MIMWEP | Flintshire County Council

Mynydd Isa Campus, Flintshire

Floodlight Assessment

FL0101-ARP-XX-XX-SP-E-00003

Stage 3 Final | 1 July 2021

Job number 280340

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Document Verification

ARUP

Job title		Mynydd Isa Campus, Flintshire			**Job number** 280340
Document title		Floodlight Assessment			**File reference** 4-50
Document ref		FL0101-ARP-XX-XX-SP-E-00003			
Revision	**Date**	**Filename**	Stage 3 Floodlight Assessment.docx		
P01	29 June 2021	**Description**	For Information		
			Prepared by	Checked by	Approved by
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
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		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
Issue Document Verification with Document ☐					

Contents

Contents

Document Verification 1

Contents **1**

1 Introduction **1**

1.1 Project Description 1
1.2 Site Context 2
1.3 Lighting Analysis Sensitive Receptors 2
1.4 Design Criteria 2
1.4.1 Outdoor Sports Pitches 2
1.4.2 Car Parking, Traffic Areas and Turning Areas 4
1.4.3 Walkways for Pedestrians 4
1.4.4 Building Perimeter 4
1.4.5 General Overview 4

2 Luminaire Selection Overview **5**

2.1 Outdoor Sports Pitches 5
2.1.1 Thorn Champion Floodlight (XB) 5
2.2 Car Parking, Traffic Areas and Turning Areas 5
2.2.1 Thorn Isaro Pro (XA) 5
2.3 Walkways for Pedestrians 6
2.3.1 Thorn Thor Bollard (XC) 6
2.3.2 Thorn Plurio (XD) 6
2.4 Building Perimeter 7
2.4.1 Thorn Piazza II LED 7

3 Calculations **7**

3.1 Methodology 7
3.2 Assumptions 7
3.3 Operational Hours 7

4 Assessment Criteria and Performance of the Proposed Design **8**

4.1 Design Notes 8
4.1.1 Environmental Zones 8
4.1.2 Upward Light Ratio (ULR) 8
4.1.3 Limits on Upward Tilt 8
4.1.4 Maximum Values of Vertical Illuminance on Properties 9

5 Summary **9**

Appendix A **10**

External Lighting Layout **10**

A1 1

Appendix B **2**

Selected Dialux Results **2**

B1 3

Appendix C **12**

Values of Vertical Illuminance **12**

C1 13
C1.1 West Houses Lighting Spillage Check 13
C1.2 North Road Lighting Spillage Check 13
C1.3 Farm North Lighting Spillage Check 14
C1.4 North East Field Lighting Spillage Check 14

Appendix D **15**

ULR Values **15**

D1 16

1 Introduction

This report is intended to provide an outline on the proposed external lighting scheme for the Mynydd Isa Campus project in the village of Mynydd Isa in Flintshire.

The purpose of this report will be to look into the impact from the proposed lighting for the scheme on nearby areas, notably the houses adjacent to the site.

The report will provide details about the proposed external lighting scheme for the various different pitches, roads, turn around areas, pedestrian walkways and car parks.

The main areas of concern for light spillage onto nearby housing will be looked into with the most detail, these are the car park areas, pitches, and turn around areas. Other areas aren't deemed to be as much of a concern for light spillage when compared to these.

This outline specification report is provided for discussion only at this stage. All details are subject to confirmation and further design development.

Figure 1 – Site Layout Option – Sketch plan

1.1 Project Description

The proposed site for the new Mynydd Isa Campus project is located on the grounds of the existing Argoed High School in the village of Mynydd Isa, Flintshire.

Mynydd Isa campus will consist of a nursey, primary and secondary school with SEN facilities.

The proposed building is generally two storey, it is shallow plan in nature with a central spine with protruding 'fingers'. This building form will maximise natural ventilation and daylight while achieving the client's adjacency requirements.

The new school campus is based on approximately 10,300m^2 gross internal area and will accommodate 1,400 pupils of various ages. The proposed building will accommodate Art, Food Technology, ICT, Science, Music and general classroom spaces.

Figure 2: Site Overview

1.2 Site Context

The site that has been proposed is made up from a primary education building and a compressive education building that are joined together. North West of the main school building is the car park and drop off points, adjacent to this area is Bryn Road. North East of the main building is a turnaround area for vehicles, with a bin store and two MUGA pitches. South of the building there are three MUGA pitches, along with various routes for pedestrians to walk. Finally, west of the building there is a pitch consisting of three different 5-a-side football areas.

Near to the site are existing suburban residential areas, notably to the North, South and West. These existing suburban residential areas contain low-rise residential properties, East of the site however contains only fields.

1.3 Lighting Analysis Sensitive Receptors

The proposed external lighting installation may have an impact on the following areas:

- Existing residential properties to the North, South and West
- Fields to the East

1.4 Design Criteria

1.4.1 Outdoor Sports Pitches

1.4.1.1 MUGA Sports Pitches

The external lighting for the MUGA or Multi Use Games Areas has been designed in accordance with:

- Sports England – Artificial Sports Lighting

The various MUGA pitches have been designed to the maximum required lux requirement of the various games included in MUGA as stated in the document – this being Tennis with a 500 lux average requirement at the Principle Playing Area or PPA of the pitch and a 0.7 uniformity requirement.

Various controlling and dimming methods should be used to ensure that the correct lux levels and uniformities are kept to for each different MUGA type of game. As seen in ‘Figure 4’, the various requirements for the MUGA can be seen.

The lighting for the MUGA pitches will be made up of floodlights that are mounted on columns located on the fencing for the pitches.

It has been assumed that in locations where MUGA pitches are joined next to each other, that both lighting systems will be operating at the same time and not on an individual pitch basis.

