Lighting Guide 5: Lighting in Education

Peter Raynham
Why update LG5?

- Originally a guide to lecture theatres, teaching and conference spaces
- Last published in 1991 addendum in 2003
- The DCSF expressed a wish to consolidate guidance
- Learning environment has changed as has legislation
Introduction

Why update LG5?

- Lighting Guide 5 now applies to all learning spaces
Introduction

Why update LG5?

• A need to bring the guidance up to date:
Introduction

A holistic approach?

- A need to bring the guidance up to date:
  - Joined up or disjointed design?
Introduction

A holistic approach?

• A need to bring the guidance up to date:
  – Joined up design or lowest cost?

Professional lighting designer working with other specialists
Introduction

A holistic approach?

- A need to bring the guidance up to date:
  - Joined up design or lowest cost?

Legislation means lighting is more complex:
  - WEEE
  - ROHS
  - EPBD
  - Building Regulations
  - EN12464 1&2
  - Regulatory Reform (Fire Safety)
  - Lighting Codes
  - EuPD
  - and so it goes on....

Professional lighting designers working with other professionals
Introduction

A holistic approach?

• Professional means?
Introduction

A holistic approach?

- Holistic needs to develop....
Introduction

A change in approach?

- Lighting performance, efficiency and comfort need to be considered as a whole
- Cost needs to allow for sustainable design
Introduction

A change in approach?

- Lighting performance, efficiency and comfort need to be considered as a whole
- Cost needs to allow for sustainable design

Zero Carbon by 2016?
Introduction

A change in approach to energy

Educational buildings without a known usage profile:

<table>
<thead>
<tr>
<th>Energy Efficiency Grade</th>
<th>Teaching Spaces, Office, Industrial, Storage (averaged for all these spaces in the building) (Luminaire Lumens per Circuit Watt)</th>
<th>Other Spaces (averaged for all these spaces in the building) (Lamp Lumens per Circuit Watt)</th>
<th>Display Lighting (averaged for all these spaces in the building) (Lamp Lumens per Circuit Watt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>55</td>
<td>55</td>
<td>22</td>
</tr>
<tr>
<td>Good*</td>
<td>67</td>
<td>67</td>
<td>26</td>
</tr>
<tr>
<td>Excellent**</td>
<td>88</td>
<td>88</td>
<td>35</td>
</tr>
</tbody>
</table>
A change in approach to energy

Educational buildings with a known usage profile, or replacing one where the usage can be measured:

<table>
<thead>
<tr>
<th>Table 2.2 'Pass' targets for lighting energy numeric indicator (LENI) for educational buildings (extract from BS EN 15193[^20]), Annex F, Table F.1, reproduced by permission of the British Standards Institution)</th>
</tr>
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<tr>
<td><strong>Quality class</strong></td>
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Introduction

A change in approach to energy

Lighting energy use is not just about driving technology
LED technology will not save the world
… at least not on its own
Educational buildings need to change behavior by educating to save energy when it's not required, the new targets specifically encourage controls
A clear need for natural light

Research in the USA by included 21000 pupils over 3 states.

High levels of daylight gave

- high improvements in learning rates,
- increased attendance
- and 20% higher results in reading and maths.

Due to

- higher levels of illuminance,
- improved visibility,
- improved melatonin production,
- better colour rendering...

It also lead to energy savings of 30-60% (70% if automatic blinds were used).

Source - Heschong & Mahone
Natural Lighting

A clear hierarchy to natural light

1 – Daylight
2 – Deal with Summer over heating
3 – Add Ventilation
4 – Balance the acoustics
Design is not meant to be easy…
Daylight Factors of 5% average with 2% minimum in classrooms
Good daylight strategies and daylight control
Natural Lighting

An ability to naturally light

These high levels of daylight demand good design by daylight professionals involved at the concept of the building

And practice by users and designers to control artificial light when it’s not needed…
Natural Lighting

Match technology to the space

All luminaires should be High frequency as a minimum and preferably with daylight and absence dimming

Classes should approach design including the performance of projection equipment rather than for out dated equipment…
Colour

Balance the environment

High reflectance

But keep some colour

Lively

Calming
Artificial Lighting

Balance the lit environment

Learning is about communication
Communication requires a balanced lit environment, not just light on the desk
# Recommendations from BS EN 12464-1 (published July 2011)

<table>
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<tr>
<th>Ref.</th>
<th>Type of interior, task or activity</th>
<th>$E_m$ (lx)</th>
<th>UGRL</th>
<th>$U_o$</th>
<th>$R_a$</th>
<th>Remarks</th>
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<td>1.1</td>
<td>Play room</td>
<td>300</td>
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<td>1.2</td>
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Artificial Lighting

Balance the lit environment

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Artificial Lighting

New lighting measures

\[ E_{cyl} \text{ of 150lux at 1.2m is the recommendation} \]
Artificial Lighting

New lighting measures

At a point:

= Modelling Index
Artificial Lighting

New lighting measures

EN12464-1 recommends

\[
\frac{E_{cyl}}{E_h} \geq 0.3
\]

\[E_{cyl} \approx \frac{1}{4} (E_{v1} + E_{v2} + E_{v3} + E_{v4})\]
Artificial Lighting

Range of Modelling Index

0.1

0.3

0.5

1.0
Artificial Lighting

Lighting for visual display
ISO9241 and En12464 recognise screen technology has moved on

<table>
<thead>
<tr>
<th>Screen high state luminance</th>
<th>High &gt; 200 cd/m²</th>
<th>Medium &lt; 200 cd/m²</th>
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<tbody>
<tr>
<td>Case A</td>
<td>≤ 3000 cd/m²</td>
<td>≤ 1500 cd/m²</td>
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<tr>
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Alternate approach: Specify the minimum permissible screen performance

“As screen technology is developing at a faster rate than that of conventional lighting it is far more appropriate to define the performance required of the screen rather than try and restrict the lighting comfort of the user of a space by restricting the available light. Given that in most learning spaces the computer screen is not the main disseminator of knowledge it is inappropriate to limit the lighting designers choices for lighting the speaker, teacher or pupil simply due to poor application of display screen technology…”
Artificial Lighting

Lighting for visual display

- Good Vertical illuminance is important on the main displays
- BUT standard & Interactive Whiteboards will need careful lighting

Chalkboard luminaire must be installed within the shaded triangle, to avoid reflections in the board to the nearest viewer.

≥10kcd/m²

≤200cd/m²
Artificial Lighting

Lighting for Sport

- Light for sports needs to be appropriate
- Don’t design for International class competition if it just local use
- Specialist sports colleges ensure lighting control selects the right light for practice and competition at the right time
- Zero upward light
- Design to a maximum Environmental E3 class except for specialist facilities
Artificial Lighting

- Good practice as BS5489-1 allowing for Security risks and CCTV
- Light nuisance to the local community should be well controlled.
As educational establishments open in hours of darkness and for public assembly they must be covered by emergency lighting (often even in spaces less than 60m$^2$)
Summary
Lighting Guide 5: Lighting in Education

Questions ?