InteriorDesign-ED

Lighting and Daylighting

4 hour CEU

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Lighting and Daylighting Handouts

Welcome to our seminar!

I. There are 2 forms of Light
   a. Natural Light which is derived from the sun and are beyond our control
      1. Sunlight
      2. Clear sky
   b. Man made light which was created by humans and which we can control
      1. Fire
      2. Electric light - which has displaced most all other man made light because it is cheap, clean, safe and flexible to use

II. The Spectrum of Light includes all the visible colors which can be seen in a rainbow or prism:
   a. 3 primary colors of light are red, blue and green and
   b. 3 secondary colors of light are cyan, yellow and magenta

III. Two Measures of White Light
   a. Color Temperature is a measure of the color appearance of a light source which help describe the apparent "warmth" (reddish) or "coolness (bluish) of that light source and has nothing to do with temperature
      1. Color Temperature is measured in Kelvin and 3000 K is considered good light for Residential use
   b. CRI – Color Rendering Index measured a lamp's ability to render colors accurately and describes the quality of light on a scale from 1 (horrible light) to 100 (natural light which is considered perfect) -90+ is considered a good CRI

IV. Main Types of Electric Lamps
   a. Incandescent lamp – standard light bulbs which have long been the typical lamp of the Residential market – have good color temperature for Residential use- 2700 K , can be easily dimmed, operate in nearly any position and start up instantly but are inefficient giving off 10-17 lumens per watt and lasting only about 750 hours - 1000 hours
      1. Halogen lamps are form of incandescent lamp that are more efficient, lasting about 2500 hours and giving off 15-25 lumens per watt and have brighter light 3000K-3500 K – they can be dimmed, operate in any position, start up instantly & offer more beam control than standard incandescent
      2. Low Voltage are small incandescent lights (MR 16's and others) that need a transformer to convert standard 120 volts to 12 volts- provide directional light with better CRI & superior beam control than incandescent or halogen

b. Fluorescent Lamps –workhorse lamps for commercial and institutional buildings
    1. Old fashioned Straight tubes and U bent lamps are inexpensive commercial lamps
    2. CFL's are new miniature versions of fluorescents that were intended to replace incandescent lamps –come with either screw in bases or are made to fit in CFL fixtures –have higher efficacy, use less energy, emit less heat, give off 40-70 lumens per watt and last 5-6 times longer than incandescent approx. 8000 hours, can have 80+ CRI and now come in a variety of good color temperatures for Residential use – they also reduce CO2 emissions
c. LED lamps – meet the latest standards, embrace the green ethic, are the lights we now use because they are very energy efficient and experts have finally fixed their color to be more like the original incandescent lamp color that we love. LED lamps are the future of light
    1. Have higher efficacy, use much less energy, emit much less heat, give off many more 50-75 lumens per watt, last much longer (50,000+) hours than any other lamp made today. And now have wide range of color temperatures suitable for both Residential and Commercial use and can be retrofitted in most lamps - are much less expensive than they used to be
d. HID lamps –are designed to emit a great deal of light from a long life light source; and have Residential and Commercial applications where someone wants a low maintenance light; examples are Metal Halide which gives off a good white light and are used for landscaping, Mercury Vapor which gives off a bluish light and are used for landscaping, and Sodium Vapor Lamps which have poor color temperature giving off a yellow light so aren't suitable for Residential use but are used for Commercial use such as gyms and warehouses and street lights - good where an inexpensive large amount of light output is more important than Color Temperature or design
e. Neon and Cold Cathode Lamps –colored light signs that last 20,000 to 40,000 hours and can be dimmed and even flashed on and off without affecting lamps life

