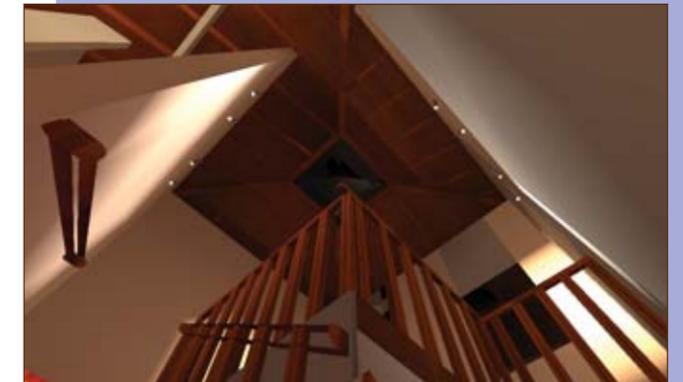


Figure 12. Contrast between cool lighting on artwork and warm amber light delineating stairs.



(Figure 13) Rendering of living room and dining room, showing the many planes of the beautiful wood ceiling; the soft grazing of the beams at the seam as one ceiling plane meets another, the accent lighting on the stone fireplace wall, general downlighting on the sofa and chair; the prairie-style dining room chandelier; the coordinating sconces above the window seats, and the subtle downlighting onto the table from the accent lights above.

settings, ranging from a very private and intimate setting to a party setting, can be created at the touch of a button, by turning off or dimming the lights. In this area, the prairie-style chandelier provides ambient light but also makes a statement as part of the furnishings of the room. Its height is lowered to about 30 inches above the table to reduce the scale of the massive dining area and to create a more intimate space. The recessed low-voltage downlights at either end of the table do the real work; they will not only add sparkle to china, crystal, and food, but will reflect off the table to make the people seated all around look great, which is the most important consideration in most situations—it's always about the people first. Another focal point here is the use of LED strips within the china cabinet to call attention to the objects on display.

### Luminaire And Product Selections

The manufacturers we've selected for this lighting design are numerous and varied due to the specific, sometimes custom, solutions required throughout the home. The driving factor behind most choices was the appropriateness of the luminaire for the area it would light, and the quality of its performance, based on our experience with the product itself or the reputation

of the manufacturer. While hundreds of similar luminaires say they do the same thing, not all actually do. For an adjustable low-voltage accent light, for example, the ability to add accessories, such as lenses and louvers, is important. Without those options you are limited in your ability to finesse the design. It's often said that the devil is in the details—and nowhere is that more evident than when selecting a solution that simply won't fit, adapt, or adjust as you'd intended. The type of lamp (bulb) it accepts, its range of adjusta-

### How this lighting design addresses the following:

- Sustainability—use of LEDs, which contain no mercury; use of natural materials when possible, i.e. the copper construction of the portable bollard
- Universal Design—location of switches: not higher than 42 inches above the floor and in accessible locations, not hidden behind appliances or cabinets; wide toggle design for easy manipulation; aging eye considerations such as shielded light sources, way-finding lights in bedroom/bathroom areas; down-lighting integrated into grab bars; blue light wall tile for circadian regulation
- LEED For Homes—energy-efficient lighting, including ENERGY STAR fixtures, where appropriate; controls, such as dimmers, motion, and occupancy sensors
- California Title 24—50 percent lighting in kitchen area must be high efficacy, which is defined as pin-based compact fluorescent lamps (CFL) with electronic ballasts (achieving a minimum of 50 lumens-per-watt for wattages higher than 40); lighting in bathrooms, garages, laundry and utility rooms must be on manual on occupancy sensors; all other rooms may use incandescent or low-efficacy sources, but they must be on dimmers
- Advanced Technology—use of LED sources where appropriate, i.e., where linear lighting in tight spaces is warranted, where use of color is desired, where easy controllability is necessary

bility, type of optics, the ability of a socket within a fixture to hold the lamp captive, or the ability to maintain a fixed focus, characteristics of ballasts and transformers, sharp or roughly finished component edges, non-corrosive materials that withstand weather and soil elements over time—all are factors that affect the performance and durability of fixtures, and all will affect the long-term maintenance and integrity of a lighting design.

Minimizing the number of manufacturers and products simplifies purchasing and maintenance for the homeowner. Whenever possible, we tried to use as many offerings from one manufacturer as possible to satisfy multiple applications. However, meeting the many criterion before us resulted in a somewhat long, not-so-simple list, especially since there are custom items involved.

