

EXTERNAL LIGHTING ASSESSMENT, REPORT & SPECIFICATION

For



BROWNS BRASSERIE & BAR

THE GEORGE, BURY ST.

RUISLIP, HA4 7TJ

BMT Ref: B3847/EXL

ISSUE: **D – 26.09.2023**

C – 13.09.2023

B – 06.09.2023

A – 10.07.2023

1.0 INTRODUCTION

This report has been compiled specifically for use by Mitchells & Butlers Plc (and associates) and the local planning authority.

The site is located at the junction of Bury Street (A4180) and Sharps Lane in Ruislip.

The site neighbours several residential properties to the North & West, Bell View Manor residences to the South and High Street commercial properties to the East.

To the southern and western boundaries of the site and immediately surrounding the car park is a green buffer of trees and hedges. *Please note that calculations **do** consider the existing boundary walls but **do not** consider the additional natural shading effect of trees and foliage around the car park.*

The purpose of the report is to highlight the design parameters of the External lighting to consider the local environment, and MAB's commitment to working with the local planning authority to maintain the amenity of the site and locality.

Lengths have been taken in the design and specification of the External lighting to reduce the amount of overspill light from the site onto the neighbouring areas.

Extracts from ILP Guidance Note, site classification is deemed to be within an E3 zone.

Guidance notes for the reduction of obtrusive light

Guidance Note 01/20

Table 2: Environmental zones			
Zone	Surrounding	Lighting environment	Examples
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations

Performance parameters to be demonstrated on adjacent properties within:

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

2.0 PURPOSE

The external lighting installation generally provides for the following:

- Replacement of obsolete and inefficient external lighting.
- Illuminate the car park and external areas for use by customers.
- Safety and security of staff and customers.
- Safe nighttime navigation of the external access routes and car park by vehicles and pedestrians.
- To aid the operation of the CCTV surveillance system.

3.0 LIGHTING DESIGN CALCULATIONS

Please also see appended computer aided calculation results document.

Car Park Horizontal Illuminance Summary:

Evaluation area 1	Reference plane 1.1
$\bar{E}_m$	Horizontal 11.9 lx
E_{min}	1.1 lx
$E_{min}/\bar{E}_m (U_o)$	0.10
$E_{min}/E_{max} (U_d)$	0.02
Position	0.00 m

Vertical Illuminance on Adjacent properties Summary:

Illuminance

No.	Measuring surface	Grid	$\bar{E}_m$	E_{min}	E_{max}	U_o	U_d
10.1	1-5 Sharps Lane	19 x 8	0.25 lx	0.16 lx	0.4 lx	0.65	0.40
10.2	2 Sharps Lane	16 x 8	0.15 lx	0.08 lx	0.26 lx	0.54	0.32
10.3	8 Sharps Lane	24 x 8	0.03 lx	0 lx	0.07 lx	0.15	0.05
10.4	9 Sharps Lane - Wall 1	5 x 30	0.14 lx	0.01 lx	0.31 lx	0.07	0.03
10.5	9 Sharps Lane - Wall 2	5 x 9	0.15 lx	0.01 lx	1.12 lx	0.04	0.01
10.6	9 Sharps Lane - Wall 3	5 x 32	0.81 lx	0.24 lx	2.49 lx	0.30	0.10
10.7	9 Sharps Lane - Wall 4	7 x 17	1.7 lx	0.23 lx	8.42 lx	0.13	0.03
10.8	9 Sharps Lane - Wall 5	8 x 9	1.13 lx	0.36 lx	3.64 lx	0.32	0.10
10.9	9 Sharps Lane - Wall 6	6 x 9	0.26 lx	0.01 lx	0.46 lx	0.04	0.02
10.10	9 Sharps Lane - Wall 7	7 x 18	0.31 lx	0.17 lx	1.38 lx	0.55	0.12
10.11	11 Sharps Lane	8 x 20	0.06 lx	0 lx	0.31 lx	0.02	0.00
10.12	Roberts House - Wall 1	8 x 18	1.02 lx	0 lx	3.76 lx	0.00	0.00
10.13	Roberts House - Wall 2	6 x 13	0.01 lx	0 lx	0.01 lx	0.61	0.44
10.14	Roberts House - Wall 3	8 x 16	0.13 lx	0.01 lx	0.27 lx	0.06	0.03
10.15	Bell View Manor	22 x 9	0.69 lx	0.44 lx	1.07 lx	0.64	0.41
10.16	Jubilee House	19 x 9	0.46 lx	0.24 lx	1.05 lx	0.52	0.23
10.17	1-2 The Oaks	28 x 8	0.07 lx	0.03 lx	0.11 lx	0.40	0.26
Summary			0.42 lx	0 lx	8.42 lx	0.00	0.00