Luminaires used for the floodlighting has been chosen for its optical efficiency and minimum light spillage, while utilizing as high efficiency and low energy consumption units as possible.

Figure 3: Site Details

Club and Community lighting for tennis, netball, 5-a-side, basketball, rush hockey					
		Club		Community	
		Horizontal Illuminance (Lux)	Uniformity (Emin / Eave)	Horizontal Illuminance (Lux)	Uniformity (Emin / Eave)
Netball		400	0.7	400	0.7
Tennis (recommended)	PPA	500	0.7	500	0.7
	TPA	400	0.6	400	0.6
5-a-side football		120	0.6	120	0.6
Basketball		200	0.6	75	0.5
Rush hockey		350	0.7	200	0.7

Figure 4: MUGA Lighting Requirements

1.4.1.2 5-a-side Football Pitches

The external lighting for the 5-a-side football pitches have been designed in accordance with:

- Sports England – Artificial Sports Lighting

The outdoor 5-a-side football pitches will be kept at 120 average lux for usage, with a uniformity of 0.6. A clause could be made to minimise running costs that during recreational play and training lighting control methods should be utilized to deliver a suitable 75 average lux, however this choice is up to the client.

1.4.1.3 Selected Luminaires

For the outdoor pitch lighting the luminaires selected will provide a low light pollution with efficient distribution of light across the pitches. The luminaires used will utilize 0° of tilt for the pitch lighting, additionally they will use a full horizontal cut-off and an upward light ratio that will not exceed 5%. Pitch lighting luminaires on the perimeter of the site will use asymmetrical optics in order to reduce backward light spill.

MUGA pitch luminaires will be mounted at a height of 10m, while the 5-a-side football pitch luminaires will be mounted at a height of 15m.

The scheme utilizes Thorn Champion 935W fittings that output a luminous flux of 117400, it projects a 65° asymmetrical light distribution. Control gear for these will be external. Ingress Protection rating of IP66 and an Impact Rating of IP08.