Selections for this project include, for example: the custom H-channel designed for the kitchen—Robert selected the Lutron ballast that would operate multiple lamps quietly, with

minimal interference to other electronics. Also for the kitchen, Alkco's T5 fluorescent under-cabinet luminaire because it has a relatively small profile, uses a high-frequency electronic rapid-start ballast, and premium long-life lamp (20,000 hours) with good color rendering. Lightolier's stainless-steel pendants were chosen for their light distribution, and also to complement the stainless-steel appliances and have a presence over the island; Arroyo Craftsman and Kichler presented several beautiful options for the prairie-style pendants and sconces throughout the house; Cooper Lumière's low-voltage exterior luminaires are of small enough scale to be unobtrusive in the planting beds, can be aimed downward onto the plants, and allow remote location of transformers; their wall-mounted exterior luminaires work well over the outdoor kitchen grill and sink because of their extension lengths, variety of lamp choices, ability to accept accessories, and non-corrosive composition; Color Kinetics' LED systems satisfy size, color, and light output requirements for the library ceiling cove, and the blue tile in the master tub; io® Lighting's luxrail integrates LEDs right into handrails and grab bars

for the master vanity and bathroom, and supplies photometric files to evaluate distribution; OSRAM SYLVANIA has many choices for LED strips on stairs, LED coin lights in guest bedrooms, and glass tile lighting system around the hot tub; Rejuvenation's custom fixtures provide good options for up and down-light on library bookshelves and guest and powder bath vanities; Sea Gull Lighting's surface-mount ENERGY STAR fluorescents for closets and pantry, and copper top pendants and sconces for vestibule, hallway, and dog run; Lightolier cedar sconces are energy-efficient and add to the natural warmth of the solarium and master bedroom; Lightolier track along with halogen and CFL track heads complete the fitting area; Lightolier's Lytutube for the suspended indirect/direct fluorescent system for the home office; W.A.C. monopoints, with electronic transformers remotely located, to maintain a smaller profile and help them "disappear" into the wood ceiling of the living room.

A fixture schedule detailing all selections, including the following manufacturers, was part of the final set of documents delivered to Gary and Marlene upon completion of the lighting

design. There are cases where product substitutions are acceptable, upon approval by the lighting design team, and there are cases where no substitution is recommended. As you can see, each luminaire chosen is not just another pretty face—each has a clear reason for being.

### Final Comments

The design details for many other areas—such as the home office, projection rooms (living room and Optimum Performance Home Theatre™), workshop, laundry room, utility room, and dog run—are not addressed here or this article would never end—but each has its unique solutions. Halfway through design development, there was a noticeable change in tenor regarding the students' interest toward this project. From merely developing a lighting design as an assignment, it became personal and they began living and breathing the challenge. They wanted to truly integrate lighting that would make a difference, for those who would live there, into the many facets of this home. Their determination to pull this together, to deliver not only interesting concepts

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but the details and documentation to go with them—dominated their days and nights as the semester neared its end—no small task since they were in the throes of finals and other project deadlines. They found themselves questioning some of the existing standards (always a good thing) and seeking answers to questions they didn't even know they needed to ask. They've learned a great deal, are grateful for the opportunity to have been part of such a significant project and design team, and look forward to seeing their 3-D visualizations come to life. **UHD**

Alkco	Kichler
Arroyo Craftsman	LED Dynamics
Artemide	Lightolier
Bega	Lutron
Color Kinetics	OSRAM SYLVANIA
Cooper Lighting/Lumiére	Power Sonic
Gardco Lighting	Rejuvenation
Cooper Lighting/HALO	Sea Gull Lighting
Hubbardton Forge	Tech Lighting
IC Lighting	W.A.C.
io Lighting	

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Gary Reber, Editor-In-Chief & Publisher

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Rui (Nancy) Qi currently holds a bachelor's degree in Material Science and Technology and a master's degree in Sustainable Energy Systems. She enrolled in the Lighting Research Center to continue her education in pursuit of her MS in Lighting to build on her professional experience and personal interests in the area of lighting technology. Prior to the Lighting Research Center, Rui's work experience includes two years at the Chinese National Lighting Testing Centre in China.