V. How an electric lamp operates determines virtually everything about the quality of And light it produces
    a. Incandescent lamps operate by having a filament heated until it glows – therefore generate more heat than light -and are energy inefficient
    b. Fluorescent lamps generate light by running a low pressure electric discharge through mercury which causes the mercury to glow or fluoresce transforming the ultraviolet energy inside the lamp into photons or visible light without much heat

being created so are energy efficient - but have a fatal flaw in that the mercury inside is toxic and can emit harmful fumes if the lamp is broken

c. LED lamps are light emitting diodes or semiconductors that convert applied voltage into energy which is released in the form of photons or units of light and are very energy efficient
d. HID – High Intensity Discharge Lamps are vapor lamps that operate by having a current passed through a metal vapor in the glass capsule causing free electrons collide and radiation to be emitted which produce light. They need a ballast to operate so are not as easy to use as lights that don't require ballasts. Metal Halide Lamps are one form of HID lamp
e. Neon Lamps operate by having high voltage power pass through an inert gas - neon inside its capsule which is negatively charged at one end and positively charged at the other end, causing all the atoms and electrons to collide and creating red light and heat. If Argon is used rather than Neon – blue light is produced instead

VI. Lamps can be selected based upon many criteria
    a. Purpose – Area Task and Accent
    b. Shape – 2 main shapes are "A" blubs and "PAR" or Reflectors
    c. Lamp size – small or large
    d. Lamp temperature – how hot lamp can get
    e. Voltage – 120 volts Residential, 277 volts Commercial vs Low voltage 12 volts
    f. Energy Efficiency – efficacy; measured in lumens per watt – the higher the better
    g. Dimming Characteristics - process by which lamps are operated at less than full light – done either to create a desired mood or as a Green energy saving method or both – incandescent and halogen lamps can be dimmed and now fluorescent and LED lamps can be dimmed as well
    h. Whether they require a ballast or transformer
    i. Starting up, warming up and restarting
    j. Operating position –some lamps have a longer lamp life when operated in specific positions with respect to gravity
    k. Operating Temperature – some lamps ie fluorescent lamps are temperature sensitive and won't operate if too hot or too cold

VII. Choosing Luminaires and Light Fixtures
    1. A luminaire is any device that includes a lamp holder and the means of electrification /support for that lamp holder ; it can be either attached or unattached to a building
    2. A light fixture is a type of luminaire that must be permanently attached to a building; so an unattached table lamp is a luminaire but not a light fixture
    3. 6 Types of Luminaires

1. Direct luminaires=downlights: emits light downward; includes most types of recessed can lighting – principal use is general illumination
   a. Recessed cans and Pendants for Residential use
   b. Troffers– lens troffers, parabolic troffers and recessed indirect troffers provide general light for Commercial use: primarily offices
   c. Commercial Fluorescent Fixtures provide inexpensive lighting
   d. Linear Lighting Systems – are assembled in patterns for offices
   e. CFL Downlight Fixtures

2. Indirect luminaires=uplights: emits light upward, bouncing light from the ceiling back into a space
   a. Sconces
   b. Tortiers
   c. Cove Lighting – Xenon, LED Rope lights, Micro-fluorescent fixtures
   d. Indirect Fluorescents - which are suspended for Commercial use

3. Diffuse luminaires= ambient lights: emits light in all directions uniformly
   a. chandeliers, pendants, ceiling drums, close to ceiling luminaires, nondirectional sconces and coach lights – which all can be decorative

4. Direct/Indirect luminaires: emits light upward & downward but not to sides
   a. Many types of suspended luminaires and some table and floor lamps

5. Accent Lighting
   a. Asymmetrical Luminaires - designed to highlight particular objects and has a larger distribution of light in *one* directions - ie wallwashers and eyeballs
   b. Adjustable Luminaires - which can be adjusted to throw light in numerous directions other than down ie track lights and flood lights
   c. Architectural Luminaires – which highlight Architectural Details

6. Decorative Lighting – "the jewelry of architecture" chosen to create design and ambiance and to call attention to itself
   a. Chandeliers, Pendants, nondirectional sconces, lanterns and coach lights

