Energy by design: Lighting

CIBSE East Midlands Region

3rd December 2013

Liz Peck  MSc FSLL
• Energy challenges
• Part L update
• Lighting for people
• Objectives & considerations
• Lighting palettes
• Getting it right
• Energy Efficiency
Dwindling energy supplies
• 80% reduction in CO₂ by 2050
• 66% of 2050 building stock already exists
• 26 million buildings exist today
• 18 million will need refurbishment
• 500,000 every year

50 buildings an hour
Drivers for change
• Payback – Return on Investment

• Incentives
  – ECA

• Loans
  – Carbon Trust
  – Energy Saving Trust
• Part L 2013

- Domestic: 6% change
- Non-domestic: 9% change
• SBEM assumes full control!
• Backstop: 60 LL/W
• Controls options
• LENI
<table>
<thead>
<tr>
<th>Control Type</th>
<th>Potential Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual on/off</td>
<td>0%</td>
</tr>
<tr>
<td>Daylight - controls penetration improvements</td>
<td>20- 40%</td>
</tr>
<tr>
<td>Absence detection</td>
<td>15-30%</td>
</tr>
<tr>
<td>Time management</td>
<td>5-15%</td>
</tr>
</tbody>
</table>

**Benefits of controls**

*Courtesy: Lou Bedocs*
Table 42: Recommended minimum lighting efficacy with controls in new and existing buildings

<table>
<thead>
<tr>
<th>Controls</th>
<th>Control factor</th>
<th>Initial luminaire lumens/circuit-watt</th>
<th>Reduced luminaire lumens/circuit-watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>a  daylit space with photo-switching with or without override</td>
<td>0.90</td>
<td>60</td>
<td>54</td>
</tr>
<tr>
<td>b  daylit space with photo-switching and dimming with or without override</td>
<td>0.85</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>c  unoccupied space with auto on and off</td>
<td>0.90</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>d  unoccupied space with manual on and auto off</td>
<td>0.85</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>e  space not daylit, dimmed for constant illuminance</td>
<td>0.90</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>a + c</td>
<td>0.80</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>a + d</td>
<td>0.75</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>b + c</td>
<td>0.75</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>b + d</td>
<td>0.70</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>e + c</td>
<td>0.80</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>e + d</td>
<td>0.75</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>General lighting in other types of space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The average initial efficacy should be not less than 60 lamp lumens per circuit-watt.

The average initial efficacy should be not less than 22 lamp lumens per circuit-watt.
• Installed power
• Standby power
• Daylight contribution
• Occupancy patterns
• Operating hours
• Lighting controls
Table 44: Recommended maximum lighting energy consumption (kWh) per sqm per year in new and existing buildings (lighting energy limit)

<table>
<thead>
<tr>
<th>Hours</th>
<th>Illuminance (lux)</th>
<th>Display Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>1000</td>
<td>1.11</td>
<td>1.92</td>
</tr>
<tr>
<td>1500</td>
<td>1.66</td>
<td>2.87</td>
</tr>
<tr>
<td>2000</td>
<td>2.21</td>
<td>3.81</td>
</tr>
<tr>
<td>2500</td>
<td>2.76</td>
<td>4.76</td>
</tr>
<tr>
<td>3000</td>
<td>3.31</td>
<td>5.72</td>
</tr>
<tr>
<td>3700</td>
<td>4.09</td>
<td>7.08</td>
</tr>
<tr>
<td>4400</td>
<td>4.89</td>
<td>8.46</td>
</tr>
<tr>
<td>5400</td>
<td>6.05</td>
<td>10.47</td>
</tr>
<tr>
<td>6400</td>
<td>7.24</td>
<td>12.57</td>
</tr>
<tr>
<td>8760</td>
<td>10.26</td>
<td>17.89</td>
</tr>
</tbody>
</table>
Identifying inefficient lighting
Lighting Design… the oldest profession in the world!
Luminaires & Controls
Lit effect  Luminaires & controls  People
People

Lit effect

Luminaires & controls
The right light
in the right place
at the right time
First Principles

Who

What

When

How long
• **Visual acuity**
• Task difficulty
• Circadian rhythm
  • Cortisol - stress hormone
  • Melatonin - sleep hormone
• Eyestrain
Design considerations

- Energy Efficiency
- Installation & Maintenance
- Architectural Integration
- Visual Amenity
- Costs (Capital & Operational)
- Lighting Design
- Legislation
- Environment
- Technology
• Aspirations

- Visual Function
- Architectural Integration
- Visual Amenity
- Installation & Maintenance (Capital & Operational)
- Legislation
- Environment
- Technology
- Lighting Design
• Visual function

Who

What

When

How long

Aspirations
Design approach
Layered approach
Designing for task
Getting it wrong

300lx

500lx
Aspirations

• Visual amenity
- Visual amenity
• Visual amenity
• Architectural Integration
• Architectural Integration
• Considerations

Energy Efficiency
Installation & Maintenance
Costs (Capital & Operational)
• Installation & Maintenance
• Installation & Maintenance
• Capital & Operating Costs
• Energy Efficiency
Lighting palettes
LED Lighting Panacea
“If it looks like a duck, swims like a duck, and quacks like a duck, then it probably is a duck”

unless it is a peanut
• Life
• Efficacy
• Lumen Output
• Colour Rendering
• Colour Temperature
• Dimmability
• Warm-up time
• Re-strike time
• Mounting position
• Building fabric
• Other building services
• Size
• Form
• Architecture
• Adjustability
• Emergency compatibility
<table>
<thead>
<tr>
<th>Country</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA/UK</td>
<td>Danger</td>
</tr>
<tr>
<td>France</td>
<td>Aristocracy</td>
</tr>
<tr>
<td>India</td>
<td>Creativity</td>
</tr>
<tr>
<td>Japan</td>
<td>Anger</td>
</tr>
<tr>
<td>China</td>
<td>Happiness</td>
</tr>
<tr>
<td>Egypt</td>
<td>Death</td>
</tr>
</tbody>
</table>

**Meaning of Colour**
Colour Psychology

- Danger
- Sex
- Strength
- Power
- Passion
- Aggression
- Speed
- Excitement

**RED**
GOOD THINGS COME TO THOSE WHO WAIT.
The right light ...

... in the right place ...

... at the right time

Lighting for people
Getting it right
The electrifying new Lincoln Rhyme thriller that will make you think twice about turning on the light.
Thank you

liz.peck@lpa-lighting.com