



Department
for Education

School Output Specification

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

November 2022

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Summary

Technical Annex 2E provides the minimum requirements for daylighting and electric lighting requirements. It is to be read in conjunction with the Generic Design Brief (GDB) and the School Specific Brief (SSB).

Review Date

Review dates for this document shall be at 6-month intervals.

Who is this publication for?

This document is for technical professionals involved in the design and construction of school premises, as part of the Employer's Requirements of the DfE Construction Frameworks (the DfE Construction Framework 2021 and the Offsite Schools Framework (incorporating Modular and MMC delivery) (MMC)). It may also be used as the basis of similar documentation for other procurement routes using the Output Specification.

Uniclass Codes

This document captures Uniclass codes for the management of exchange of information. To access all codes and associated titles reference should be made to [Uniclass 2015 | NBS \(thenbs.com\)](https://www.thenbs.com/uniclass-2015)

1. Introduction

1.1. Overview

1.1.1 This document is one of the Technical Annexes that forms part of the Generic Design Brief (GDB). [PM_10_20]

1.1.2 The definitions listed in GDB shall apply to this Technical Annex and all other parts of the Output Specification. [PM_10_20]

1.1.3 This document shall be read in conjunction with the GDB and all other Technical Annexes as well as the School-specific Brief (SSB), including the School-specific Annexes. [PM_10_20]

1.1.4 This document sets out the required technical standards and performance criteria for daylight and electric lighting. [PM_10_20]

1.1.5 The information exchange required at each stage of the design, build and completion process is detailed in the DfE's Exchange Information Requirements (EIR). [PM_10_20_28]

1.1.6 The requirements in this Technical Annex shall apply to all parts of the works; New or Refurbished. [PM_10_20]

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 Technical Annexes 1A and 1B. These are used in the tables and text in this document. [PM_10_20_90]

2.2. Refurbishment

2.2.1 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). [Ac_10_70_70]

2.2.2 The work shall be categorised as Renewed, Replaced, Repaired, Retained or have 'No Work':

- a) Renewed electrical lighting element or system shall be designed to satisfy the relevant outputs of the GDB and this Technical Annex (and by the code in the ADS where relevant). [Ac_10_70_70]
- b) 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. [Ac_10_70_70]
- c) Repaired electrical lighting element or system shall comply to the specifications in any project-specific drawing issued as part of the SSB. The overall performance after repair shall be at least as good as that of the existing provision. [Ac_10_70_70]
- d) 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. [Ac_10_70_70]
- e) Elements requiring 'No Work' shall be left as existing. [Ac_10_70_70]

2.2.3 In respect of Refurbished Works, the required level of compliance with this Technical Annex is set out in the RSoW. [PM_10_20]

2.2.4 The requirements in this Technical Annex refer 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 Annex SS1. [PM_10_20_82]

2.2.5 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 facade). [Ac_10_70_70]

2.2.6 All refurbishment works shall be assessed to identify where retrospective legislation may apply and works shall be carried out to comply. [Ac_10_70_70]

2.2.7 Where the window layout is unchanged, daylight modelling is not required but any glare problems shall be addressed e.g., by provision of blinds. [PM_35_70_20]

2.2.8 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 (m²) as existing but with an upgraded specification. [PM_10_20_82]

3. Daylighting

3.1. Daylight Performance Criteria

3.1.1 The performance criteria for daylight, based on the types of space are defined in Annex 1A and 1B by the lighting ADS code. [PM_35_70_20]

3.1.2 Daylighting calculations shall be as the specification in Section 8. [PM_35_70_20]

3.1.3 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. [PM_35_70_20]

3.1.4 It is recognised that the primary performance criteria may not be able to be met in every space. [PM_35_70_20]

3.1.5 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 1. [PM_35_70_20]

3.1.6 Daylight access shall be demonstrated through spaces receiving daylight directly or indirectly that enhances the visual environment. [PM_35_70_20]

3.1.7 For Basic Teaching Areas (except drama studios), it should be as near the sDA and UDI levels quoted as possible. [PM_35_70_20]

3.1.8 For halls, dining and PE areas, LRCs, study spaces and circulation areas, a lower level of daylight is acceptable. See Table 1. [PM_35_70_20]

