Enhance Your Vision: Lighting in Libraries

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Library Architects and Interior Designers
Evolution of Lighting the Library

- Daylight Source Sized Proportionally to Collection and Task
- Amount of Light Needed Relative to Era
- Task was Primary in Early Age of Artificial Illumination
- Form of Building Shaped by Daylight
The Technical Stuff

- Know the “Terms of Art”
- Challenge Assumptions
- Ask for “In-place” examples and actual fixtures
- Check and Double Check
- Use Computer Modeling
Historical Perspective on Electrical Illumination

• The Roles of the Librarian, Engineer and Architect defined by “job description”—in other words strict territories of expertise
• Manufacturers created the solutions
• Subjectivity and multiple influences not taken fully into account
Looking Back to the Future

• Lighting is major concern
• Glare, daylight and variations
• Impact of shelving heights
• Controversy over lighting quantity and quality (foot-candle vs. visual acuity)
• General vs. task
• What you see is what you get
Lessons from the Past 40 Years

- Too Much Light—cooking the staff
- Lighting the ceiling not the task
- Too Little Light
- Not in the Right Place or Type
- Costly—too many fixture
- Less skepticism and in-depth Understanding—Letting the industry and engineers dictate
Architecture or the Library

- Subservient to Architecture
- Function Follows Form
- Fixture Performance Inadequate
- Contrast Too High or Too Low
- Lack of Understanding of Fixture Impact on Staff and Space
- Integration of Architecture & Lighting
Daylight & Electric Light

- Monumental Form not matched to Task
- High Contrast Ratio
- Integrate Sources
- Daylight Matched to Circulation
- Glare and Uncontrolled Illumination
M S & R

- Integrate with history
- Task Specific—but allowing for flexibility
- Daylight Controlled—orientation and shading devices
- Understanding human needs—welcoming, easy on the eyes, heliotropes, intimate
- Uniformity—with attention to glare, brightness ratios, fixture variety
Summary: Developing Uniform and Better Lighting

- Minimize different lamp types and fixtures—insist on illustrations, physical samples and photographs of proposed fixtures
- Lighting system should maximize acoustical performance of ceiling
- Flexibility of Space: desk locations, activities, shelving, seating and patron visual comfort
Summary: Developing Uniform and Better Lighting

- Provide lighting system within stacks that does not interfere with future stack reorganization
- Where possible use task lighting and motion detectors to reduce connected loads and increase local control
- Integrate power system with lighting to ensure flexibility and compatibility
Summary: Developing Uniform and Better Lighting

- Stress coordinated aesthetic characteristics of the fixture with the design of the library
- During the design process—be a doubter and tough questioner!
Thanks!

PowerPoint presentation is available on our website.

www.msrltd.com
Terms of Art

Color Temperature
Color Rendering Index
Veiling Reflections
Vertical Illumination
Room Surface Brightness
Task Lighting
Lamps & Luminaires
Efficacy (Lumen per Watt)
Distribution
Footcandles
The correlated color temperature scale provides a rough indication of the color balance of various sources of white light.

The higher the degree Kelvin, the bluer the light.
Color and Vision Performance

Pupil efficiency is affected by the color spectrum of the light source

5000 K fluorescent is 25% more pupillary efficient than common cool white

5000K fluorescent lamps could operate with 14% less energy to achieve the same brightness perception

Consider the visual value of daylight which has a color temperature of between 6000K and 1000K.

Photometric means of measuring these study results are not available.

BERMAN STUDY: COLOR SPECTRUM AND VISUAL SENSITIVITY

Energy and Environment Division, Lawrence Berkley National Laboratory
Glare is the sensation produced when a source of light within a person’s field of view is so much brighter that the light level to which the eyes are adapted that the persons experienced discomfort of loss in visual performance.

If you can eliminate glare you can improve visual acuity at lower light levels.
Veiling Reflections are reflections of a light source that partially or totally obscures details (such as words printed on a page) by reducing the contrast between details and their background.
### Vertical Illumination

**Parallel - 84 light fixtures**

- Average: 38fc
- Maximum: 54fc
- Minimum: 21fc
- Max:Min: 2.59

Lights placed parallel to the stacks limit flexibility and provide good vertical uniformity at lower average light levels.

**Perpendicular - 84 light fixtures**

- Average: 46fc
- Maximum: 74fc
- Minimum: 20fc
- Max:Min: 3.74

Lights placed perpendicular to the stacks provide flexibility in arrangement and higher average light levels with lower vertical uniformity.
Surface Brightness Ratios

Reading Tasks

Task to Immediate Surroundings 3:1
  *Book to Desk*

Task to General Surroundings 5:1
  *Book to Partitions*

Task to Remote Surroundings 10:1
  *Book to Remote Wall*

Light Source to Large Adjacent Area 20:1
  *Window to Adjacent Wall*
Task Lighting
## Comparison of Lighting Types