All calculated results are within Pre and Post curfew recommendations (lighting extinguished at 2300)

Horizontal Spill Light Summary:

Illuminance

Average illuminance	$\bar{E}_m$	0.4 lx
Minimum illuminance	E_{min}	0 lx
Maximum illuminance	E_{max}	15.9 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	1:--- (---)
Diversity U_d	E_{min}/E_{max}	1:--- (---)

4.0 REFERENCE STANDARDS

CIBSE Lighting Guide LG6. Surface car park accessible to the public, recommended average lighting level – 10-20Lux.

ILP Guidance notes for the Reduction of Intrusive Light.

BS EN 12464-2: Lighting of Workplaces - Outdoor Workplaces, British Standards Institute, 2007.

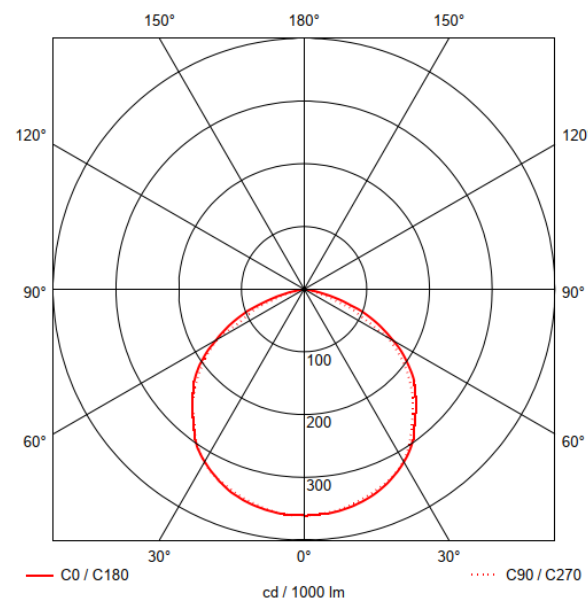
BS 5489-1: Code of Practice for the Design of Outdoor Lighting - Lighting of Roads and Public Amenity Areas, British Standards Institute, 2003.

For reference purposes:

Lighting condition	From (lux)	To (lux)	Mean value (lux)	Lighting step
Pitch Black	0	10	5	1
Very Dark	11	50	30	2
Dark Indoors	51	200	125	3
Dim Indoors	201	400	300	4
Normal Indoors	401	1000	700	5
Bright Indoors	1001	5000	3000	6
Dim Outdoors	5001	10,000	7500	7
Cloudy Outdoors	10,001	30,000	20,000	8
Direct Sunlight	30,001	100,000	65,000	9

5.0 INSTALLED LIGHTING EQUIPMENT DETAIL

Luminaires	ROBUS LED Group UK Cosmic LED Floodlight RCM50 46.4watt IP65 
Control Gear	Electronic driver
IP Rating	IP65
Light Source	LED Array, nominal 4000k, 47.7W 5269 lumens
Distribution	Symmetrical
Tilt angle	5degree max. relative to ground (site installation to be amended to suit)
Control	Remote Photocell and time schedule
Mounting	5metre, galvanised finish tubular column with base compartment for cut-out unit & bracket.
Final connection Cabling	3core 1.5sq.mm Heat resisting flexible.
Standards	UKCA Marked
Luminous Intensity @ 5degrees	$360 \times 5.269 = 1897\text{cd}$ Pre-curfew limit 10,000cd Post Curfew Limit – 1,000cd (<i>luminaires to be extinguished during curfew hours</i>)