3.1.9 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. [PM_35_70_20]

3.1.10 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%. [PM_35_70_20]

3.1.11 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. [PM_35_70_20]

3.1.12 The final UDI result is taken as an average of the results across the task plane.
 [PM_35_70_20]

| Types of space (as identified in Annex 1A and 1B) | 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); independent life skills rooms (in special schools); science preparation rooms; administration offices; staff rooms | L1 | 80% of spaces | sDA (300/50%) shall be 50% | UDI-a (100~3000lux) shall be 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; LRCs | L2 | 65% of spaces | No requirement | UDI-a (100~3000lux) shall be 80% | Daylight access |
| SEN and support spaces; Arts learning resources and study areas; staff areas | L3 | 50% of spaces | No requirement | UDI-a (100~3000lux) shall be 80% | None |
| Circulation areas; DT preparation room; kitchen | L4 | Stairwells, and wherever | Daylight access required | Daylight access required | None |

| | | | | | |
|--|----|--------------------|--|--|-----|
| preparation areas; changing rooms | | possible elsewhere | | | |
| 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 1 Daylight Performance Criteria by Area Type

3.2. Shading Devices

3.2.1 Passive shading devices

3.2.1.1 As part of the overall façade design strategy the contractor shall consider the use of passive internal and external shading devices such as extended eaves, overhangs verandas, brise soleil to overcome both solar gain and solar glare. These methods should be investigated first and the remaining glare and overheating dealt with via blinds.

[Pr_30_59_07]

3.2.2 Blinds

3.2.2.1 Blinds or other means of solar glare and daylight control shall be provided to all exterior glazing (including rooflights) in Basic Teaching Areas, learning resource areas and staff areas (L1, L2 & L3), except within 15 degrees of absolute North where the Contractor proves the visual environment is adequate without blinds. [Pr_30_59_07]

3.2.2.2 The type of blind(s) or shading employed shall be dependent on factors such as window orientation, daylight performance and visual environment requirements of each space. [Pr_30_59_07]

3.2.2.3 The blinds shall not adversely affect the ventilation of the space. See Technical Annex 2F for the operability of the openable windows or glazed doors. [Pr_30_59_07]

3.2.2.4 Vertical blinds shall not be used in teaching areas as they can be easily damaged. [Pr_30_59_07]

3.2.2.5 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 paragraph 3.2.7. [Pr_30_59_07]

3.2.2.6 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%. [Pr_30_59_07]

3.2.2.7 Blinds can have a higher overall transmission and a higher openness or can be excluded, if the Contractor can demonstrate that the visual environment shall 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 facade. [Pr_30_59_07]

3.2.2.8 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 shall 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 desk lights. [Pr_30_59_07]

3.2.2.9 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 analysis to show that the rooflights are positioned to avoid solar glare. [Pr_30_59_07]

3.2.2.10 Assembly halls shall be daylit and drama studios may be daylit. [PM_35_70_20]

3.2.2.11 In assembly halls, and drama studios if they are daylit, blackout blinds or curtains are required for audio visual purposes. Low level background lighting is required for safety purposes. [Pr_30_59_07]

3.2.2.12 Requirements for blinds and curtains are also included in Technical Annex 2D Section 4 and Technical Annex 3 Section 5. [Pr_30_59_07]

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 2, Table 3 and Table 10. [PM_35_70_46]

4.1.2 Where Unified Glare Rating Limit (UGRL) calculations are not possible, compliance shall be demonstrated through luminaire intensity being limited to 3000 cd/m² above 65 degrees from a downward vertical. [PM_35_70_46]

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 3. [PM_35_70_46]

| Types of Space (as defined in Annex 1A and 1B) | Horizontal Illuminance Em lx | Horizontal Illuminance Uo | Horizontal Illuminance Task height (m) | Cylindrical Illuminance (WP height 1.2m) Ez lx | Cylindrical Illuminance (WP height 1.2m) Uo | Glare UGR | ADS Code |
|--|------------------------------------|---------------------------------|---|---|--|--------------|-------------|
| Primary Basic Teaching Area; Primary School libraries | 300 | 0.6 | 0.55 | 150 | 0.1 | 19 | a |
| Secondary General Teaching spaces; music rooms; SEN and support spaces; arts learning resources and study areas | 300 | 0.6 | 0.7 | 150 | 0.1 | 19 | b |
| LRCs | 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 |
| 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 and indoor 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 |
| Circulation areas | 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 2 Interior Horizontal and Cylindrical Illumination Criteria

¹ General lighting installation to be duplicated with a safelight installation for print development.

