



Department  
for Education

# **Technical Annex 2E: Daylight and Electric Lighting**

## **Output Specification**

**May 2020**

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## Summary

This document is one of a number of Technical Annexes which form part of the Generic Design Brief (GDB).

## Review Date

The next planned review date for this document is November 2020.

## Who is this publication for?

This document is for technical professionals involved in the design and construction of school premises, to use as part of the Employer's Requirements of the DfE Construction Framework. It may also be used as the basis of similar documentation for other procurement routes using the Output Specification.

## Document Updates

- **Version 9:** May 2020 – Amendments to blinds.
- **Version 8:** May 2019 – Revised to incorporate end user feedback, evidence collected and updates to applicable standards.
- **Version 7:** November 2017 - Issued as OS 2017.
- **Versions 1-6:** July 2016 – November 2017 - Includes initial working towards OS 2017.

# 1. Introduction

- 1.1. This document is one of a number of Technical Annexes which form part of the Generic Design Brief (GDB). It sets out the required technical standards and performance criteria for daylight and electric lighting and should be read in conjunction with Section 2.7.2 of the GDB, as well as the School-Specific Brief, including the School-Specific Schedule of Accommodation (SoA), Area Data Sheets (ADS) and, where relevant, the Refurbishment Scope of Works (RSoW). The definitions in paragraph 1.3 of the GDB apply to this Technical Annex and all other parts of the OS.
- 1.2. Evidence of compliance with these requirements is required as part of the Employer's Requirements Deliverables, including design strategies and calculations, production of a sample room, submittals of equipment details, O&M manuals and other tests and documentation during commissioning and at handover.
- 1.3. The requirements in this Technical Annex are in respect of Buildings, FF&E and ICT Infrastructure and shall apply to all parts of the Works in any New Buildings, as well as to any Building Elements or Building Services provided in Refurbished Building(s) which are designated Renewed or Replaced in the RSoW.
- 1.4. Where the requirements refer to an area, space or Suite of Spaces, this shall apply to all spaces in any New Building(s) or Remodelled Area. Any area or space within New Buildings or Remodelled Area shall conform to all relevant requirements in this Technical Annex.

## 2. General Requirements

### 2.1. Area Definitions

2.1.1. The type and definition of spaces in School Buildings have been categorised and described in Table 1. These are used in the tables and text in this document.

Categories of space <sup>1</sup>	Sub-categories of space types	Types of spaces
Basic Teaching Area	Primary basic teaching areas	Primary School classrooms or classbases, shared teaching areas and large group rooms (over 30m <sup>2</sup> ), specialist practical spaces
Basic Teaching Area	Secondary general teaching spaces	Secondary School general classrooms, seminar rooms, ICT-rich classrooms and music rooms
Basic Teaching Area	Drama studios	Secondary School drama studios
Basic Teaching Area	Secondary Practical spaces	Secondary School science laboratories, art rooms, design and technology spaces (including food rooms)
Learning resource areas	Primary libraries	Primary School libraries
Learning resource areas	Secondary libraries	Secondary School learning resource centres (LRCs)
Learning resource areas	Group rooms	Primary School small group rooms, Secondary School small group rooms, therapy and MI rooms
Learning resource areas	Secondary practice rooms and study areas	Secondary School music group/practice rooms, sixth form and general study areas, local resource areas, practical learning resources

<sup>1</sup> Categories based on those in DfE Building Bulletins 103 and 104.

Learning resource areas	Other learning resource areas	Dark rooms, control rooms, kiln rooms and sensory rooms
Halls, dining and PE area	Halls, studios and PE spaces	Primary School main hall, small hall and studios, Secondary School main hall, activity studios and fitness studios
Halls, dining and PE area	Sports halls	Secondary Schools sports halls of 180m <sup>2</sup> or more
Halls, dining and PE area	Dining and social areas	Secondary School dining areas and social areas
Staff and administration area	Administration offices	Permanently occupied offices, including general office, head teacher's office, PA to head teacher
Staff and administration area	Staff room	Main staff room, or staff social area
Staff and administration area	Staff areas	Interview room, sick bay or sick room, reprographic facilities, staff work rooms, offices, meeting or conference rooms, offices / workshops for facilities manager or ICT technician, reception area
Storage area	Science preparation rooms	Secondary School science preparation rooms. Areas used solely for storage may be treated as storage
Storage area	D&T preparation	D&T preparation rooms for workshops
Storage area	Storage (excluding preparation)	Teaching storage, including chemical stores and non-teaching storage, including cloakrooms and lockers
Toilets and personal care (non-net)	Toilets and hygiene rooms	Toilets, accessible toilets and hygiene rooms
Toilets and personal care (non-net)	Changing rooms	Changing rooms and showers



Kitchen suite (non-net)	Kitchen preparation areas	Area of school kitchen used for preparing food and drink, and washing up afterwards, as well as any workstation for administration and the main servery
Kitchen suite (non-net)	Other kitchen areas	Food store rooms; facilities for catering staff, including changing areas and toilets
Circulation and plant (non-net) Circulation and plant (non-net)	Circulation	Corridors, stairways and lobbies
Circulation and plant (non-net) Circulation and plant (non-net)	Plant areas	Plant rooms, hub rooms, server rooms, risers and ducts

**Table 1 Definitions of Area Types**

## 2.2. Refurbishment

2.2.1. As described in the GDB, any work required to Refurbished Buildings shall be as defined in the Refurbishment Scope of Works (RSoW), under the headings of architectural elements, including FF&E, and M&E elements (including ICT infrastructure), and required to be Renewed, Replaced, Repaired, Retained or have 'No works'.