	C0	C90	C180
0°	361	361	361
5°	360	359	360
10°	357	355	357
15°	351	348	351
20°	343	340	344
25°	332	331	331
30°	318	316	317
35°	300	294	300
40°	275	269	275
45°	252	245	253
50°	229	217	229
55°	199	187	200
60°	164	154	162
65°	128	97	127
70°	92	52	86
75°	48	20	44
80°	16	1	13
85°	1	0	0
90°	0	0	0
	cd / 1000 lm		

6.0 POWER SUPPLY & CONTROL DETAIL

- Private circuits from external lighting distribution boards.
- 24hour/7day programmable time switch
- Photo-electric cell
- Car park lighting to be **disabled between curfew hours 2300 – 0700.**

7.0 SUMMARY & CONCLUSIONS

- The lux-plot provided demonstrates MABs commitment to providing lighting to ensure the health & safety of staff and public using the site but also shows that the lighting should not unduly affect the surroundings.
- Luminaires chosen for the task have quality optics to accurately control the distribution of illuminance to the area that requires it and minimise spill light off the site.
- Lighting is designed to be within the recommendations of the Institute of Lighting Professionals (ILP) Guidance for the Reduction of Obtrusive Light.
- Lighting levels are chosen from Lighting Guide 6 published by the Chartered Institute of Building Service Engineers
- All external (and internal) lighting will be LED, chosen not only for its obvious energy efficiency but also for their reduced spectrum of wavelengths and UV values vs the lighting that was replaced.
- Car park column lighting is illuminated only when ambient light levels fall and is extinguished when the establishment closes (2300).
- Column numbers to external boundaries have purposely been kept to a minimum to reduce the potential light spill.
- ***Aiming and tilt angles currently in use at the site will be adjusted in accordance with the lux plot included in this report and reduces the potential for nuisance illumination to neighbours.***

EXTERNAL KEY



5TG post with custom galvanized metal bracket to affix 50W cosmic LED flood light.

APPROVAL

Do not scale from this drawing. All dimensions are to be checked on site prior to manufacture & construction. Any discrepancies are to be relayed to KIRK NOLAN immediately. © KIRK NOLAN 2019

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Client
MITCHELLS & BUTLERS

Project
Browns, Ruislip
Bury Street, Ruislip, HA4 7TJ

Drawing
Proposed Car Park Lighting

First Issue Scale Sheet Size Drawn
MAR 2023 As Shown A1 JT

Drawing No. Rev
2206/824 A

EXTERNAL CAR PARK
Scale 1:100



Browns, Ruislip External Car Park Calculation

Installation :

Project number : B3847 Browns, Ruislip

Customer : Mitchells & Butlers

Processed by :

Date : 14.09.2023

The following values are based on precise calculations performed on calibrated lamps and luminaires, and their configurations, whereby gradual, unavoidable deviations can occur in practice. All guarantee claims are excluded for the specified data.

This exclusion of liability applies irrespective of the legal grounds for both damages and consequential damages suffered by users and third parties.

1 Luminaire data

1.1 ROBUS, Cosmic (RCM5040-04)

1.1.1 Data sheet

Manufacturer: ROBUS

ROBUS®

RCM5040-04 Downlight/spot/floodlight Cosmic

* Suitable for use in decking areas, drives, pathways, sign illumination, wall washing, atriums, patios, car parks, garages, industrial units * LED replacement for 80W Metal Halide/ 350W Halogen flood lights * Die cast aluminium housing providing optimal heat dissipation and high resistance to weather conditions * Self regulating valve on the fitting to stop the condensation * Tempered glass providing high impact rating of IK07 * Complete with stainless steel screws * Prewired with 1m of rubber flex * Pre-drilled mounting bracket with 180° adjustable angle * No warm up or cool down period required by LED * High efficacy of 110lm/W * Wide operating ambient temperature range of -20°C to 40°C * Suitable for switching by PIR, Microwave or Photocell