² Additional specialist SEN lighting is required.

| Areas | Vertical Illuminance Em lx | Vertical Illuminance Uo |
|---------------------------------|---|-------------------------|
| Whiteboards | 150 | 0.6 |
| Shelving and racking | 100 | 0.4 |
| Basic Teaching spaces: Walls | 50% of horizontal task illuminance or E_v min>100lx | 0.1 |
| Basic Teaching spaces: ceilings | 30% of horizontal task illuminance or E_h min>50lx | 0.1 |
| Offices: walls | 75 | 0.1 |
| Offices: ceilings | 50 | 0.1 |
| Circulation: walls | 50 | 0.1 |
| Ceilings | 30 | 0.1 |

Table 3 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 4 and Table 11. [PM_35_70_46]

4.2.1.2 Colour rendering and colour temperature shall be in accordance with Section 6. [PM_35_70_46]

| Areas | Horizontal Illuminance Em lx | Horizontal Illuminance Uo | Horizontal Illuminance WP Height (m) | Glare GRI |
|---|------------------------------|---------------------------|--------------------------------------|-----------|
| 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 |
| External Plant Areas and Walkways | 50 | 0.40 | 0 | 50 |

Table 4 Exterior Illumination Criteria

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. [PM_35_70_46]

4.3.2 The zoning definitions and performance criteria are summarized in Table 5 and Table 6, however refer to the ILP document. [PM_35_70_46]

| Zone | Surroundings | Lighting Environment | Examples |
|-------------|---------------------|-----------------------------|---|
| E0 | Protected | Dark | Unesco Straight Reserve, 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 5 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 |
| | Post-curfew | 0 | 0 | 500 | 1000 | 2500 |
| Building facade luminance (Lb) (cd/m2) Ave | Pre-curfew | 0 | 0 | 5 | 10 | 25 |

| | | | | | | |
|--|------------------------|---|-----|-----|-----|-----|
| Sign luminance (Ls) (cd/m ²) Max | Up to 10m ² | 0 | 100 | 400 | 600 | 600 |
| N/A | Over 10m ² | 0 | 0 | 200 | 300 | 300 |

Table 6 Performance Criteria for Obtrusive Light

4.4. Reference Standards

4.4.1 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. [PM_10_20_90]

- a) SLL Lighting Guide 5: Lighting for Education. [FI_70]
- b) BS EN 12464-1: Light and lighting. Lighting of workplaces. Indoor workplaces. [FI_70_85]
- c) BS EN 12464-2: Light and lighting. Lighting of workplaces. Outdoor workplaces. [FI_70_85]
- d) ILP GN01 Guidance. [FI_70]
- e) ILP GN08 Bats and artificial lighting. [FI_70]
- f) SLL Fact file 07 Design and assessment of exterior lighting schemes. [FI_70]

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 7, Table 8 and Table 9. [PM_35_70_46]

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. [PM_70_95_70]

| Parameter | Value | Notes |
|-----------------------------|---|-------|
| Area size | Generally, 60 m ² 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 _d) | <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 Ra 40 | N/A |

Table 7 Open Area Emergency Lighting Criteria

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 | 3 hours |
| Colour rendering | Lamp Ra 40 |

Table 8 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 Ra 40 | 1, 2, 3 |

Table 9 High Risk Task Area Emergency Lighting

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. [Ss_70_80_33]

5.1.2.2 Central or distributed batteries shall be located in environments with ambient temperature of 25°C or lower. [Ss_70_80_33]

5.1.2.3 Battery duration shall be at least 3 hours. [Ss_70_80_33]

5.1.2.4 The Contractor shall identify whether he is providing an emergency lighting automatic testing and monitoring system. [PM_10_20_82]