- a) Any **Renewed** electrical lighting element or system shall be designed to satisfy the relevant outputs of the Generic Design Brief and this Technical Annex (and by the code in the ADS where relevant).
- b) Any **Replaced** electrical lighting element or system shall satisfy the relevant outputs of the GDB and this Technical Annex (and by the code in the ADS where relevant), as far as possible within the constraints of the location, the adjacent elements and the sub-structure.
- c) Any **Repaired** electrical lighting element or system shall comply to the specifications in any project-specific drawing issued as part of the School-

Specific Brief, and the overall performance after repair shall be at least as good as that of the existing provision.

d) Any **Retained** electrical lighting element or system shall be left as existing, with minimal work required unless needed in order to complete other Works that form part of the project, and the overall performance shall be no worse than the existing performance.

e) Any element requiring **No work** shall be left as existing.

2.2.2. Subject to paragraphs 1.3 and 1.4 of this Technical Annex and Section 1.5 in the GDB, in respect of work to Refurbished Buildings, the required level of compliance with this Technical Annex is set out in the RSoW.

2.2.3. Generally, the requirements in this Technical Annex refers to all parts of the Works except any building elements or services that are designated Repaired, Retained or 'no work' in the RSoW, or spaces designated 'Untouched' in the School-Specific SoA.

2.2.4. In Refurbished Buildings, the requirements for daylight in this Technical Annex shall apply to any windows identified in the RSoW to be Renewed (typically as part of a renewed external façade). Where the window layout is unchanged daylight modelling is not required but any glare problems shall be addressed, e.g. by provision of blinds.

2.2.5. If glazing is being Replaced in a Refurbished Building, the specification shall be met as far as possible, within the constraints of the location and opening, unless otherwise agreed by the Employer. Typically, the Contractor shall be required to supply glazing to an equivalent area (m<sup>2</sup>) as existing but with an upgraded specification.

## 3. Daylighting

### 3.1. Daylight Performance Criteria

- 3.1.1. Table 2 specifies the performance criteria for daylight, based on the types of space defined in Table 1. Daylighting calculations shall be as the specification in Section 9.2.
- 3.1.2. Percentages of spaces are defined by room quantities not area. For example, 80% of spaces for which ADS code L1 applies refers to 80% of the quantity of these spaces.
- 3.1.3. It is recognised that the primary performance criteria may not be able to be met in every space. Where the primary performance criteria are not met, spaces are expected to be as close to full compliance as is feasible and daylight access is required in Basic Teaching areas (excluding drama studios), halls, dining and PE spaces, libraries and permanently occupied administration offices. See Table 2.
- 3.1.4. Daylight access shall be demonstrated through spaces receiving daylight directly or indirectly that enhances the visual environment. The level of daylight access provided shall take into account the activities in the space. For Basic Teaching Area (except drama studios), it should be as near the sDA and UDI levels quoted as possible.
- 3.1.5. For halls; dining and PE area; secondary libraries and study areas; and circulation, a lower level of daylight is acceptable to provide daylight access, see Table 2.
- 3.1.6. Daylight Autonomy (DA) is the percentage of time that a point in a space can expect to achieve or exceed an illuminance threshold (typically 300 lux) from daylight alone. Spatial Daylight Autonomy sDA (300/50%) defines the percentage of the task plane which receives at least 300 lux, for at least 50% of the annual occupied hours, i.e. the percentage of the task plane which can achieve a DA of 50%
- 3.1.7. Useful Daylight Illuminance UDI-a (100~3000 lux) is the annual occurrence of illuminance, at a point in a space, within the range 100~3000 lux, measured across the task plane, during occupied hours. The final UDI result is taken as an average of the results across the task plane.

Types of space (as identified in Table 1)	ADS Code	Spaces requiring primary performance criteria	Primary performance criteria  Spatial Daylight Autonomy (sDA (300/50%))	Primary performance criteria  Useful Daylight Illuminance (UDI- a (100-3000lux))	Requirements for spaces that do not meet primary performance criteria
Basic Teaching spaces (excluding drama studios); life skills (in special schools); science preparation Rooms; administration offices; staffroom	L1	80% of spaces	sDA (300/50%) shall be $\geq 50\%$	UDI-a (100-3000lux) shall be $\geq 80\%$	Daylight access required to achieve levels as near to those for compliant spaces as possible and visual connection to adjoining daylight spaces to provide visual comfort.
Halls, dining and PE area; Secondary libraries	L2	65% of spaces	No requirement	UDI-a (100-3000lux) shall be $\geq 80\%$	Daylight access
Group rooms; Secondary practice rooms and study areas; staff areas	L3	50% of spaces	No requirement	UDI-a (100-3000lux) should be $\geq 80\%$	None
Circulation; D&T preparation; kitchen preparation areas; changing rooms	L4	Stairwells, and wherever possible elsewhere	Daylight access required	Daylight access required	None

Types of space (as identified in Table 1)	ADS Code	Spaces requiring primary performance criteria	Primary performance criteria  Spatial Daylight Autonomy (sDA (300/50%))	Primary performance criteria  Useful Daylight Illuminance (UDI- a (100-3000lux))	Requirements for spaces that do not meet primary performance criteria
Storage (excluding preparation); toilets and hygiene rooms; other kitchen areas; plant areas; kiln rooms	L5	100% of spaces	No requirement	No requirement	N/A
Drama studio, dark room, control room, sensory room	L6	100% of spaces	Daylight to be excluded or blinds provided	Daylight to be excluded or blinds provided	N/A

**Table 2 Daylight Performance Criteria by Area Type**

## 3.2. Shading Devices

### 3.2.1. Blinds

3.2.1.1. Blinds or other means of solar glare and daylight control shall be provided to all exterior glazing (including rooflights) in all Basic Teaching spaces and learning resource areas and staff areas (L1, L2 & L3), except within 15 degrees of absolute North where the Contractor proves the visual environment will be adequate without blinds. The type of blind(s) employed will be dependent on factors such as window orientation, daylight performance and visual environment requirements of each space. The blinds shall not adversely affect the ventilation of the space. See Annex 2F: 'Mechanical services and public health engineering' for the operability of the operable windows or glazed doors.