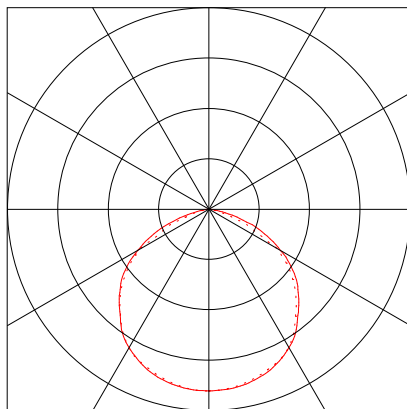
Luminaire data

Absolute Photometry
Luminaire efficacy : 110.2 lm/W
Classification : A40 ↓100.0% ↑0.0%
CIE Flux Codes : 50 84 99 100 100
UGR 4H 8H : 31.2 / 29.9
Control gear : Electronic ballast
Power : 47.7 W
Luminous flux : 5256.4 lm

Equipped with

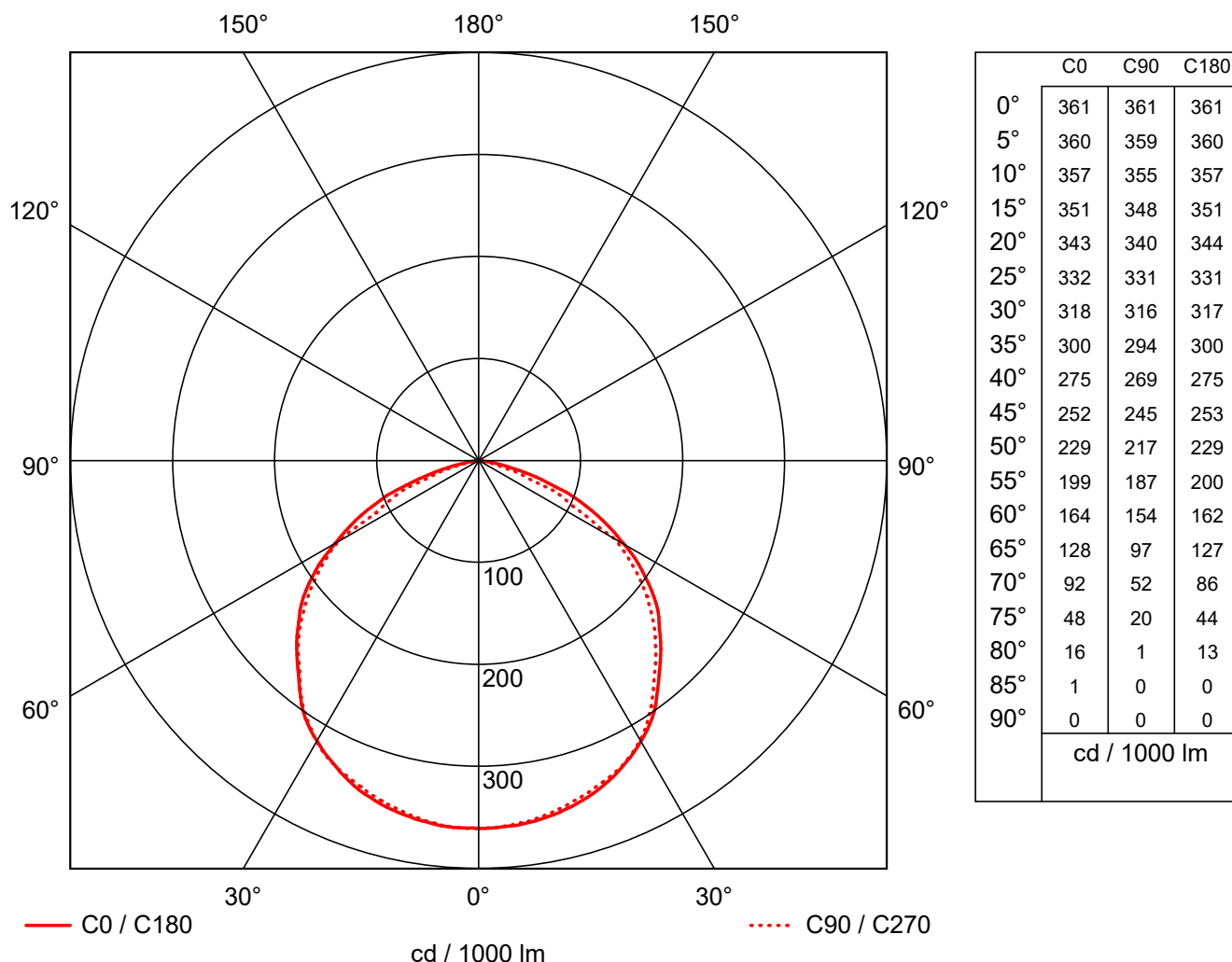
Quantity : 1
Designation : LED
Colour : 4000K
Colour reproduction : 80