5.1.2.5 Details shall be provided of the School's responsibilities for testing the emergency lighting system aligned with the emergency lighting risk assessment, Fire Regulation Reform Order 2005, BS5266 pt1 and BS EN 50172. The details shall be included in the O&M Manuals. [PM_10_20_90]

5.1.2.6 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.
[Pr_70_70_47_02]
- b) A proprietary luminaire self-test system based upon individual luminaires.
[Pr_70_70_47_02]
- c) A centralised dedicated proprietary emergency lighting test and monitoring system. [Pr_70_70_47_02]
- d) Emergency lighting test and monitoring control algorithms as part of a centralised lighting control system. [Pr_70_70_47_02]

5.1.2.7 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. [PM_35_30_20]

5.2. Reference Standards

5.2.1 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. [PM_10_20_90]

- a) SLL Lighting Guide 12: Emergency Lighting. [FI_70]
- b) BS 5266 Emergency lighting. [FI_70_85]
- c) BS EN 1838:2013 Emergency lighting. [FI_70_85]
- d) BS 5499-4 Safety Signs. [FI_70_85]
- e) BS EN 50171 Central supply systems. [FI_70_85]
- f) BS EN 50172 Emergency Escape Lighting Systems. [FI_70_85]
- g) BS EN 50172-2 Battery Requirements. [FI_70_85]
- h) BS EN 60598-2-22 Luminaire Particulars - Emergency Lighting. [FI_70_85]
- i) BS EN 62034 Automatic test systems for battery powered emergency escape lighting. [FI_70_85]

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 10. [Ss_70_80_33]

| Criteria | LED | Non-LED |
|-------------|---|---|
| Colour | CCT: 3500-4000K CRI: >=80 MCAD: 3 | CCT: 3500-4000K CRI: >=80 MCAD: 4 |
| Efficacy | In accordance with AD L | In accordance with AD L |
| Design Life | Occupied spaces ⁽¹⁾ L80, B10 @ >= 50,000 hours, 25C ambient | Rated life: 20,000 hours min Lamp survival factor: 80% Lamp lumen maintenance factor: 80% |
| Design Life | Unoccupied spaces ⁽²⁾ Rated life: 30,000 hours min L70, B50 @ >= 30,000 hours, 25C 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 | General Areas: IP2X WCs, science areas: IP44 |

| | | |
|------------------------------|------------------------|------------------------|
| | Plants Space: IP65 | Plants Space: IP65 |
| Luminaire Warranty Period | 5 years ⁽³⁾ | 5 years ⁽⁴⁾ |

Table 10 Light Source Criteria for Interior Environments

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 areas.

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 Indicate the maintainability of luminaires specified and the degree to which components can be replaced by skilled or unskilled labour. [PM_10_20_82]

6.2. Exterior Luminaires and Lamps

6.2.1 Appropriate external lighting systems for safe pedestrian and user access shall be provided. [Ss_70_80_25]

6.2.2 Security lighting to temporary and permanent buildings shall be provided if required in the School-specific Brief following the Access and Security Strategy and the Risk Assessment as detailed in the SSB. All as required by GBD Section 2.14 Safety and Security. [PM_10_20_90]

6.2.3 If required in the School-specific Brief, underground ducts to MUGAs shall be provided to enable future provision of lighting by the School at a later date. [PM_10_20_82]

6.2.4 Lighting equipment for exterior environments shall be provided in accordance with the criteria given in Table 11. [Ss_70_80_25]

| 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, 25C 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 ⁽¹⁾ | 5 years ⁽²⁾ |

Table 11 Light Source Criteria for Exterior Environments

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 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. [PM_10_20_90]

- a) BS EN 60598 Luminaires (and all relevant subsections). [FI_70_85]
- b) IEC 62717 LED-modules for general lighting - Performance requirements. [FI_70_85]
- c) IEC 62722-2-1 Particular requirements for LED luminaires. [FI_70_85]

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. [Pr_70_70_47]

7.1.2 Control devices shall be simple and intuitive with clear and robust labelling of the lighting switches showing the function of each input. [Pr_70_70_47]