3.2.1.2. Vertical blinds shall not be used in teaching areas as they can be easily damaged.

3.2.1.3. Where roller blinds are used, the material shall be a screen (dim-out) type with a total visible light transmittance of 5-7%. The exception to this requirement is given in 3.2.1.4. In rooms where the blinds are for solar glare

control, i.e., not north facing classrooms, the openness of the weave of the material shall not be greater than 3%.

- 3.2.1.4. Blinds can have a higher overall transmission and a higher openness or can be excluded, if the Contractor can demonstrate that the visual environment will be adequate. The primary method of demonstration is by showing that the glazing orientation is within 15 degrees of absolute North and all visual display equipment in the space can achieve a contrast ratio of at least 3000:1. Alternatively the Contractor may provide a disability glare analysis to justify the choice of blinds with a higher transmission or the exclusion of blinds on a particular façade.
- 3.2.1.5. Blinds shall be provided in all science spaces and these shall provide glare reduction whilst maintaining daylight and ensuring adequate ventilation at all times. One in three science spaces will also need to provide blackout for specific physics and biology experiments. In these cases it is acceptable for the required summertime ventilation to be temporarily obstructed during the experiments. A low level of lighting is needed for safety during these experiments which can be provided by task lights.
- 3.2.1.6. Sports halls require solar glare control. Where rooflights are employed, the use of a diffusing material, such as frosted/fritted/prismatic glass or plastics is an acceptable alternative to blinds as long as the Contractor coordinates the rooflight layout with the layout of the sports courts (e.g. they are located between badminton courts) and provides a disability glare assessment to show that the rooflights are positioned to avoid solar glare .
- 3.2.1.7. Assembly halls shall be daylit and drama studios may be daylit. If drama studios and/or assembly halls are daylit, blackout blinds or curtains are required for audio visual purposes. Low level background lighting is required for safety purposes.
- 3.2.1.8. Requirements for blinds and curtains are also included in paragraph 4.2, Annex 2D: 'Internal Elements and Finishes' and paragraph 5.2.6, Annex 3: 'Fittings, Furniture and Equipment'.

## **4. Electric Lighting**

### **4.1. Interior Lighting**

- 4.1.1. An interior lighting system shall be provided in accordance with the criteria given in Table 3, Table 4 and Table 11.
- 4.1.2. Where UGRL calculations are not possible, compliance shall be demonstrated through luminaire intensity being limited to 3000 cd/m<sup>2</sup> above 65 degrees from a downward vertical.
- 4.1.3. In Basic Teaching spaces, learning resource areas, administration offices, other staff areas and storage areas, surfaces shall be illuminated in accordance with Table 4.

Types of Space (as defined in Table 1)	Horizontal Illuminance $\bar{E}_m$ lx	Horizontal Illuminance $U_o$	Horizontal Illuminance Task height (m)	Cylindrical Illuminance (WP height 1.2m) $\bar{E}_z$ lx	Cylindrical Illuminance (WP height 1.2m) $U_o$	Glare $UGR_L$	ADS Code
Primary basic teaching area; primary libraries	300	0.6	0.55	150	0.1	19	a
Secondary General Teaching spaces; group rooms; secondary practice rooms and study areas	300	0.6	0.70	150	0.1	19	b
Secondary libraries	300 200 for shelving	0.6	0.7 On vertical edge of books	150	0.1	19	d
Darkrooms (1)	200	0.6	0.85	50	0.1	19	e



Types of Space (as defined in Table 1)	Horizontal Illuminance $\bar{E}_m$ lx	Horizontal Illuminance $U_o$	Horizontal Illuminance Task height (m)	Cylindrical Illuminance (WP height 1.2m) $\bar{E}_z$ lx	Cylindrical Illuminance (WP height 1.2m) $U_o$	Glare UGRL	ADS Code
Sensory rooms (2)	200	0.6	0	50	0.1	19	f
Control rooms	300	0.6	0.7	150	0.1	19	g
Dining and social areas	200	0.4	0.7	50	0.1	22	h
Halls, studios and PE spaces	300	0.6	0 (0.7 for exams)	100	0.1	19	i
Sports halls	500 switchable to 300	0.6	0 (0.7 for exams)	100 - 150	0.1	22	j
Storage (excluding science preparation); other kitchen areas	100	0.4	0	N/A	N/A	25	l
Kitchen preparation areas	500	0.6	0.9	N/A	N/A	22	m

Types of Space (as defined in Table 1)	Horizontal Illuminance $\bar{E}_m$ lx	Horizontal Illuminance $U_o$	Horizontal Illuminance Task height (m)	Cylindrical Illuminance (WP height 1.2m) $\bar{E}_z$ lx	Cylindrical Illuminance (WP height 1.2m) $U_o$	Glare UGR <sub>L</sub>	ADS Code
Circulation	100	0.4	0	50	0.1	25	n
Toilets and hygiene rooms; changing rooms	100	0.4	0	N/A	N/A	25	o
Plant areas (including server room)	200	0.4	0	N/A	N/A	22	p