VIII. Layers of Lighting

1. In order to create a lighting plan for a room – one must use several layers of lighting which can work together to create the correct ambiance for the room and also create functional lighting for the entire room
2. Layers of lighting combine to make a composition
3. Each layer has unique responsibilities to light certain tasks
4. The lighting layer includes:
   a. The Ambient Layer which is general lighting
   b. The Task Layer which illuminates a specific area

c. The Decorative Layer – to catch the eye and make a statement
d. The Focal Layer – accent lighting
e. The secret is learning how to combine light layers to add drama and style without adding too many lights, particularly too many types of lights, which can be visually busy or too few lights which will leave the space dark

Daylighting

I. Daylighting is practice of using natural light (especially indirect light) to illuminate building spaces rather than relying solely on electric lighting during the day

a. Reduces need for electric lighting
b. Connects people to the outdoors
c. Provides pleasing illumination at a fraction of the cost of the most efficient electric light
d. Goal of Daylighting is to supply sufficient high quality light as deep in to a building as possible enabling visual comfort throughout the building while controlling thermal comfort and surface brightness within the users flied of vision minimizing direct glare, veiling reflections, and excessive brightness ratios
e. Daylighting is not a new concept – used in 14th C Churches and 16th C English manor homes
f. Hazards of Daylight
    a. Heat gain, Glare, Low contrast, Damage to art, fabrics (especially curtains), furniture, flooring and other materials, excessive brightness from window light

II. Principles of Daylighting Design

a. Begin by planning the building so that every occupied space has access to a source of natural light, such as a windows or skylights - giving special attention to windows that provide a view
    1. Reduce the size of the east and west sides of the building
    2. Maximize south and north sides of the building
        a. North-facing windows present no solar heating problems
        b. South-facing windows are the easiest to protect with overhangs, awnings, and light shelves

III. Our ability to see and perceive detail is influenced by many factors

a. Physiological Factors
    1. Size of object – the bigger the more visible
    2. Time – the more time allotted, the better

3. Contrast – difference between brightness of object and its immediate background
4. Brightness

b. Sky conditions

c. Building Orientation

d. Weather Conditions

e. Climatic Conditions

f. Individual needs of specific building and its inhabitants

ie some buildings like schools need more light than others like gyms

IV. Daylighting Strategies vary with sky conditions: Direct sun, clear sky, overcast sky and partly cloudy sky

a. Direct sunlight is very bright and has glare; concerns are to maximize light entering building while minimizing radiant heat and to minimize glare and excessive brightness

b. Clear Sky is very bright: concern is to maximize the light entering the building while minimizing the radiant heat

c. Overcast sky is diffuse indirect sunlight: concern is to insure that user has enough light

d. Partly Cloudy Sky has constant changes: concern is insuring that users light is consistent

V. Daylighting Strategies vary with Building Orientation

a. Sun rises in the East and sets in the West

1. Spaces facing these directions have the potential for direct sunlight exposure in mornings and evenings of every day

b. Living in the northern hemisphere means that the sun will always arc across the sky to the south

1. This means that south facing spaces have the potential for direct sunlight all day, while north facing spaces will receive exclusively clear sky light
2. Therefore, north facing windows present no solar heating problem, while south facing windows need to be protected with passive elements like exterior shading devices
3. While in winter, it is fine to introduce as much sunlight as possible, in summer it is best to introduce only as much daylight as can be effective

VI. Daylighting Strategies vary with Weather conditions

a. Outside influences: Sun, wind, light clouds

b. Inside influences: windows, doors, skylights and walls

VII. Daylighting strategies are needed for each of for 4 different Climate types with 4 seasons in each and 17 different climate zones

a. Hot Humid Climates : Turn your back to the sun: control direct sunlight and heat, maximize cross ventilation and control glare use large North windows and use solar controls on east and west sides – mitigate light on south side

b. Hot- Arid Climates: Similar to Hot- Humid but need even more controls

c. Temperate Climates: Permit greater flexibility - can use large expanses of un-shaded glass and louvered doors for shade

d. Cool/Cold Climates: have seasonal changes and rapid temperature changes can have more and larger daylight openings on east south/west sides of building for heat gain in winter – minimize glass on north side to minimize heat loss