7.1.3 Sensor coverage shall include all the usable space minus a 500mm perimeter margin. [Pr_70_70_47]

7.1.4 Building spaces shall be categorised and controlled based on the definitions in Table 12. See Technical Annex 1A and 1B for detailed definitions of types of spaces. [PM_10_20_90]

7.1.5 In temporarily and permanently owned spaces of up to 35m² (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. [Ss_70_80_33]

7.1.6 In temporarily and permanently owned spaces of over 35m² (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. [Ss_70_80_33]

7.1.7 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 the lighting in response to space vacancy and daylight level. Manual local controls shall be provided to override automatic controls. [Ss_70_80_33]

7.1.8 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. [Ss_70_80_33]

| Types of Space | Description | CIBSE category reference | Control method | ADS code |
|---|---|--------------------------------------|--|-----------------|
| Administration offices; staff areas; SEN and support spaces; arts learning resources and study areas; Primary School libraries; 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; independent life skills rooms (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 areas (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 areas | Transient spaces | Un-owned spaces | Presence on, absence off | L0.4 |
| 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 and indoor PE spaces; dining and social areas; LRCs | 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 12 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.

7.1.9 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, ensure that:

- a) automatic controls activate and deactivate the lighting system [Pr_70_70_47]
- b) the lighting system includes motion sensors to switch lighting in response to space vacancy [Ss_70_80_33]
- c) manual controls override the automatic controls for a period of 30 minutes. [Pr_70_70_47]

7.1.10 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. [Ss_70_80_33]

7.1.11 In Basic Teaching spaces, manual control shall override automatic control and facilitate group switching. [Ss_70_80_33]

7.1.12 Each luminaire row shall be independently controllable via manual inputs and the automatic system. A sensor device shall cover approximately 30m². A 55 m² or 62 m² 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. [Ss_70_80_33]

7.1.13 Luminaire switching shall be designed to prevent glare to any A/V installation. [Ss_70_80_33]

7.2. Reference Standards

7.2.1 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. [PM_10_20_90]

- a) SSL/CIBSE - LG14 Controls for Electric Lighting. [FI_70_85]
- b) IEC 62386 Pts 101-209 Digital Addressable Lighting Interface (DALI). [FI_70_85]
- c) IEC 60929 Technical Annex E 0-10v. [FI_70_85]
- d) CIBSE Commissioning Code L: Lighting. [FI_70_85]

8. Specific Requirements

8.1. Lighting of Special Schools and Designated Units

8.1.1 Ensure that the lighting design in Special Schools, Designated Units and Specially Resourced Provision meets the particular requirements of the School-specific Brief, which takes account of pupils' individual needs, such as:

- a) pupils with a hearing impairment needing higher light levels/clear visibility for lip-reading and signing [PM_35_50_01]
- b) pupils with a visual impairment needing higher light levels to facilitate wayfinding and minimise the risk of accidents [PM_35_50_01]
- c) pupils being very sensitive to glare from direct or reflected sunlight [PM_35_50_01]
- d) automatic sensors that switch off lighting when no movement is detected not being suitable for children with limited mobility. [PM_35_50_01]

8.1.2 Light fittings shall be low glare, avoiding any flicker and unwanted noise. [PM_35_50_01]

8.1.3 Light sources shall not give off any disabling glare over changing beds or therapy couches. [PM_35_50_01]

8.1.4 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. In particular, modelling index and visual contrast shall be increased to suit their needs. [PM_10_20_90]

8.1.5 The lighting strategy and luminaires chosen shall be agreed with the Employer. [PM_35_70_46]

8.2. Reference Standards

8.2.1 Ensure that the design and installation of electric lighting takes account of the relevant parts of the following standard CIBSE LG05 (or updated document if relevant). [PM_35_70_46]

8.2.2 Where criteria are conflicting, precedence shall be given to the most recent publication. [PM_35_70_46]

8.2.3 The Royal National Institute for the Blind (RNIB) or similar organisation can advise on specialist environments for children with visual or multiple impairments. [PM_10_20_82]

8.3. Specialist Lighting

8.3.1 Refer to the School-specific Brief in order to identify any additional lighting requirements. [PM_10_20_90]

8.3.2 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 [PM_10_20_82]
- b) provide general lighting to the entire space in accordance with the Technical Annex 2E [PM_10_20_90]
- c) ensure the Contractors' design is fully co-ordinated with specialist lighting equipment. [PM_10_20_82]