**Table 3 Interior Horizontal and Cylindrical Illumination Criteria**

## Notes

1. General lighting installation to be duplicated with a safelight installation for print development
2. Additional specialist SEN lighting is required

Areas	Vertical Illuminance $\bar{E}_m$ lx	Vertical Illuminance $U_o$
Whiteboards	150	0.6
Shelving and racking	100	0.4
Basic Teaching spaces: Walls	50% of horizontal task illuminance or $E_v \text{ min} > 100 \text{ lx}$	0.1
Basic Teaching spaces: ceilings	30% of horizontal task illuminance or $E_h \text{ min} > 50 \text{ lx}$	0.1
Offices: walls	75	0.1
Offices: ceilings	50	0.1
Circulation: walls	50	0.1
Ceilings	30	0.1

**Table 4 Surface Illumination Criteria**

## 4.2. Exterior Lighting

### 4.2.1. Site Lighting

4.2.1.1. An exterior lighting system shall be provided in accordance with the criteria given in Table 5 and Table 12.

Areas	Horizontal Illuminance $E_m$ lx	Horizontal Illuminance $U_o$	Horizontal Illuminance WP height (m)	Glare $GR_L$
Walkways exclusively for pedestrians	5	0.25	0	50
Traffic areas for slowly moving vehicles (max 10 km/h, e.g. bicycles)	10	0.40	0	50
Pedestrian passages, vehicle turning, loading and unloading points	50	0.40	0	50
Parking areas	10	0.25	0	50
Security	5	0.25	0	50

Table 5 Exterior Illumination Criteria

4.2.1.2. Light colour rendering and colour temperature shall be in accordance with Section 6.

## 4.3. Obtrusive Light

4.3.1. Light spill shall be controlled to a level appropriate to the surrounding environment. This is demonstrated through compliance with ILP guide GN01 - Guidance Notes for the Reduction of Obtrusive Light. The foundation of this method is to agree an environmental zone with the local planning authority.

4.3.2. The zoning definitions and performance criteria are summarized in Table 6 and Table 7 however the Contractor shall refer to the ILP document.

<b>Zone</b>	<b>Surrounding</b>	<b>Lighting environment</b>	<b>Examples</b>
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark	National parks and AONB
E2	Rural	Low brightness	Village or dark outer suburban areas
E3	Suburban	Medium brightness	Small town centre or suburban locations
E4	Urban	High brightness	Town/city centres with high levels of night-time activity

**Table 6 Environmental Zoning for Obtrusive Light**

Parameter	Application conditions	E0 Value of parameter for stated environmental zone	E1 Value of parameter for stated environmental zone	E2 Value of parameter for stated environmental zone	E3 Value of parameter for stated environmental zone	E4 Value of parameter for stated environmental zone
Upward light ratio (ULR)	Maximum permitted percentage of luminous flux that goes directly into the sky	0	0	2.5	5	15
Illuminance in vertical plane (Ev) (lx)	Pre-curfew	0	2	5	10	25
	Post-curfew	0	0	1	2	5
Luminous intensity emitted by luminaires (I) (cd)	Pre-curfew	0	2500	7500	10000	25000

Parameter	Application conditions	E0 Value of parameter for stated environmental zone	E1 Value of parameter for stated environmental zone	E2 Value of parameter for stated environmental zone	E3 Value of parameter for stated environmental zone	E4 Value of parameter for stated environmental zone
N/A	Post-curfew	0	0	500	1000	2500
Building facade luminance ( $L_b$ ) ( $\text{cd/m}^2$ ) Ave	Pre-curfew	0	0	5	10	25
Sign luminance ( $L_s$ ) ( $\text{cd/m}^2$ ) Max	Up to $10\text{m}^2$	0	100	400	600	600
N/A	Over $10\text{m}^2$	0	0	200	300	300

**Table 7 Performance Criteria for Obtrusive Light**

## 4.4. Reference Standards

4.4.1. The Contractor shall ensure that the design and installation of electric lighting takes account of the relevant parts of the following standards (or updated documents if relevant). Where criteria are conflicting, precedence shall be given to the most recent publication.

1. SLL Lighting Guide 5: 'Lighting for Education'
2. BS EN 12464-1: 'Light and lighting. Lighting of workplaces. Indoor workplaces'
3. BS EN 12464-2: 'Light and lighting. Lighting of workplaces. Outdoor workplaces'
4. ILP GN01 Guidance



## 5. Emergency Lighting

### 5.1. Visual Environment

#### 5.1.1. Performance Criteria

5.1.1.1. Emergency lighting systems shall meet the requirements given in Table 8, Table 9 and Table 10.

5.1.1.2. Emergency lighting performance (including possible exclusions) shall be based on the area specification and a risk assessment carried out with the School.