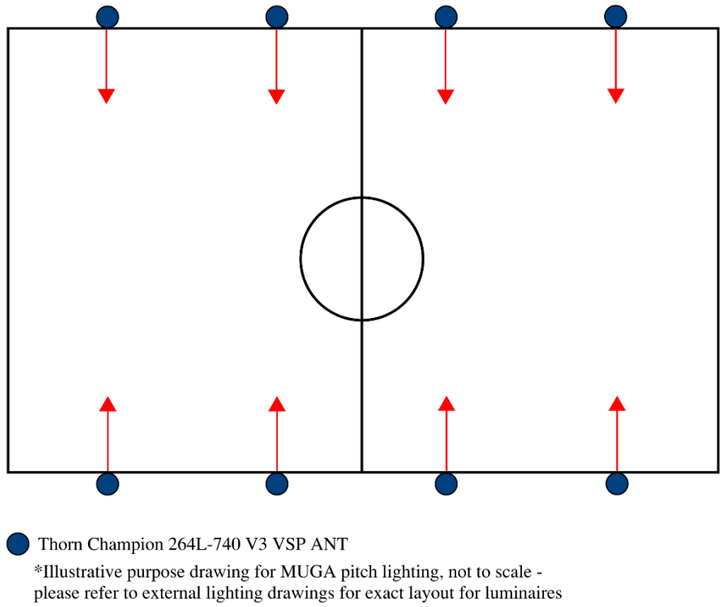


Figure 6: MUGA Lighting illustrative layout for single pitch

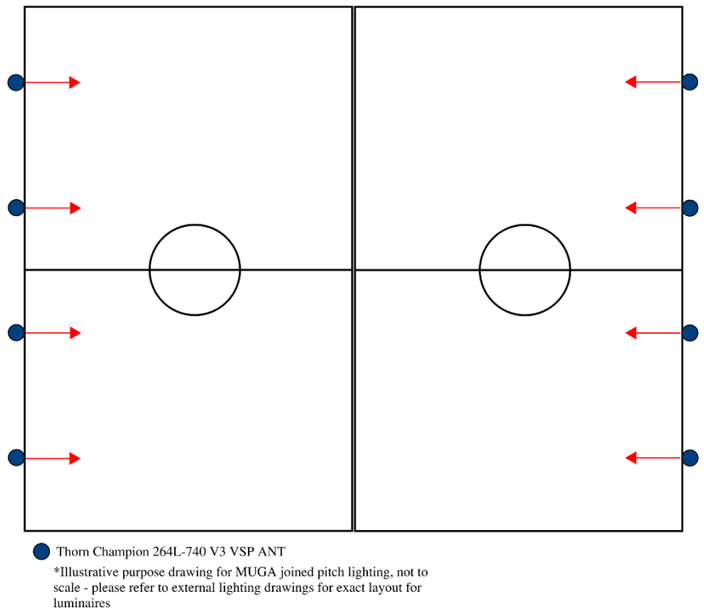


Figure 5: MUGA Lighting illustrative layout for pitches beside each other

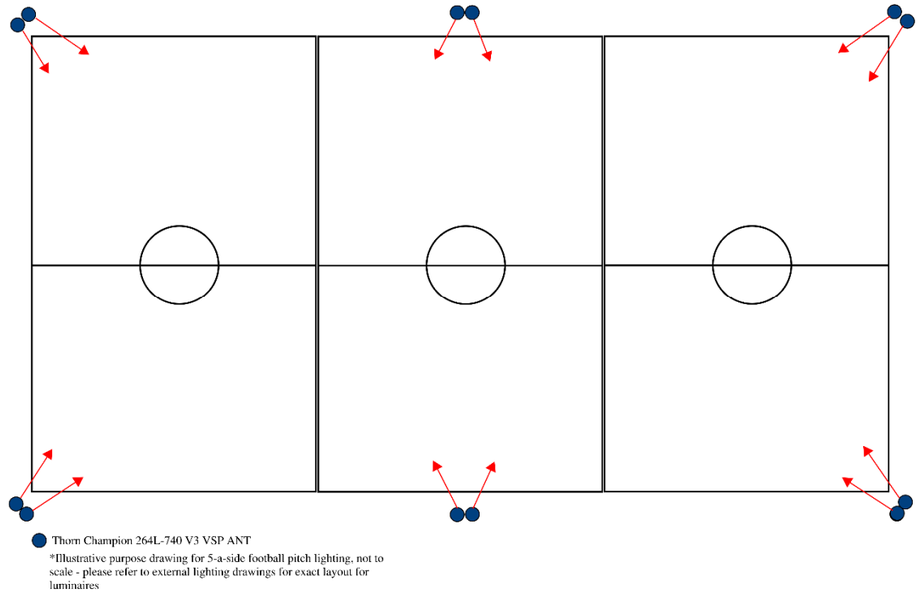


Figure 7: 5-a-side Pitch Lighting illustrative layout

1.4.2 Car Parking, Traffic Areas and Turning Areas

The car park and traffic areas on the site have been designed to ensure that the area is safe and secure for students and the teaching staff at the campus. These areas have been designed in accordance to the 'Appendix 1 – ACRs (Generic Design Requirements)' recommended levels from the school authority. With the traffic areas found on the premises utilizing a 10 lux average minimum level with a uniformity of 0.4, parking areas having a 10 lux average minimum level with a uniformity of 0.25 and finally turning points having a 50 lux average minimum level with a uniformity of 0.4.

The luminaires for these areas will be column mounted at heights of 6m. Please refer to the external lighting drawing for more details on these areas.

The turning area located North of the main campus building uses some column mounted luminaires that are tiled at 15° to ensure correct lighting of the area is completed, please refer to the external lighting layout for more details on these particular fittings.

1.4.2.1 Selected Luminaires

For the car park, traffic and turning areas a high-performance LED street lantern has been chosen, the unit chosen is highly efficient and robust.

The scheme has been designed to use Thorn Isara Pro 41W fittings that output a luminous flux of 5369, it has a choice of several different light distributions available to be used.

1.4.3 Walkways for Pedestrians

In order to illuminate the walkways that surround the campus, a combination of fittings have been utilized in the design.

One of the fittings used on the smaller pedestrian walkways is a low level bollard type of luminaire, in particular the walkways located near the pedestrian footbridge, primary school MUGAs, high school MUGAs, and some of the walkways from the staff and visitor car park. However, for more detailed information on their positioning, please refer to the external lighting layout drawing.

These bollards will give benefit from creating very little light spill to the residential areas that they are near, while providing a consistent light coverage along its designated walkways which will help highlight any potential tripping hazards that may be along the routes.

The second fitting chosen to be used on the larger pedestrian walkways is a post top LED lantern type fitting, this is to ensure a greater spread of light distribution when the walkway is wider than what a bollard type fitting would be used for. Notably this type of fitting is employed near the campus entrance and the walkways surrounding the campus. For more detailed information on their positioning, please refer to the external lighting layout drawing.

The low-level bollard type fitting is around 1m high and the post top lantern type fitting is 4m high.

1.4.3.1 Selected Luminaires

For the low level bollard fitting, a slim bollard with a high performance optic has been chosen offering energy saving and a comfortable light level. The optic gives low glare direct and indirect lighting and a symmetric distribution.

The scheme has been designed for the usage of a Thorn Thor 11W Bollard that is able to output a luminous flux of 872,

For the post top LED lantern a high efficiency and performance luminaire has been selected, it uses a radially symmetric distribution.

The scheme has designed for the usage of a Thorn Plurio 26W fitting which would be able to output a luminous flux of 3261.

1.4.4 Building Perimeter

Around the perimeter building lighting has been designed for staff and students to walk from point to point, to design for this a combination of fittings has been used.

As discussed in the luminaires for 1.4.3, both the low level bollard and post top LED lantern will be used along with a wall mounted fitting. The wall mounted luminaire will be a dedicated building perimeter type of fitting that will have very little upward light throw. For more information regarding the positioning of these wall mounted fittings, please refer to the external lighting layout.

1.4.4.1 Selected Luminaires

For the building perimeter lighting, the wall mounted fitting used will be a Thorn Piazza II 25W LED which is a robust IP65 unit capable of a luminous flux of 2910.

1.4.5 General Overview

For the light spillage on the vertical and horizontal caused by the external lighting fittings used, the scheme has been assessed following the 'Guidance Notes for the Reduction of Obtrusive Light' created by the Institution of Lighting Professionals'.

Each element of the external lighting scheme will be created in line to comply with the guidance note to ensure any light spillage is in accordance with the referenced document.

2 Luminaire Selection Overview

2.1 Outdoor Sports Pitches

2.1.1 Thorn Champion Floodlight (XB)

Figure 8: Luminaire Image for Thorn Champion Floodlight

The Thorn Champion 935W fitting outputs a luminous flux of 117400, it projects a 65° asymmetrical light distribution. Control gear for these will be external. Ingress Protection rating of IP66 and an Impact Rating of IP08.

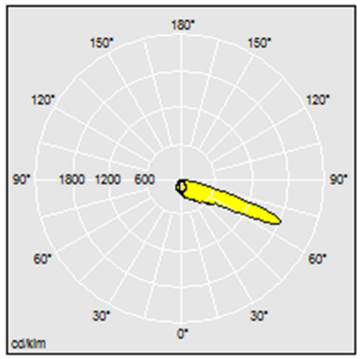


Figure 9: Photometric Distribution for Thorn Champion

2.2 Car Parking, Traffic Areas and Turning Areas

2.2.1 Thorn Isaro Pro (XA)

Figure 10: Luminaire Image for Thorn Isaro Pro

The Thorn Isara Pro 41W fitting outputs a luminous flux of 5369, it has a choice of several different light distributions available to be used. Its column mounted with an Ingress Protection rating of IP66 and an Impact Rating of IK09.