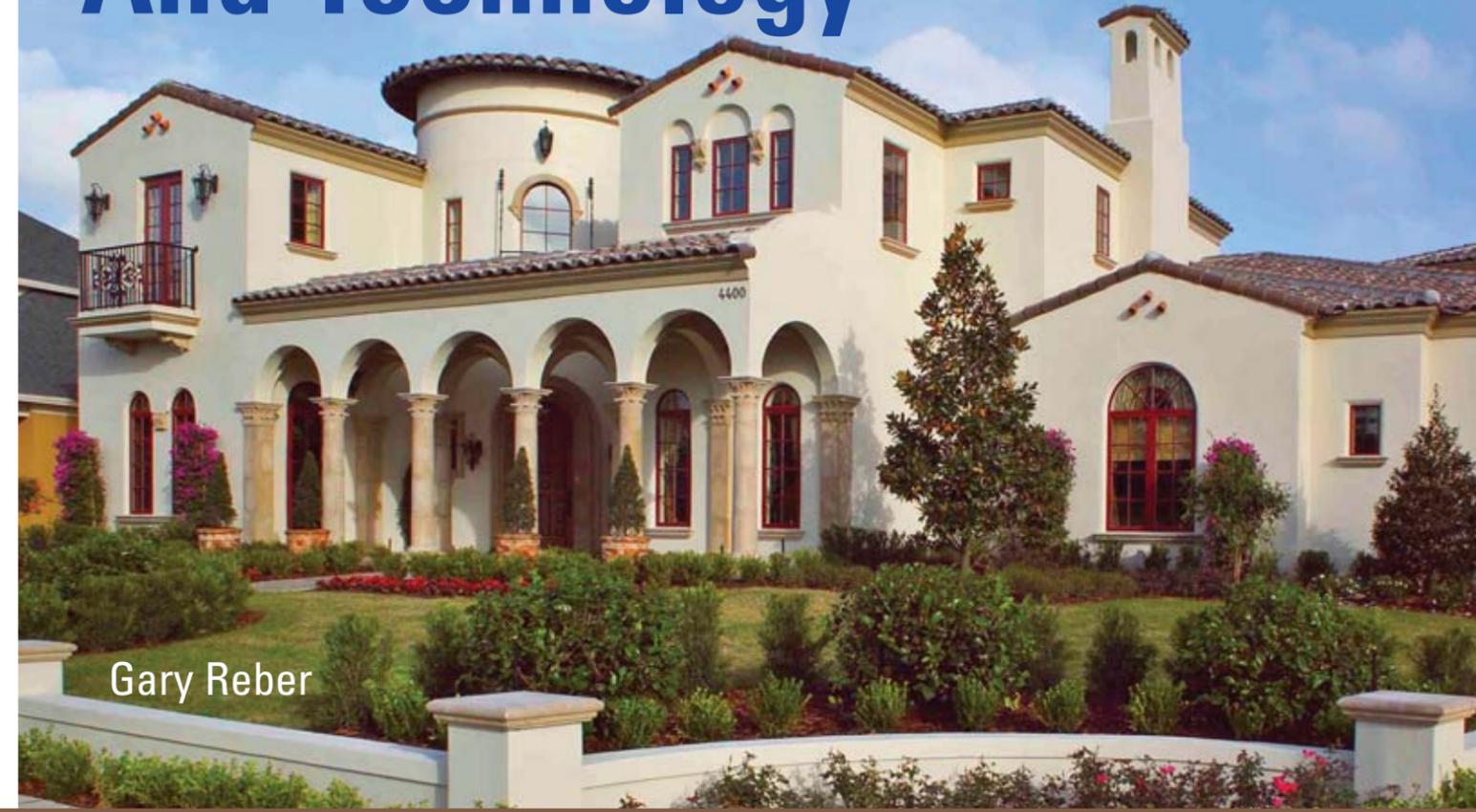
Robert Soler entered the Lighting Research Center with a bachelor's degree in Electrical Engineering from California State Polytechnic University. Robert's "true passion" is illumination. Since the completion of his undergraduate studies, Robert has continued to complete continuing education and professional development courses related to lighting controls for energy management and daylighting controls.

Justin Bosa, who is completing his fourth year undergraduate work in architecture at the Rensselaer Polytechnic Institute, was part of the graduate-level Lighting Design class who mastered this project.