Item	Value	Notes
Area size	Generally, • 60 m <sup>2</sup> except in places of public assembly or where a sufficient risk is identified	(1)
Design illuminance	Minimum design value 0.5 lx on empty floor excluding 0.5 m wide perimeter margin	N/A
Diversity (U <sub>d</sub> )	<40 (max/min)	N/A
Response time	50% design value in 5 s and 100% design value in 60 s until the end of the rated duration	N/A
Minimum duration	3 hours	N/A
Colour rendering	Lamp R <sub>a</sub> • 40	N/A

**Table 8 Open Area Emergency Lighting Criteria**

#### Notes

1. Classrooms used outside typical school hours (adult education for example) shall have emergency lighting

Item	Value
Route size	≤ 30 m long, up to 2 m wide (each 2 m wide strip if route is wider)
Design illuminance on centre line	Minimum design value of 1 lx, on the floor along the centre line of the route
Design illuminance on centre band	Minimum design value 0.5 lx, on the floor of the centre band (i.e. at least 50% of the route width)
Diversity ( $U_d$ )	Illuminance on centre line < 40 (max. /min.)
Response time	Design value within 5 s of supply failing, until the end of the rated duration
Minimum duration	3 hours
Colour rendering	Lamp $R_a \geq 40$

**Table 9 Defined Escape Routes Emergency Lighting Criteria**

Item	Value	Notes
Area size	As defined by task size, location and plane	1, 2, 3
Design illuminance	Minimum 10% of maintained illuminance on the reference plane but at least 15 lx	1, 2, 3
Uniformity	>0.1 (minimum/average)	1, 2, 3
Response time	Design value in 5 s or faster if the risk requires it	1, 2, 3
Duration	Period for which the risk to people exists	1, 2, 3
Colour rendering	Lamp $R_a \geq 40$	1, 2, 3

**Table 10 High Risk Task Area Emergency Lighting**

### Notes

1. Typical high-risk areas include catering kitchens and in the immediate vicinity of rotating machinery.
2. High-risk task lighting is in addition to open area lighting
3. Further advice in BS5266 Part 10

## 5.1.2. Equipment

- 5.1.2.1. Emergency battery packs shall be internal or external to luminaires. Central or distributed batteries shall be located in environments with ambient temperature of 25 °C or lower. Battery duration shall be at least 3 hours.
- 5.1.2.2. The Contractor shall identify whether he is providing an emergency lighting automatic testing and monitoring system. The Contractor shall provide details of the School's responsibilities for testing the emergency lighting system aligned with the 'Fire Regulation Reform Order 2005' in the O&M manuals. The emergency lighting testing and monitoring system shall consist of one of the following options.
- a) Manual key-switches for each individual lighting final sub-circuit.
  - b) A proprietary luminaire self-test system based upon individual luminaires.
  - c) A centralised dedicated proprietary emergency lighting test and monitoring system.
  - d) Emergency lighting test and monitoring control algorithms as part of a centralised lighting control system.
- 5.1.2.3. All systems shall comply with the testing and monitoring requirements of BS 5266 for self-contained or centralised power supply systems and provide auditable test results in both hard and soft copy formats.

## 5.2. Reference Standards

- 5.2.1. The Contractor shall ensure that the design and installation of emergency lighting takes account of the relevant parts of the following standards (or updated documents if relevant). Where criteria are conflicting, precedence shall be given to the most recent publication:
- 1. SLL Lighting Guide 12: Emergency Lighting
  - 2. BS 5266 Emergency lighting
  - 3. BS EN 1838:2013 Emergency lighting
  - 4. BS EN 62034 Automatic test systems for battery powered emergency escape lighting

## 6. Lighting Equipment

### 6.1. Interior Luminaires and Lamps

6.1.1. Lighting equipment for interior environments shall be provided in accordance with the criteria given in Table 11.

Criteria	LED	Non-LED
Colour	CCT: 3500-4000K CRI: >=80 MCAD: 3	CCT: 3500-4000K CRI: >=80 MCAD: 5
Efficacy	In accordance with AD L	In accordance with AD L
Design Life	Occupied spaces L80, B10 @ >= 50,000 hours, 25°C ambient	Rated life: 20,000 hours min Lamp survival factor: 80% Lamp lumen maintenance factor: 80%
Design Life	Unoccupied spaces Rated life: 30,000 hours min L70, B50 @ >= 30,000 hours, 25°C ambient	Rated life: 20,000 hours min Lamp survival factor: 80% Lamp lumen maintenance factor: 80%
Driver	Power Factor: 0.9 min Flicker factor: < 15% Dimming range: 1-100% of measured output	Power Factor: 0.9 min Frequency: 16,000Hz min Dimming range: 1-100%
IP	General Areas: IP2X WCs, science areas: IP44 Plants Space: IP65	General Areas: IP2X WCs, science areas: IP44 Plants Space: IP65
Luminaire Warranty Period	5 years <sup>(3)</sup>	5 years <sup>(4)</sup>

**Table 11 Light Source Criteria for Interior Environments**

#### Notes

1. Occupied spaces are generally Basic Teaching spaces, learning resource areas, halls, dining and PE areas, staff and administration areas, preparation areas, toilets and hygiene rooms, changing rooms, kitchen preparation areas and circulation.
2. Unoccupied areas are generally storage (including storage areas in science preparation rooms), other kitchen areas and plant areas.
3. For luminaires using LED sources the warranty shall include all LEDs, componentry, optics and body
4. For luminaires to include all major componentry

6.1.2. The Contractor shall indicate the maintainability of luminaires specified and the degree to which components can be replaced by skilled or unskilled labour.

## 6.2. Exterior Luminaires and Lamps

6.2.1. The Contractor shall provide external lighting systems that:

- a) ensure safe pedestrian and vehicular access
- b) are designed in accordance with LG5: covering car parks; sports facilities; walkways and roads; entrances; particular building features such as cycle stores, outbuildings and refuse collection areas; and security requirements
- c) are fitted with both time controls and daylight level photocell controls
- d) minimise light pollution (for example due to sports facilities or security lighting) and ensure light levels are kept within the limits as required by BS 5489<sup>2</sup> and avoid nuisance to the adjacent neighbourhood

6.2.2. If required in the School-Specific Brief, the Contractor shall provide underground ducts to MUGAs to enable future provision of lighting by the School at a later date.