Dimensions : 251 mm x 562 mm x 42 mm



1.1 ROBUS, Cosmic (RCM5040-04)

1.1.2 LDC



Manufacturer : ROBUS
Order number : RCM5040-04
Luminaire name : Cosmic
Equipment : 1 x LED 47.7 W / 5269 lm
Dimensions : L 251 mm x W 562 mm x H 42 mm
File name : RCM5040-04-Photometrics.Idt

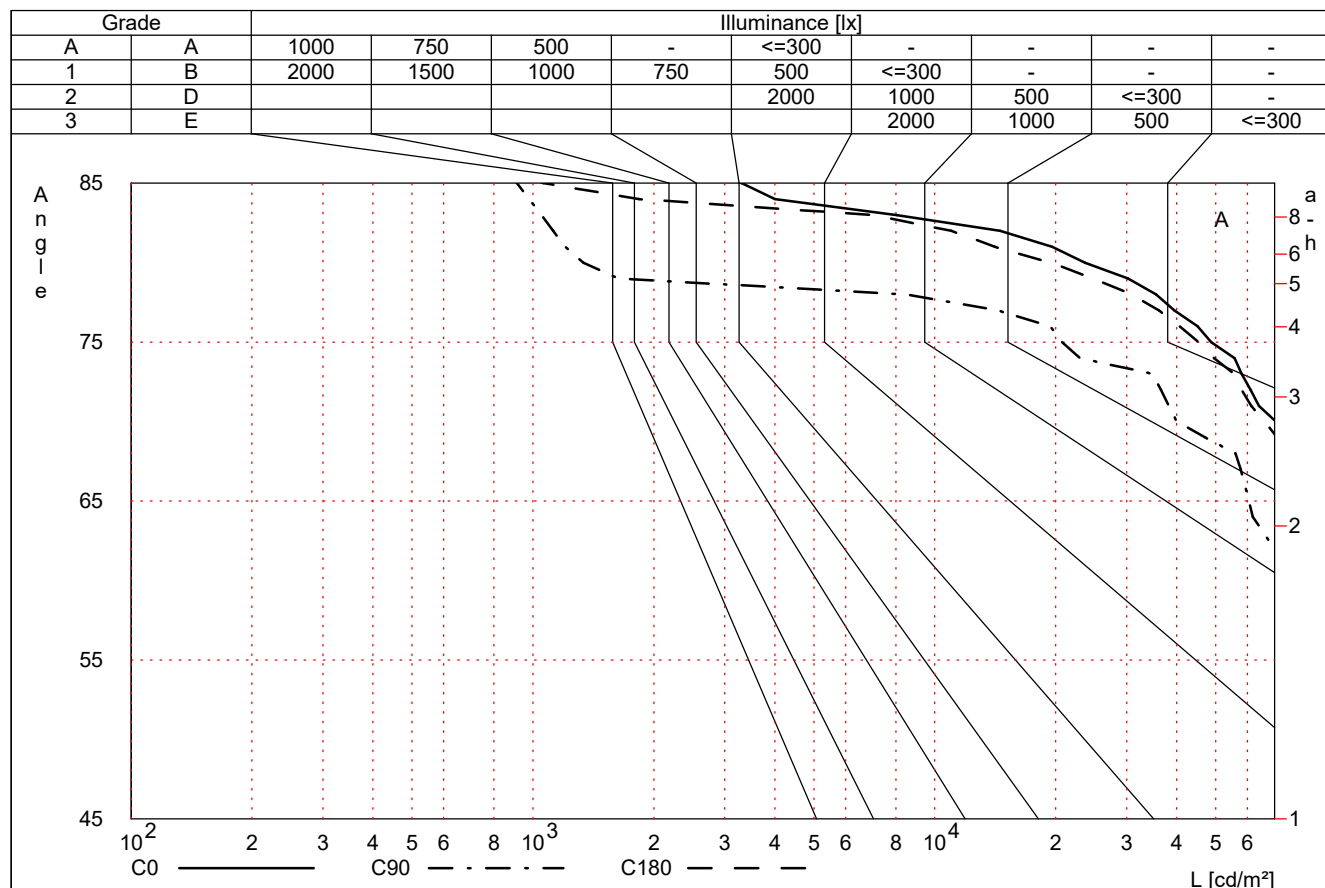
Luminaire efficacy : 110.2 lm/W (A40)
Light distribution : asymmetric
Beam Angle : 58.0° C0
56.1° C90
57.7° C180
56.9° C270