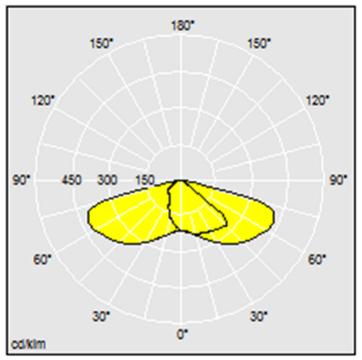


Figure 11: Photometric Distribution for Thorn Isaro Pro

2.3 Walkways for Pedestrians

2.3.1 Thorn Thor Bollard (XC)

Figure 12: Luminaire Image for Thorn Thor Bollard

The Thorn Thor 11W Bollard outputs a luminous flux of 872. It's a slim bollard with a high-performance optic, offering energy saving and a comfortable light level. The optic gives low glare direct and indirect lighting and a symmetric distribution. It has an Ingress Protection rating of IP66 and an Impact Rating of IK10 making it vandal resistant.

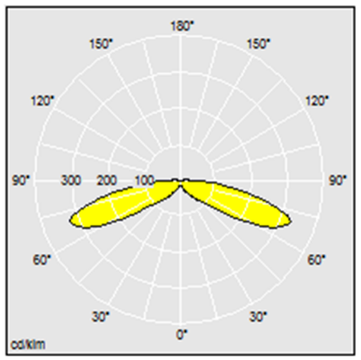


Figure 13: Photometric Distribution for Thorn Thor Bollard

2.3.2 Thorn Plurio (XD)

Figure 14: Luminaire Image for Thorn Plurio

The Thorn Plurio 26W outputs a luminous flux of 3261. Its a post top LED lantern with a high efficiency and performance, it uses a radially symmetric distribution. It has an Ingress Protection rating of IP66 and an Impact Rating of IK08.

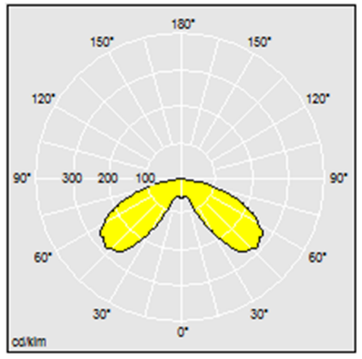


Figure 15: Photometric Distribution for Thorn Plurio

2.4 Building Perimeter

2.4.1 Thorn Piazza II LED

Figure 16: Luminaire Image for Thorn Piazza II LED

The Thorn Piazza II 25W LED outputs a luminous flux of 2910. It's a building perimeter fitting that has low upward throw and it has an Ingress Protection rating of IP65 and an Impact Rating of IK10.

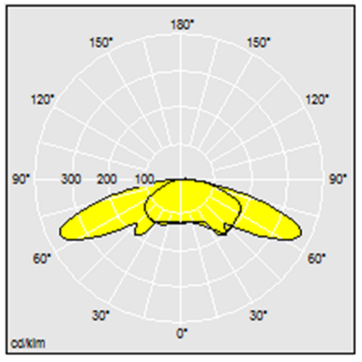


Figure 17: Photometric Distribution for Thorn Piazza II LED

3 Calculations

3.1 Methodology

Using the Dialux® software package, the external lighting design was conducted. The package was used to check the horizontal luminance levels, luminous intensity, upward light spill and glare. Designs were created for the site using the attributes of the area and making sure all contributions of light for spillage were considered.

The horizontal luminance and uniformity levels have been calculated to the required levels as discussed earlier in this report. All calculations conducted are subject to change and revision further into design, and items discussed in this report are as the design stands as of RIBA Stage 3.

3.2 Assumptions

- Maintenance factors for the schemes design are 0.80 for all external lighting except the pitch lighting, which is assumed to be 0.75.
- Vegetation and trees have been included in calculations where possible, however not all additions were possible.
- Differences in ground levels on the site and nearby areas have been considered negligible to our calculations for this stage of design.
- Contribution of existing road lighting or light sources nearby have not been considered for this design.
- Calculation point for source intensity was set at a standing height of 1.7m.
- Pitch surround has been assumed to be a minimal mesh pattern with little blockage to light sources.
- All luminaire outputs have been set to 100% in light outputs.
- Reflectance values used for 3G and grass pitch areas is 24%

3.3 Operational Hours

It's assumed that the lighting used for the campus will only be operating during standard school hours, along with the additional usage from community activities that may occur before or after school on the various MUGA pitches and the 5-a-side football pitches. With these hours considered, its imagined that the maximum range that the lighting would be operational is from 0700 hours to 2300 hours. In order to comply with the ILP referenced document discussed in the report earlier, light spillage occurring during curfew hours needs to be kept to an absolute minimum.

The switching off of various sections that aren't needed overnight for the external lighting layout will be determined at a later stage in design.

4 Assessment Criteria and Performance of the Proposed Design

4.1 Design Notes

The 'Guidance Notes for the Reduction of Obtrusive Light' by the Institution of Lighting Professionals considers many different aspects for obtrusive light, however not all criteria of calculations were able to be conducted at this point in the design. Therefore, only the main criteria will be discussed in this document. Further analysis will be conducted at a later stage of the design.

4.1.1 Environmental Zones

In order to correctly specify lighting requirements, a designation of the type of zone that the site is located at must be conducted. The zone designation will provide a basis that the design criteria can be designed to.

Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

The Mynydd Isa Campus project in the village of Mynydd Isa in Flintshire should be considered a E3 zone, a well inhabited mix of rural/urban settlements. With the residential area nearby to the campus, and the area being a relatively small town this designation can be justified.

4.1.2 Upward Light Ratio (ULR)

To ensure that skyglow effects are limited, boundaries are set out on the percentage of flux that can be directly emitted above the horizontal plane. In this projects scenario this percentage will be 5%.

Table 6 (CIE 150 table 5): Maximum values of upward light ratio (ULR) of luminaires.

Light technical parameter	Environmental zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR)/%	0	0	2.5	5	15

The current proposed design achieves a compliant ULR level of 2.5%. See 'Appendix D' for the ULR values found in the calculation models, separate models had to be used due to software limitations.

4.1.3 Limits on Upward Tilt

Luminaires beams shall not be tilted more than 70° from vertical.

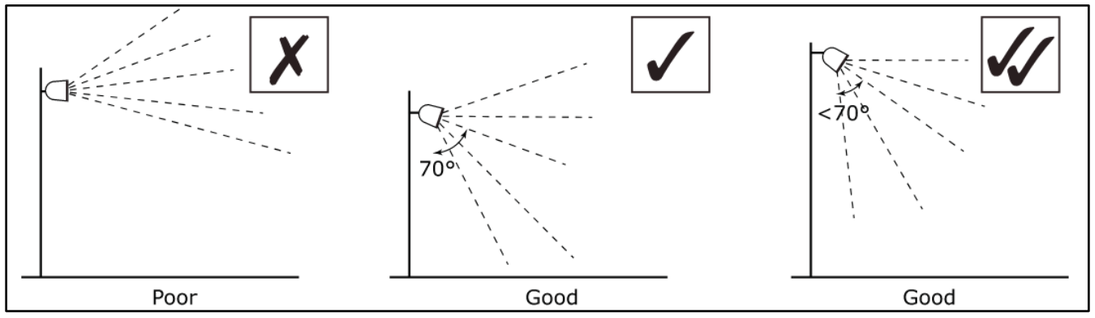


Figure 18: Upward Tilt

None of the fittings proposed in the current design utilize any form of combined tilt of luminaire heads and optics more than 70°, therefore the proposed design is compliant.

4.1.4 Maximum Values of Vertical Illuminance on Properties

Table 3 (CIE 150 table 2): Maximum values of vertical illuminance on properties.

Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (E_v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx

The ‘Guidance Notes for the Reduction of Obtrusive Light’ highlights the maximum values of illuminance that are allowed to reach nearby properties to the campus.

As seen in ‘CIE 150 Table 2’ above, the maximum permitted value that is allowed for an E3 environmental zone is 10 lux during pre-curfew and 2 lux post-curfew.

The results shown in ‘Appendix C’ show that the current external lighting design complies with the required illuminance criteria.

5 Summary

The results seen in ‘Appendix C’ show that the proposed design for the external lighting complies with the maximum values of illuminance on properties shown in ‘CIE 150 Table 2’ without any mitigation methods used, with all values of vertical surface illumination staying below the allowed 10 lux.

In addition the calculation conducted show that the maximum ULR value achieved in all scenarios did not exceed 2.5%, which complies with the maximum allowed ULR of 5% as per ‘CIE 150 Table 5’. See ‘Appendix D’ for the ULR values found in the calculation models, separate models had to be used due to software limitations.

Appendix A

External Lighting Layout

A1

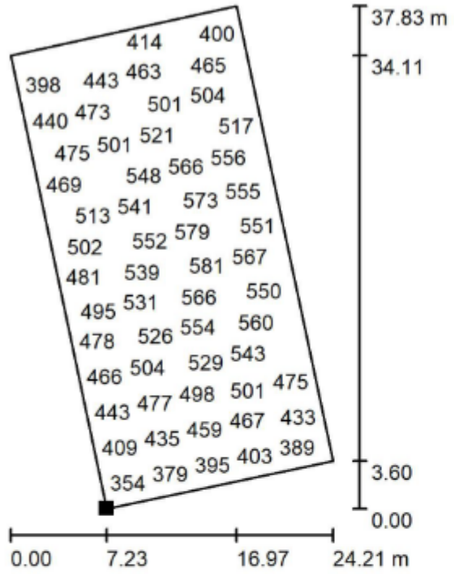

BRYN ROAD
TURN RIGHT
Highlighted fittings are set at a 15° tilt to ensure correct illuminance of turning area
MUGA pitch luminaires to be mounted at 10m
5-a-side pitch luminaires to be mounted at 15m
52902
44797
MUGA pitch luminaires to be mounted at 10m
MUGA pitch luminaires to be mounted at 10m
A
B
D
E
F
H
I
K
L
M

Appendix B

Selected Dialux Results

B1

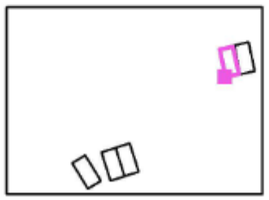
Exterior Scene 1 / G Pitch Calculation 1 TPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

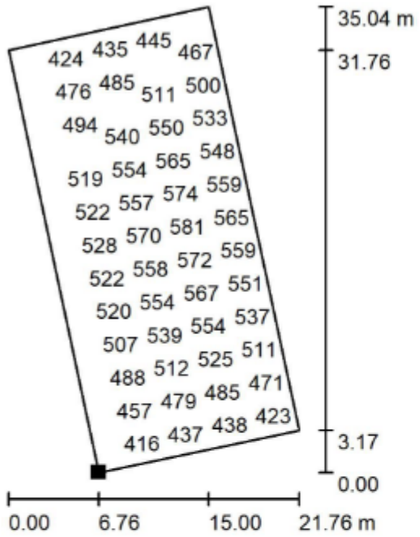
Position of surface in external scene:
Marked point:
(-137.496 m, 22.035 m, 0.100 m)