6.2.3. Lighting equipment for exterior environments shall be provided in accordance with the criteria given in Table 12.

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<sup>2</sup> BS 5489 Code of practice for the design of road lighting

Criteria	LED	Non-LED
Colour	CCT: 3000-4000K CRI: 60 MCAD: 5	CCT: 3000-4000K CRI: 60 MCAD: 5
Efficacy	In accordance with AD L	In accordance with AD L
Design Life	Rated life: 30,000 hours L80, B10 @ >= 50,000 hours, 25°C ambient	Rated life: 20,000 hours LSF: 80% LLMF: 80%
Driver	Power Factor: 0.9 Flicker factor: < 15% Dimming range: 10-100% of measured output	Power Factor: 0.9 Flicker factor: < 15% Dimming range: 10-100%
IP	Exterior Areas: IP65	Exterior Areas: IP65
Warranty Period	5 years <sup>(1)</sup>	5 years <sup>(2)</sup>

**Table 12 Light Source Criteria for Exterior Environments**

## Notes

1. For luminaires using LED sources the warranty to include all LEDs, componentry, optics and body
2. For luminaires to include all major componentry

## 6.3. Reference Standards

6.3.1. The Contractor shall ensure that the design and installation of lighting equipment takes account of the relevant parts of the following standards (or updated documents if relevant). Where criteria are conflicting, precedence shall be given to the most recent publication:

1. BS EN 60598 Luminaires (and all relevant subsections)
2. IEC 62717 LED-modules for general lighting - Performance requirements
3. IEC 62722-2-1 Particular requirements for LED luminaires

# 7. Lighting Controls

## 7.1. System Functionality

- 7.1.1. Automatic lighting controls shall be provided to all spaces except stores in order to facilitate control of the visual environment and energy savings. Control devices are to be simple and intuitive with clear and robust labelling of the lighting switches showing the function of each input. Sensors coverage shall include all of the usable space minus a 500mm perimeter margin.
- 7.1.2. Building spaces shall be categorised and controlled based on the definitions in Table 13. See Table 1 for detailed definitions of types of spaces.
- 7.1.3. In temporarily and permanently owned spaces of up to 35m<sup>2</sup> (L0.1), automatic controls shall deactivate, but not activate the lighting system. The lighting system shall include motion sensors to switch the lighting in response to space vacancy. Manual controls shall override the automatic controls for a period of 40 minutes.
- 7.1.4. In temporarily and permanently owned spaces of over 35m<sup>2</sup> (L0.2), automatic controls shall deactivate, but not activate the lighting system. The lighting system shall include motion and constant illuminance sensors to switch and dim the lighting in response to space vacancy, daylight and initial over-lighting (resulting from maintenance factors used in calculations). Manual controls shall override the automatic controls for a period of 40 minutes.
- 7.1.5. In daylit corridors, stairs and lobbies which are classified as unowned transient spaces (L0.3), automatic controls shall activate and deactivate the lighting system. The lighting system shall include motion and illuminance sensors to switch and lighting in response to space vacancy and daylight level. Manual local controls shall be provided to override automatic controls.
- 7.1.6. In unowned transient spaces (L0.4), including corridors, stairs and lobbies which are not daylit, toilets, hygiene rooms and changing rooms, automatic controls shall activate and deactivate the lighting system. The lighting system shall include motion sensors to switch the lighting in response to space vacancy. Manual local controls shall be provided to override automatic controls.

<b>Types of Space</b>	<b>Description</b>	<b>CIBSE category reference</b>	<b>Control method</b>	<b>ADS code</b>
Administration offices; staff areas; group rooms; secondary practice rooms and study areas; primary libraries; D&T preparation; science preparation rooms	Temporary or permanently owned rooms for individuals and small groups	Owned spaces	Manual on, absence off	L0.1
Basic Teaching spaces (including classrooms); staff rooms; life skills (in special schools)	Temporary or permanently owned rooms for larger groups	Owned spaces	Manual on, absence off, daylight dimmed (only in a daylit space)	L0.2
Daylit circulation (including corridors, stairs and lobbies)	Transient spaces	Un-owned spaces	Presence on, absence off, daylight off (only in a daylit space)	L0.3
Toilets and hygiene rooms; changing rooms; non-daylit circulation	Transient spaces	Un-owned spaces	Presence on, absence off	L0.4



Types of Space	Description	CIBSE category reference	Control method	ADS code
Storage (excluding preparation); dark rooms; control rooms; sensory rooms; kiln rooms; kitchen preparation areas; other kitchen areas; plant area	Infrequently used areas or temporarily owned spaces	Un-owned or temporarily owned spaces	Manual on, manual off	L0.5
Halls, studios and PE spaces; sports halls; dining and social areas; secondary libraries	Spaces where individuals do not expect to control the lighting	Managed spaces	Key switch staff control with override on; presence on, daylight dimming (only in a daylight space) and absence off	L0.6

**Table 13 Lighting Control Categories**

**Note**

1. Spaces for SEND pupils require particular care. ‘Absence off’ should not be used where there are non-ambulant pupils or where required in the SSB.