Object : Browns, Ruislip External Car Park Calculation
Installation :
Project number : B3847 Browns, Ruislip
Date : 14.09.2023



1.1 ROBUS, Cosmic (RCM5040-04)

1.1.3 Soellner diagram



Manufacturer : ROBUS
Order number : RCM5040-04
Luminaire name : Cosmic
Equipment : 1 x LED 47.7 W / 5269 lm
Dimensions : L 251 mm x W 562 mm x H 42 mm
File name : RCM5040-04-Photometrics.Idt

Luminaire efficacy : 110.2 lm/W (A40)
Light distribution : asymmetric
Beam Angle : 58.0° C0
56.1° C90
57.7° C180
56.9° C270

1.1 ROBUS, Cosmic (RCM5040-04)

1.1.4 Luminance chart

	C0	C15	C30	C45	C60	C75	C90	C105	C120	C135	C150	C165
65°	80041	81260	80596	78047	68753	62888	60449	58567	63664	75740	76793	77957
70°	70596	71694	68194	60097	56502	49806	40008	44900	49162	52795	64513	68960
75°	48686	52190	50066	42314	32468	25279	20745	19756	23265	31270	41747	46416
80°	23667	24181	21143	14551	4552	148	1337	7602	10298	9426	15059	18416
85°	3307	2820	2091	1118	1046	978	913	991	1011	972	883	913

	C180	C195	C210	C225	C240	C255	C270	C285	C300	C315	C330	C345
65°	79231	81115	80949	78732	66701	61403	62836	61562	67380	80291	[82313]	82230
70°	66136	71002	68976	60058	57439	52583	45493	53366	57783	58741	70632	74583
75°	45276	49256	48065	41703	33713	29020	27626	29085	35104	45683	53275	54276
80°	19496	19998	18045	13638	8694	5846	5093	5899	9175	14921	21737	24653
85°	1061	1233	1349	1410	1442	1441	1407	1450	1558	1732	2007	2532

Luminance [cd/m²]

Manufacturer	: ROBUS	Luminaire efficacy	: 110.2 lm/W (A40)
Order number	: RCM5040-04	Light distribution	: asymmetric
Luminaire name	: Cosmic	Beam Angle	: 58.0° C0
Equipment	: 1 x LED 47.7 W / 5269 lm		: 56.1° C90
Dimensions	: L 251 mm x W 562 mm x H 42 mm		: 57.7° C180
File name	: RCM5040-04-Photometrics.Idt		: 56.9° C270