Grid: 32 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
486	297	588	0.611	0.505

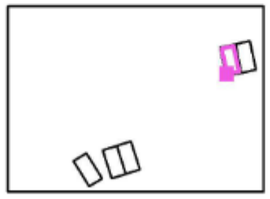
Exterior Scene 1 / G Pitch Calculation 1 PPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

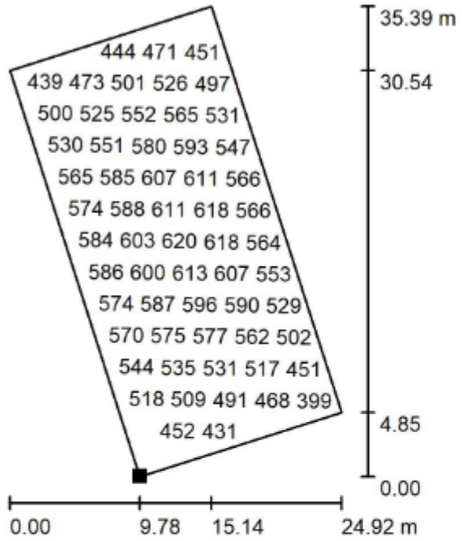
Position of surface in external scene:
Marked point:
(-136.710 m, 23.653 m, 0.100 m)



Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
502	356	588	0.710	0.606

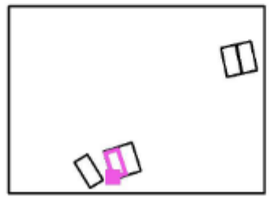
Exterior Scene 1 / D Pitch Calculation 1 TPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

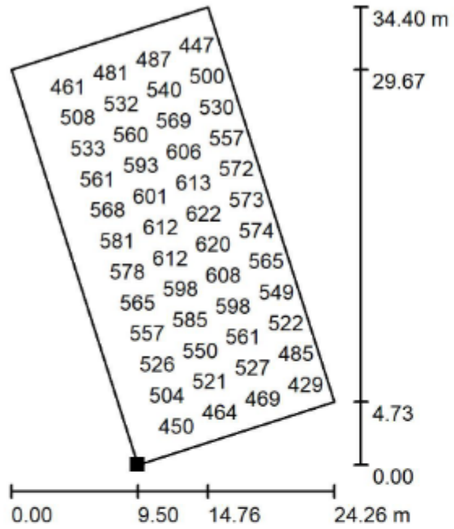
Position of surface in external scene:
Marked point:
(-280.588 m, -104.346 m, 0.100 m)



Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
531	365	625	0.687	0.584

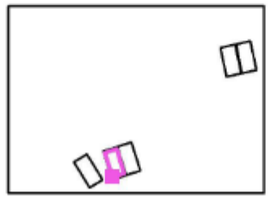
Exterior Scene 1 / D Pitch Calculation 1 PPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

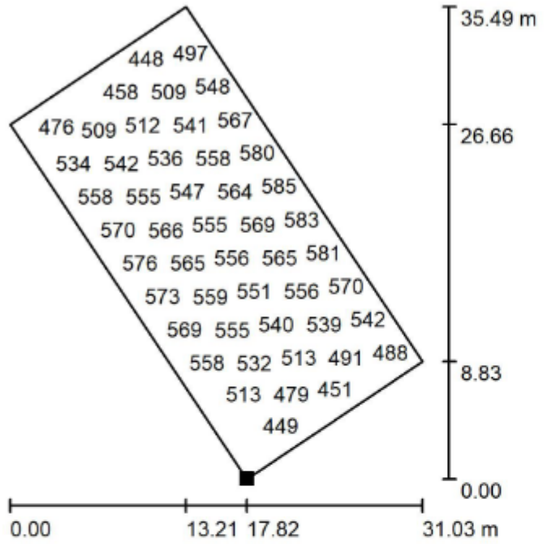
Position of surface in external scene:
Marked point:
(-280.884 m, -103.695 m, 0.100 m)



Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
536	378	626	0.704	0.603

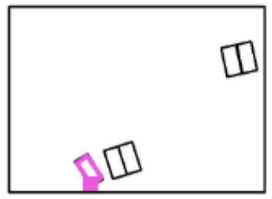
Exterior Scene 1 / D Pitch Calculation 3 TPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

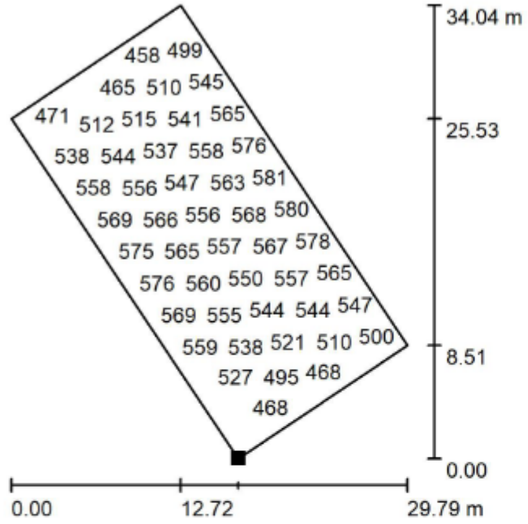
Position of surface in external scene:
Marked point:
(-309.010 m, -113.987 m, 0.100 m)



Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
529	399	591	0.754	0.675

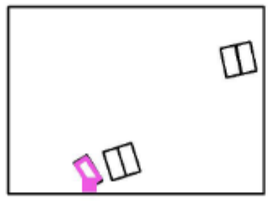
Exterior Scene 1 / D Pitch Calculation 3 PPA / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