7.1.7. In store rooms that are occasionally visited, dark rooms, control rooms and sensory rooms for SEN pupils, automatic controls are not required (L0.5). If automatic controls are provided the Contractor shall ensure that:

- a) automatic controls activate and deactivate the lighting system
- b) the lighting system includes motion sensors to switch lighting in response to space vacancy
- c) manual controls override the automatic controls for a period of 30 minutes

7.1.8. In managed spaces (L0.6) the lighting system shall be fully controllable by a member of staff, but controls shall not be accessible to students. Automatic controls shall deactivate, but not activate the lighting system. The lighting system shall include motion and constant illuminance sensors to switch and dim the lighting in response to space vacancy, daylight and initial over lighting (resulting from maintenance factors used in calculations). Manual controls shall override the automatic controls for a period of 40 minutes. Where exams take place, it should be possible to override the automatic control for a longer period.

### **7.1.9. Basic Teaching Spaces**

7.1.9.1. Manual control shall override automatic control and facilitate group switching.

7.1.9.2. Each luminaire row shall be independently controllable via manual inputs and the automatic system. A sensor device shall cover approximately 30m<sup>2</sup>. A 55 m<sup>2</sup> or 62 m<sup>2</sup> classroom shall include at least 1 sensor device located within 3.9m from the main window wall. Where a sensor controls multiple rows, dimming shall be algorithmic in order to factor the rows' distances from the window.

## **7.2. Reference Standards**

7.2.1. The Contractor shall ensure that the design and installation of lighting controls takes account of the relevant parts of the following standards (or updated documents if relevant). Where criteria are conflicting, precedence shall be given to the most recent publication:

1. CIBSE - LG14 'Controls for Electric Lighting'
2. IEC 62386 Pts 101-209 'Digital Addressable Lighting Interface (DALI)'
3. IEC 60929 Annex E 0-10v
4. CIBSE Commissioning Code L: 'Lighting'

## 8. Specific Requirements

### 8.1. Lighting of Special Schools and Designated Units

- 8.1.1. The Contractor shall ensure that the lighting design in Special Schools, Designated Units and Specially Resourced Provision meets the particular requirements of the School-Specific Brief, which take account of pupils' individual needs, such as:
- a) pupils with a hearing impairment needing higher light levels/clear visibility for lip-reading and signing
  - b) pupils with a visual impairment needing higher light levels to facilitate wayfinding and minimise the risk of accidents
  - c) pupils being very sensitive to glare from direct or reflected sunlight
  - d) automatic sensors that switch off lighting when no movement is detected not being suitable for children with limited mobility
- 8.1.2. Light fittings shall be low glare, avoiding any flicker and unwanted noise. Light sources shall not give off any disabling glare over changing beds or therapy couches.
- 8.1.3. The Contractor shall ensure that the guidance on design of lighting for SEND in CIBSE LG05 Sections 3.8 and 5.17 is followed, and that advice from a lighting specialist is taken for spaces for pupils with hearing impairments, visual impairments and complex visual needs<sup>3</sup>. In particular, modelling index and visual contrast shall be increased to suit their needs.
- 8.1.4. The lighting strategy and luminaires chosen shall be agreed with the Employer.

### 8.2. Reference Standards

- 8.2.1. The Contractor shall ensure that the design and installation of electric lighting takes account of the relevant parts of the following standard (or updated

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<sup>3</sup> The Royal National Institute for the Blind (RNIB) or similar organisations can advise on specialist environments for children with visual or multiple impairments.

document if relevant). Where criteria are conflicting, precedence shall be given to the most recent publication.

### **8.3. Specialist Lighting**

8.3.1. The Contractor shall refer to the School-Specific Brief in order to identify any additional lighting requirements. Where the Contractor employs a specialist to provide elements of the lighting (such as theatre lights), the Contractor shall:

- a) provide infrastructure as required by the specialist
- b) provide general lighting to the entire space in accordance with the Technical Annex
- c) ensure the Contractor's design is fully co-ordinated with specialist lighting equipment

8.3.2. The Contractor shall provide a stage lighting system in any school hall or drama studio. Unless otherwise stated in the SSB, these stage lighting systems shall use Digital Multiplex (DMX 512 Standard) controlled LED lights appropriate for the purpose.

8.3.3. Where LED stage lighting is provided in school halls and drama studios, it shall provide not less than the following.

- a) For a Primary School main hall:
  - i. one internally wired lighting bar with power and control outlets to support at least 6 DMX controlled LED lights
  - ii. four DMX controlled LED lights
- b) For a Secondary School main hall:
  - i. three internally wired lighting bars with power and control outlets to support at least 18 DMX controlled LED lights
  - ii. twelve DMX controlled LED lights
- c) For a drama studio:

- i. one internally wired lighting bar with power and control outlets to support at least 6 DMX controlled LED lights
- ii. 6 DMX controlled LED lights

8.3.4. All stage lighting systems shall be capable of being connected to a mobile lighting control system that can be used by students and teachers for educational purposes.

8.3.5. The position of the lighting bars and the selection of the lights must be carried out in such a way as to provide the school with the ability to cast light from a range of physical positions, change colours without need for working at height and use differing types of light fittings for creative effect, for example wash lights, profile lights and special effect lights.

8.3.6. The lighting control room shall have a control to enable the house lights to be dimmed or turned on/off at the start and end of a performance.

## 9. Demonstrating Compliance

### 9.1. Overview

9.1.1. The information exchange required is detailed in the Employer's Requirements Deliverables.

### 9.2. Calculation Specifications

9.2.1. Daylighting calculations shall be in accordance with Tables 14 to 18. Minimum surface reflectance's are provided in Annex 2D: 'Internal Elements and Finishes'.