IX. Daylighting Design Criteria

a. Avoid Direct Sunlight and Sunlight on critical tasks

b. Bounce Daylight off surrounding surfaces to diffuse light in more even brightness patterns

c. Bring Daylight in from above to obtain deeper penetration

d. Filter daylight to avoid harshness of direct sunlight and skylight

e. Maximize ceiling heights to gain better light distribution

f. Use design strategies that separate View glass from Daylight glass

g. Develop appropriate control strategies ie dimmers

h. Building geometry and spatial arrangements should promote rather than preclude distribution of daylight

i. Buildings should be massed and configured so maximum number of spaces are near daylight

X. Daylighting Strategies

a. Properly designed daylighting strategies screen out 99% of sun's heat while providing 50 foot candles of light

b. Heat is a function of amount and quality of light

1. 50% of solar radiation is infrared which provides only heat – not light
2. Light off clouds or from clear blue sky is diffuse, has smaller proportion of infrared and therefore higher efficacy
3. Direct sunlight is directional and extremely bright

c. Shading in form of external awnings, porte cocheres, overhangs, and internal solar shades, window film and curtains is advisable on south, west and east sides of building – not north because it can reduce effective daylight

d. Rooms are divided into 3 zones front area nearest windows, middle of room and rear of room – light from sky may light front area near windows 100%, center of room 60% and rear of room only 10% to we must balance that light and bounce it into rest of space or use artificial light to get 75% daylighting throughout to get L.E.E.D. point ... we can do this using:

1. Vertical strategies – side-lighting for Northern exposures in warm climates and Southern exposures in cool climates which need to be shaded with soffit overhangs, awnings or light shelves to minimize excessive glare and heat gain
    a. Clerestory –high windows
        1. 7’ above floor – great for southern, western and even eastern exposures in South
        2. Allows in just the light but not the glare and not as much radiant heat
        3. Bounces harsh direct daylight against beveled shelf surface to convert it into softer indirect light and spread it throughout room
2. Horizontal Strategies – top-lighting for eastern and western exposures
    a. Good for distributing light on top floor or few floors of building
    b. Can get deeper penetration into space than can be achieved from sides
    c. Can be in form of solar tubes, skylights, or roof monitors
        1. Solar tubes introduce light from hole in roof and create continuous illumination for entire space
        2. Skylight is most common top-light
        3. Roof Monitor is a flat roof raised about an adjacent roof with vertical glazing on all sides of raised bay
            a. Sawtooth roof is a roof of leaves or louvers

XI. Daylighting Controls

a. Electric lights must be switched off manually or automatically or dimmed

XII. Daylighting Pros and Cons

a. Gives 6 times the light of incandescent lamps & 2 times light of fluorescent
b. Gives endorphins which makes people feel great
c. Conflicts with energy efficiency and structural cost
d. Has a bluish color temperature – which is not what we like for Residential use

Biography

Beverly Vosko, RID, ASID (Allied Member), CAPS, L.E.E.D Green Associate, CGP (Certified Breen Professional), TAID, MBA… is a "Full Service", Registered Interior Designer in Texas #6333. She is President and founder of both Beverly Vosko Interiors, and InteriorDesign-ED; both DBA's for C. V Design Inc. For over 25 years, she has been designing homes across the United States and Europe, specializing in creating custom Residential and Commercial environments, be they Traditional, Transitional, Contemporary or Eclectic, that match her Design clients' every need, through her Design Firm, Beverly Vosko Interiors. For nearly 20 years she has taught Interior Design, Aging in Place, Green/Sustainable Design, and Antiques at Rice University, the University of Houston, and for the last 10 years nationally, with her Continuing Education company, InteriorDesign-ED. She graduated Phi Beta Kappa, Magna Cum Laude from the University of Pennsylvania, studied Art History at Harvard University, received her MBA in Marketing from NYU Stern Graduate Business School, and her Design and Antiques training from Sotheby's and the world renown Inchbald School of Design. Please check out her websites, www.vosko.com and www.InteriorDesign-ED.com

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