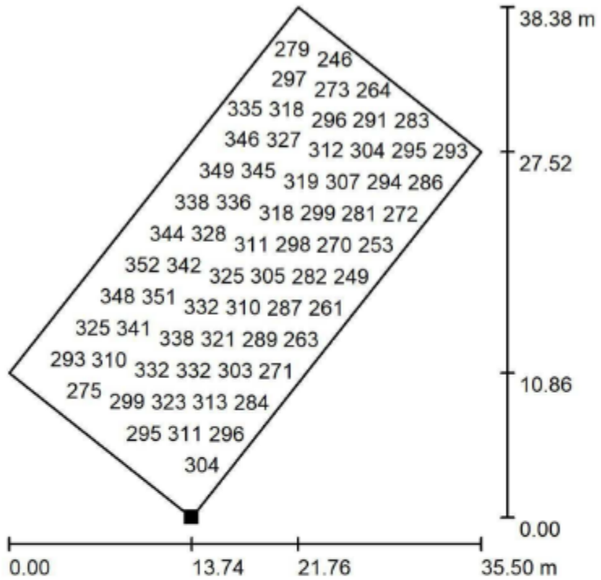
Position of surface in external scene:
Marked point:
(-309.401 m, -113.156 m, 0.100 m)



Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
533	410	591	0.769	0.694

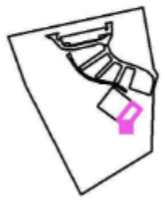
Exterior Scene 1 / 5-a-side Pitch 1 Calculation Surface / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

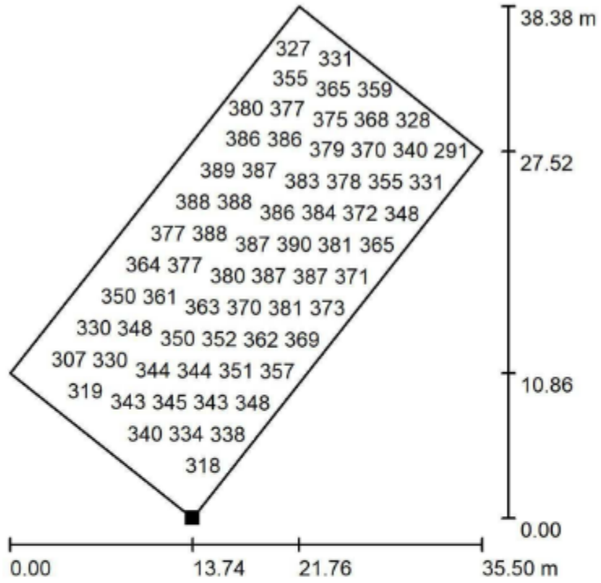
Position of surface in external scene:
Marked point:
(-323.041 m, -14.093 m, 0.100 m)



Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
303	227	354	0.748	0.641

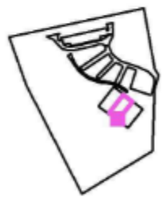
Exterior Scene 1 / 5-a-side Pitch 2 Calculation Surface / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

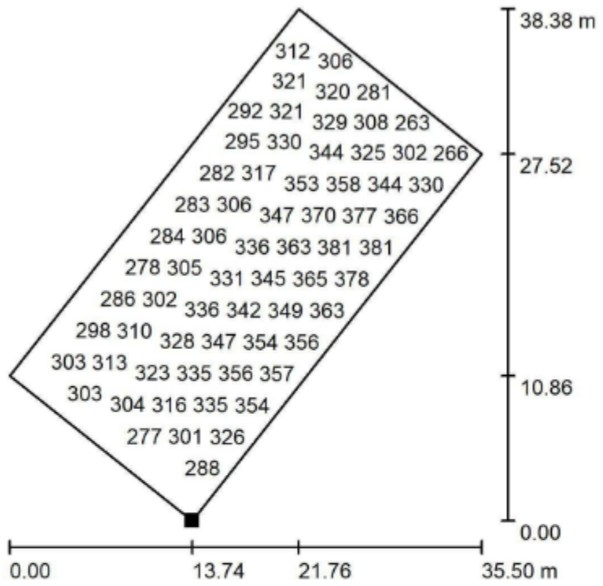
Position of surface in external scene:
Marked point:
(-337.671 m, -2.409 m, 0.100 m)



Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
355	248	393	0.698	0.631

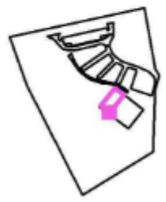
Exterior Scene 1 / 5-a-side Pitch 3 Calculation Surface / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(-351.603 m, 8.818 m, 0.100 m)



Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
317	231	384	0.731	0.603

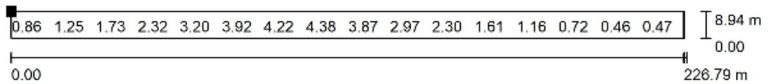
Appendix C

Values of Vertical Illuminance

C1

C1.1 West Houses Lighting Spillage Check

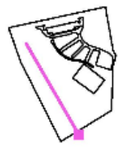
Exterior Scene 1 / Light Spillage Check West Houses 1 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 1622

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point: (-354.771 m, -104.866 m, 9.964 m)

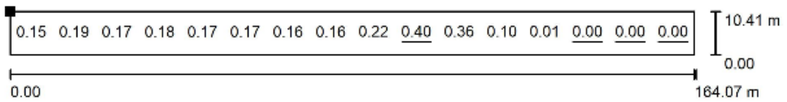


Grid: 64 x 4 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
2.02	0.40	5.47	0.197	0.073