Criteria	Description	Notes
Calculation Method	Radiosity, raytracing	(1), (2)
Analysis Method	Climate based daylight modelling	(2)
Weather file	EPW climate-based file, nearest to School Site	(2), (3)
Occupied hours	Typically, 08.30 – 16.00	(2)
Maximum Time Increments	≤ 15 minutes	(2)

**Table 14 Calculation Specifications**

#### Notes

1. Raytraced calculations require at least 5 light bounces
2. Applicable to daylighting calculations only
3. There are five EPW weather files for England. These are Gatwick (south), Birmingham (west-mid), Hemsby (east coast Norfolk), Finningley (Yorkshire) and Aughton (north west coast-Lancashire).

Criteria	Description	Notes
Model geometry detail	Main structural elements, window fenestration and external obstructions shall be included in the calculations	(1)
Wall reflectance	Wall reflectance to be area-weighted, to allow for the fact that 20% of the surface will be covered with items at 0.2 reflectance	(2), (3)

**Table 15 Model Geometry and Surface Specifications**

### Notes

1. Examples include pillars, beams, window reveals, window frames, overhangs, etc.
2. For example, if a paint finish is 0.7 reflective, factoring 20% of this area is covered with items 0.2 reflective results in a weighted average of 0.6 reflectance ( $0.7 * 0.8 + 0.2 * 0.2 = 0.6$ )
3. 20% of the area at 0.2 reflectance allows for the impact of posters, student work etc., on the walls.

Criteria	Value	Notes
Maximum point offset from wall	500 mm	(1)
Distance between calculation points	250 to 500 mm	N/A
Height of working plane above finished floor level	All spaces - according to Table 3.	N/A

**Table 16 Calculation Grid Specifications**

### Notes

1. The offset can include large, fixed pieces of furniture each as cupboards

Criteria	Description	Notes
Lamp Lumen Maintenance Factor (LLMF)	Calculations shall include a reduction factor to allow for a reduced light output resulting from lamp depreciation and failure rates	(1)
Luminaire Maintenance Factor (LMF)	Calculations shall include a reduction factor to allow for a reduced light output resulting from dirt build-up on luminaires	N/A
Room Surface Maintenance Factor (RSMF)	Manufacturers' surface reflectivity specifications shall be reduced by 10% in order to factor impact of dirt build up.	(2), (3)
Glazing Maintenance Factor	Calculations shall allow a 5% reduction to manufacturers' surface transmissivity specifications to factor impact of dirt build up.	(4)

**Table 17 Maintenance Factors**

**Notes**

1. LLMF: use manufacturers depreciation figures at 30,000 hours for proposed LED equipment
2. Applicable to daylight calculations only
3. For example: 0.8 reflectance with a 10% maintenance factor is 0.72 reflectance (0.8 \*0.9 = 0.72)
4. For example: 0.7 transmittance with a 5% maintenance factor is 0.67 transmittance (0.7 \*0.95 = 0.67)

**9.3. Calculation Reports**

9.3.1. As detailed in the Employer's Requirements Deliverables, an electric lighting and daylighting calculation report/drawing shall be provided in order to demonstrate compliance with the performance criteria for all spaces. A single calculation can be used to validate multiple spaces where the results can be meaningfully extrapolated. Calculation reports shall include the data as listed in Table 18.



Criteria	Notes
Software and calculation method used (raytracing or radiosity)	N/A
Data sheets for luminaires included in calculation. To show product reference, luminaire lumen output, polar curve and luminaire wattage	(1)
Room name (as shown in the project drawings) that the calculation is simulating and additional rooms the calculation is validating	N/A
Dimensioned luminaire layout in space	N/A
Type and location of weather file used	(2)
Results for horizontal, vertical and cylindrical illuminance and for glare calculations	(1)
Space geometry and surface properties	N/A
Calculation summary figures including the calculation grid average, minimum, maximum task illuminance and task uniformity	(1)
Iso-contour or pseudo-colour diagram of the results	N/A
Maintenance factors applied to calculation	(3)
Specification of the calculation grid	N/A

**Table 18 Required Data in Calculation Reports**

### Notes

1. Electrical lighting calculations only
2. Daylight calculations only
3. In accordance with Table 17

## 9.4. Equipment Submittals

9.4.1. As detailed in the Employer's Requirements Deliverables, a datasheet or schedule shall be submitted in order to demonstrate compliance with the performance criteria for all proposed lighting equipment. The datasheet/schedule shall clearly show the information in Table 19.

Criteria	Data	Notes
Luminaire	Reference as shown on drawings	N/A
Luminaire	Manufacturer and model	N/A
Luminaire	Image of product	N/A
Luminaire	Dimension of product	N/A
Luminaire	Mounting type (surface/recessed/suspended)	N/A
Luminaire	Material and finish (including colour)	N/A
Luminaire	Optics (louvre, lens, diffuser)	N/A
Luminaire	IP/IK (where appropriate)	N/A
Luminaire	Median rated useful life	N/A
Luminaire	Warranty	(1)
Light Source	Correlated Colour Temperature	N/A
Light Source	Colour Rendering Index	N/A
Light Source	Macadam Ellipse	N/A
Light Source	Luminaire Lumens/Circuit Watt	N/A
Light Source	L, B values	(2)
Light Source	Lamp depreciation and failure percentage at lamp design life	N/A
Driver / Ballast	Power Factor	N/A
Driver / Ballast	Frequency	N/A
Driver / Ballast	Driver DC Ripple Current	N/A
Driver / Ballast	Dimming range	N/A

**Table 19 Required Data in Luminaire Submittals**

**Notes**

1. For luminaires using LED sources the warranty to include all LEDs, componentry and luminaire
2. Applicable to LEDs only



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