#### Product Information

- ALKCO, 11500 Melrose Avenue, Franklin Park, Illinois 60131, 847 451 0700, www.alkco.com
- Arroyo Craftsman, 941 Cernan Drive, Bellwood, Illinois 60104, 708 547 5757, www.arroyocraftsman.com
- Artemide, 1980 New Highway, Farmingdale, New York 11735, 631 694 9292, www.artemide.us
- BEGA-US, 1000 BEGA Way, Carpinteria, California 93013, 805 684 0533, www.bega-us.com
- Color Kinetics Incorporated, 10 Milk Street, Suite 1100, Boston, Massachusetts 02108, 617 423 9999, www.colorkinetics.com
- Cooper Lighting/Lumiére/HALO, 1121 Highway 74 South, Peachtree City, Georgia 30269, 770 486 4800, www.cooperlighting.com
- D-BOX Technologies, Inc., 2172 Rue de la Province, Longueuil, Québec, Canada 450 442 3003, www.d-box.com
- Earth Weave Carpet Mills, Inc., P.O. Box 6120, Dalton, Georgia 30722, 706 278 8200, www.earthweave.com
- Engineered Environments, 1250 Marina Village Parkway, Alameda, California 94501, 510 521 7500, www.engenv.com
- Fortress Seating, 11969 Arrow Route, Rancho Cucamonga, California 91739, 909 483 6092, 800 873 2828, www.fortresseating.com
- Gardco Lighting, 2661 Alvarado Street, San Leandro, California 94577, 512 753 1000, www.sitelighting.com
- Hubbardton Forge, 154 Route 30 South, Castleton, Vermont 05735, 802 468 3090, www.hubbardtonforge.com
- IC Lighting/ImageCrafters, Inc., 7 Jewett Hill, Ipswich, Massachusetts 01938, 978 356 6260, www.imagecraftersinc.com
- io Lighting, 370 Corporate Woods Parkway, Vernon Hills, Illinois 60061-3107, 847 735 7000, www.ioighting.com
- Kichler Lighting, 7711 East Pleasant Valley Road, Cleveland, Ohio 44131-8010, 866 558 5706, www.kichler.com
- LED Dynamics, P.O. Box 444, 44 Hull Street, Randolph, Vermont 05060, 802 728 4533, www.ledynamics.com
- Lightolier, 631 Airport Road, Fall River, Massachusetts, 02720, 508 679 8131, www.lightolier.com
- Lutron® Electronics Company, Inc., 7200 Suter Road, Coopersburg, Pennsylvania 18036-1299, 610 282 3800, 800 523 9466, www.lutron.com
- Osram Sylvania, Inc., 100 Endicott Street, Danvers, Massachusetts 01923, 978 777 1900, www.osram.com, www.sylvania.com
- Power Sonic, 7550 Panasonic Way, San Diego, California 92154, 619 661 2020, www.power-sonic.com
- Rejuvenation, 2550 NW Nicolai, Portland, Oregon 97210, 888 401 1900, www.rejuvenaqtion.com
- Sea Gull Lighting, P.O. Box 15114, Seattle, Washington 98115, 206 526 9393, www.seagullighting.com
- Stewart Filmscreen® Corporation, 1161 West Sepulveda, Torrance, California 90502, 310 326 1422, 800 762 4999, www.stewartfilm.com
- Tech Lighting, 7400 Linder Avenue, Skokie, Illinois 60077, 847 410 4400, www.techlighting.com
- W.A.C. Lighting, 615 South Street, Garden City, New York 11530, 516 515 5000, www.waclighting.com/USA

# InSync Home Brings Balance To Living And Technology



Gary Reber

At this year's International Builders Show (IBS), attendees had the opportunity to view the latest in innovative whole-house lighting and audio, with the unveiling of the new InSync Home. The two-story, 6,500-square foot house in Orlando's exclusive Baldwin Park community was designed by architect Bobby Morales of Morales-Keese Design Associates and features a range of leading-edge technologies, including state-of-the-art integrated lighting and digital audio systems from Loveland, Colorado-based Colorado vNet.

*BUILDER Magazine*, which sponsors the annual home builders' showcase to coincide with IBS, teamed this year with *Home* magazine, opening the event to more than four million subscribers in the builder and residential homeowner markets. Unlike the typical open house, the InSync Home was not open to the general public.

Behind the home's inspired architecture, an integration of low-voltage technologies offered up a new level of control over

lighting and distributed digital audio to every room in the house, employing Colorado vNet's integrated lighting control and Vibe™ audio systems. The system, designed and installed by Winter Park, Florida-based Wilson Technologies, is the result of comprehensive research into what today's homeowners really want.

"We put together several focus groups, before the ground was even broken, and asked people from a wide range of backgrounds and demographics what they looked for in residential technology," reports company president David Wilson. "The common thread throughout was simplicity in design and ease of use. Everyone wants technology to be more in sync with their lifestyles. It's all about connectivity, about convenience, and about intuitive control. The technology has to serve a purpose and adapt to the user. No one wants to have to re-educate themselves to basic tasks we take for granted."

As Wilson explains, the goal in designing the InSync Home systems was to create something that would serve to inspire