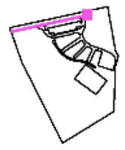
C1.2 North Road Lighting Spillage Check

Exterior Scene 1 / Light Spillage Check North Road 1 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 1173

Position of surface in external scene:
Marked point: (-340.699 m, 152.498 m, 10.491 m)

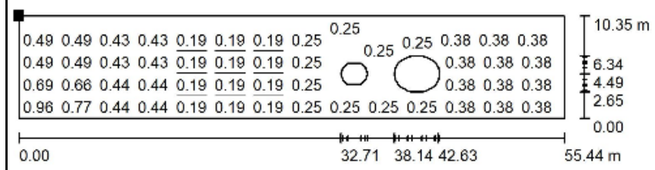


Grid: 16 x 1 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.15	0.00	0.40	0.009	0.003

C1.3 Farm North Lighting Spillage Check

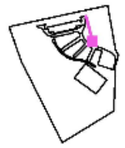
Exterior Scene 1 / Light Spillage Check Farm North 1 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 500

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point: (-329.639 m, 94.386 m, 10.466 m)

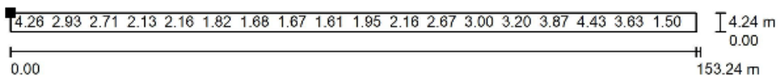


Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.34	0.19	0.96	0.558	0.198

C1.4 North East Field Lighting Spillage Check

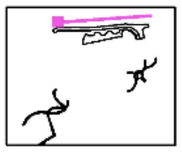
Exterior Scene 1 / Lighting Spillage into Field Check 1 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 1096

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point: (-277.697 m, 85.208 m, 4.242 m)



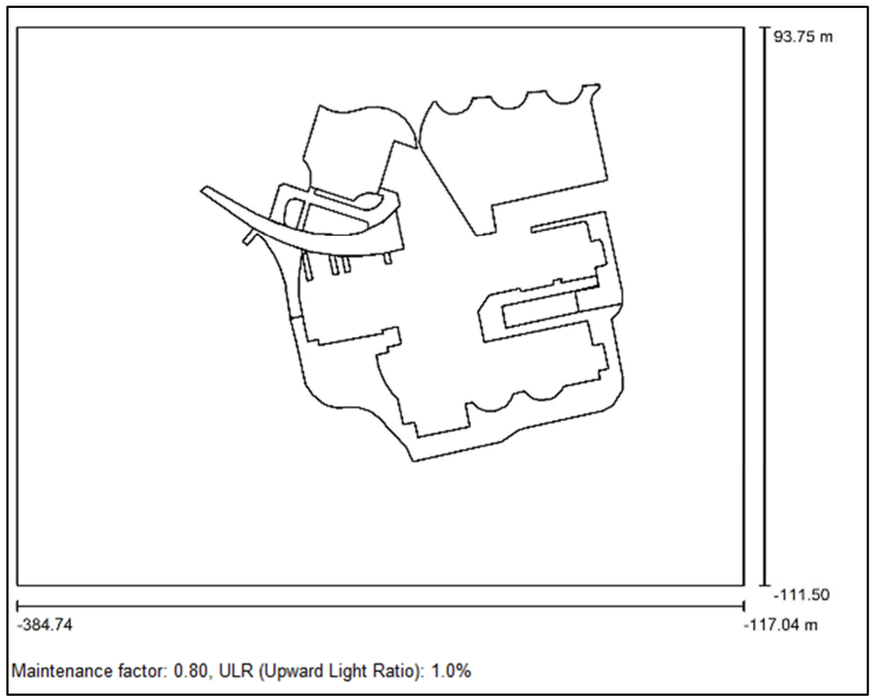
Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
2.39	1.16	8.22	0.485	0.141

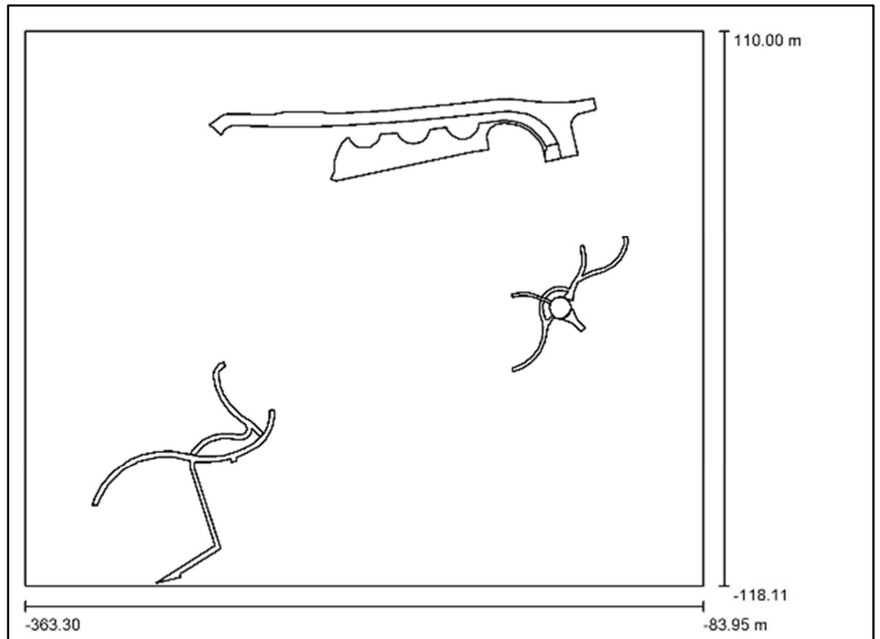
Appendix D

ULR Values

D1



Maintenance factor: 0.80, ULR (Upward Light Ratio): 1.0%



Maintenance factor: 0.80, ULR (Upward Light Ratio): 1.5%