1.1 ROBUS, Cosmic (RCM5040-04)

1.1.5 Glare Rating (RUG)

Reflectance of										
Ceiling	0.7	0.7	0.5	0.5	0.3	0.7	0.7	0.5	0.5	0.3
Walls	0.5	0.3	0.5	0.3	0.3	0.5	0.3	0.5	0.3	0.3
Floor	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Room dimension		Viewed crosswise					Viewed endwise				
x	y										
2H	2H	28.5	30.1	28.8	30.4	30.7	28.1	29.7	28.5	30.0	30.3
	3H	29.8	31.3	30.2	31.6	32.0	29.0	30.4	29.3	30.7	31.1
	4H	30.2	31.5	30.6	31.9	32.3	29.1	30.4	29.5	30.8	31.1
	6H	30.3	31.6	30.7	31.9	32.3	29.1	30.3	29.5	30.7	31.1
	8H	30.3	31.5	30.7	31.8	32.2	29.0	30.2	29.4	30.6	31.0
	12H	30.2	31.4	30.6	31.8	32.2	29.0	30.1	29.4	30.5	30.9
4H	2H	29.1	30.5	29.5	30.8	31.2	28.8	30.2	29.2	30.5	30.9
	3H	30.6	31.7	31.0	32.1	32.5	29.8	30.9	30.2	31.3	31.7
	4H	31.1	32.1	31.5	32.5	32.9	30.0	31.0	30.4	31.4	31.8
	6H	31.2	32.1	31.7	32.5	33.0	29.9	30.8	30.4	31.3	31.7
	8H	31.2	32.0	31.7	32.4	32.9	29.9	30.7	30.4	31.2	31.6
	12H	31.2	31.9	31.7	32.4	32.9	29.9	30.6	30.4	31.1	31.6
8H	4H	31.1	31.9	31.6	32.4	32.8	30.1	30.9	30.6	31.4	31.8
	6H	31.2	31.9	31.7	32.4	32.9	30.0	30.7	30.5	31.2	31.7
	8H	31.3	31.9	31.8	32.4	32.9	30.1	30.6	30.6	31.2	31.6
	12H	31.3	31.8	31.8	32.3	32.8	30.0	30.5	30.6	31.0	31.5
12H	4H	31.1	31.9	31.6	32.3	32.8	30.1	30.8	30.6	31.3	31.8
	6H	31.3	31.9	31.8	32.4	32.9	30.1	30.7	30.6	31.2	31.7
	8H	31.3	31.8	31.8	32.3	32.8	30.0	30.5	30.6	31.0	31.6