<table>
<thead>
<tr>
<th>DISTRIBUTION</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
<th>USE AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIRECT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downlights</td>
<td>Adds sparkle/Character</td>
<td>Direct Glare</td>
<td>Lobbies &amp; Corridors</td>
</tr>
<tr>
<td>Recessed Lens</td>
<td>Defines Texture</td>
<td>Lighting Cut-Off</td>
<td>Conference Rooms</td>
</tr>
<tr>
<td>Recessed Parabolic</td>
<td>Definition of Shadows</td>
<td></td>
<td>Children &amp; Youth</td>
</tr>
<tr>
<td></td>
<td>High Vertical Illumination</td>
<td></td>
<td>Performance / Story Telling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stacks</td>
</tr>
<tr>
<td><strong>INDIRECT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pendant Linear</td>
<td>Eliminates Glare</td>
<td>Requires High Ceilings</td>
<td>Research</td>
</tr>
<tr>
<td>Pendant Round</td>
<td>Best Visual Performance</td>
<td>Eliminates Shadows</td>
<td>Special Collections</td>
</tr>
<tr>
<td>Surface Wall</td>
<td>Lights Walls &amp; Ceiling</td>
<td>Requires Reflective Surfaces</td>
<td>Admin Offices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DIRECT/INDIRECT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pendant Linear</td>
<td>Reduces Glare</td>
<td>Potential Glare</td>
<td>General Collections</td>
</tr>
<tr>
<td>Pendant Round</td>
<td>Good Visual Performance</td>
<td></td>
<td>Children &amp; Teens</td>
</tr>
<tr>
<td>Semi-Recessed</td>
<td>Adds Shadow Definition</td>
<td>Pendant Requires High Ceilings</td>
<td>Meeting Rooms</td>
</tr>
<tr>
<td></td>
<td>Lights Walls &amp; Ceiling</td>
<td>Semi-Recessed Cuts Off Lighting</td>
<td>Admin Offices</td>
</tr>
<tr>
<td></td>
<td>Good Vertical Illumination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Comparison of Lamps

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Color Temperature (Kelvin)</th>
<th>Color Rendering Index (CRI)</th>
<th>Dimming</th>
<th>Start-up</th>
<th>Lamp Life (Hours)</th>
<th>Efficacy (Lumen/Watt)</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daylight</strong></td>
<td>6000K – 9000K</td>
<td>98 - 100</td>
<td>Window Coverings</td>
<td>Cyclical</td>
<td>Renewable</td>
<td>3,000</td>
<td>Renewable</td>
</tr>
<tr>
<td><strong>Incandescent Argon</strong></td>
<td>2800K</td>
<td>98</td>
<td>Continuous to 1%</td>
<td>Instant On</td>
<td>3,000-6,000</td>
<td>10 - 22</td>
<td>Toxic Waste*</td>
</tr>
<tr>
<td><strong>Incandescent Halogen</strong></td>
<td>3000K</td>
<td>98</td>
<td>Continuous to 1%</td>
<td>Instant On</td>
<td>3,000-6,000</td>
<td>10 - 22</td>
<td>Toxic Waste*</td>
</tr>
<tr>
<td><strong>Fluorescent</strong></td>
<td>3000K-5000K</td>
<td>70 - 90</td>
<td>Continuous to 5%</td>
<td>Rapid On Instant On</td>
<td>10,000 – 20,000</td>
<td>40 104</td>
<td>Toxic Waste*</td>
</tr>
<tr>
<td><strong>Metal Halide</strong></td>
<td>3000K – 4800K Color Shifts</td>
<td>60 – 92</td>
<td>Bi-level Step</td>
<td>10 - 15 Minutes</td>
<td>7,000 – 15,000</td>
<td>44 - 95</td>
<td>Toxic Waste</td>
</tr>
<tr>
<td><strong>High Pressure Sodium</strong></td>
<td>2800K - 3000K</td>
<td>21 - 85</td>
<td>Bi-Level Step</td>
<td>10 – 15 Minutes</td>
<td>24,0000</td>
<td>36 - 114</td>
<td>Toxic Waste</td>
</tr>
</tbody>
</table>

* Low mercury lamps that meet TLCP tests have been exempt in many states.
** Not recommended for indoor use.
System Cost Comparison

5000 Square Feet

Base = Cost to Install
Energy Cost 10 yr.
Maintenance Cost 10 yr.

Legend
- Incandescent Halogen
- Metal Halide
- Fluorescent Indirect - 3 Lamp
- Fluorescent Direct/Indirect - 2 Lamp
- Task

70 fc Average

40 fc Average with Task Lights
Comparison of Lighting Controls

<table>
<thead>
<tr>
<th></th>
<th>Switches</th>
<th>Occupancy Sensors</th>
<th>Daylight Control</th>
<th>Automated Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common, easy to use.</td>
<td>Common, easy to use.</td>
<td>Low initial cost</td>
<td>Low initial cost</td>
<td>Low initial cost</td>
</tr>
<tr>
<td></td>
<td>Lights may be left on.</td>
<td>Energy savings and extended lamp life based on occupancy time.</td>
<td>Dims electric light when daylight is present.</td>
<td>Switches lights on and off based on time schedule.</td>
</tr>
<tr>
<td>High initial cost</td>
<td>High initial cost</td>
<td>High initial cost</td>
<td>High initial cost</td>
<td>High initial cost</td>
</tr>
<tr>
<td>Potential for high energy cost and short useable lamp life.</td>
<td>Energy savings and extended lamp life based on occupancy time.</td>
<td>Significant savings in energy and lamp life.</td>
<td>Energy savings and extended lamp life based on time scheduled</td>
<td></td>
</tr>
</tbody>
</table>
One Footcandle

One footcandle is the intensity of one candela on one square foot surface one foot away.

The flame of a wax candle of standard composition = 1.02 candela.
How Much Light?

Visual task, occupant age, and task accuracy are the primary criteria for establishing required light levels.

Recommended Light Levels

<table>
<thead>
<tr>
<th>Ambient Illumination</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Circulation</td>
<td>30fc</td>
</tr>
<tr>
<td>Library Areas</td>
<td>40fc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task Illumination (Print/Contrast)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Large/High</td>
<td>30fc</td>
</tr>
<tr>
<td>Small/Medium</td>
<td>75fc</td>
</tr>
<tr>
<td>Very Small/Low</td>
<td>150fc</td>
</tr>
</tbody>
</table>