8.3.3 Provide a stage lighting system in any assembly hall or drama studio. [Ss_70_80_33_88]

8.3.4 Unless otherwise stated in the SSB, these stage lighting systems shall use Digital Multiplex (DMX 512 Standard) controlled LED lights appropriate for the purpose. [Ss_70_80_33_88]

8.3.5 Where LED stage lighting is provided in school halls and drama studios, it shall provide not less than the following. [Ss_70_80_33_88]

- a) For a Primary School assembly hall:
 - i) One internally wired lighting bar with power and control outlets to support at least 6 DMX controlled LED lights. [Ss_70_80_33_88]
 - ii) Four DMX controlled LED lights. [Ss_70_80_33_88]
- b) For a Secondary School assembly hall:
 - i) Three internally wired lighting bars with power and control outlets to support at least 18 DMX controlled LED lights. [Ss_70_80_33_88]
 - ii) Twelve DMX controlled LED lights. [Ss_70_80_33_88]
- c) For a drama studio:

i) Two internally wired lighting bars with power and control outlets to support at least 3 DMX controlled LED lights on each. Bars shall be capable of being positioned in a T, + or X shape. [Ss_70_80_33_88]

ii) Six DMX controlled LED lights. [Ss_70_80_33_88]

8.3.6 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. [PM_10_20_82]

8.3.7 The position of the lighting bars and the selection of the lights should 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. [PM_10_20_82]

8.3.8 The lighting and audio 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. [PM_10_20_82]

9. Demonstrating Compliance

9.1. Overview

9.1.1 The Contractor shall demonstrate compliance with the Employer's Requirements by use of protocols detailed in the Contractor's Quality Assurance procedures capturing evidence of both coordinated design and its implementation into the construction of the School Building(s) with photographic evidence and/or third-party accreditation. [PM_70_15]

9.2. Calculation Specifications

9.2.1 Daylighting calculations shall be in accordance with Tables 13 to 17. [PM_40_30_20]

9.2.2 Minimum surface reflectances are provided in Technical Annex 2D. [PM_10_20_90]

| Criteria | Description | Notes |
|--------------------------|--|----------|
| Calculation Method | Radiosity, raytracing | (1), (2) |
| Daylight 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 | <1 hour | (2) |

Table 13 Calculation Specifications

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 (westmid), Hembsy (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 shall be covered with items at 0.2 reflectance | (2), (3) |

Table 14 Model Geometry and Surface Specifications

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 ($0.7 \times 0.8 + 0.2 \times 0.2 = 0.6$).

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 2. | N/A |

Table 15 Calculation Grid Specifications

¹ The offset can include large, fixed pieces of furniture such 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 16 Maintenance Factors

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 ($0.8 \times 0.9 = 0.72$)

⁴ For example: 0.7 transmittance with a 5% maintenance factor is 0.67 transmittance ($0.7 \times 0.95 = 0.67$)

9.3. Calculation Reports

9.3.1 As detailed in the DfE's EIR, an electric lighting and daylighting calculation report/drawing shall be provided in order to demonstrate compliance with the performance criteria for all spaces. [PM_10_20_28]

9.3.2 A single calculation can be used to validate multiple spaces where the results can be meaningfully extrapolated. [PM_40_30_20]

9.3.3 Calculation reports shall include the data as listed in Table 17. [PM_40_30_20]

| 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, | (1) |

| | |
|---|-----|
| minimum, maximum task illuminance and task uniformity | |
| 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 17 Required Data in Calculation Reports

¹ Electrical lighting calculations only.

² Daylight calculations only.

³ In accordance with Table 16.

9.4. Equipment Submittals

9.4.1 As detailed in the DfE's EIR, a datasheet or schedule shall be submitted in order to demonstrate compliance with the performance criteria for all proposed lighting equipment. [PM_10_20_28]

9.4.2 The datasheet/schedule shall clearly show the information in Table 18. [PM_10_20_82]

| 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 18 Required Data in Luminaire Submittals

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

² Applicable to LEDs only.



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