Distance between luminaires: 0.25

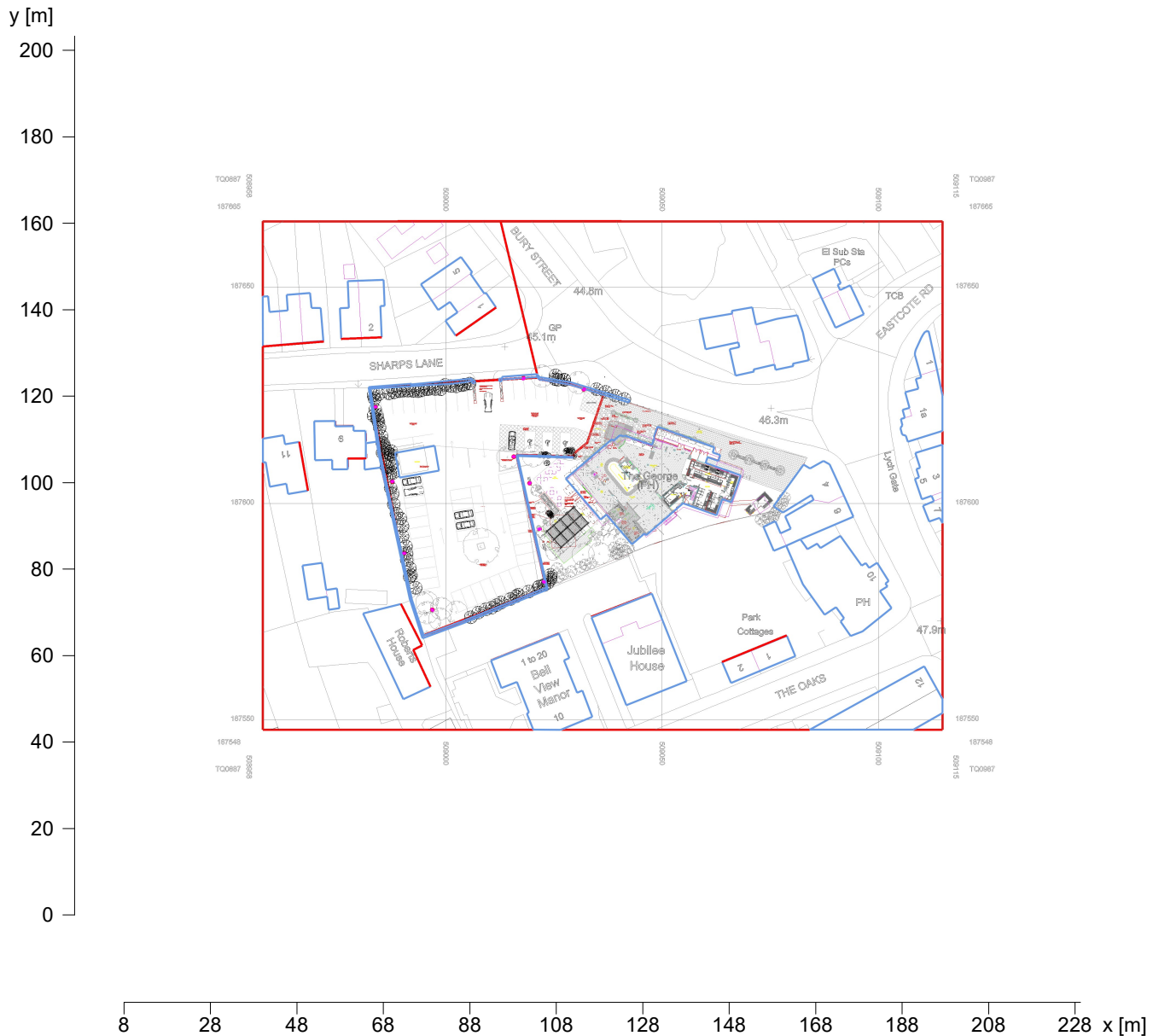
Due to missing symmetry characteristics the values apply only to the indicated line of sight.

Manufacturer	: ROBUS	Luminaire efficacy	: 110.2 lm/W (A40)
Order number	: RCM5040-04	Light distribution	: asymmetric
Luminaire name	: Cosmic	Beam Angle	: 58.0° C0
Equipment	: 1 x LED 47.7 W / 5269 lm		: 56.1° C90
Dimensions	: L 251 mm x W 562 mm x H 42 mm		: 57.7° C180
File name	: RCM5040-04-Photometrics.ltd		: 56.9° C270

2 Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.1 Description, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

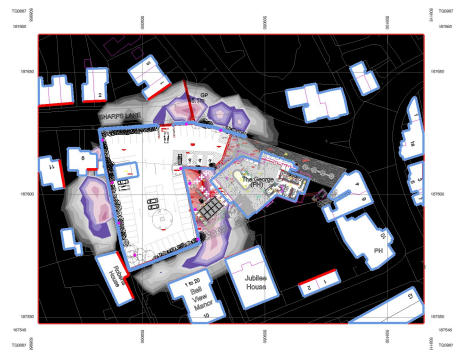
2.1.1 Floor plan



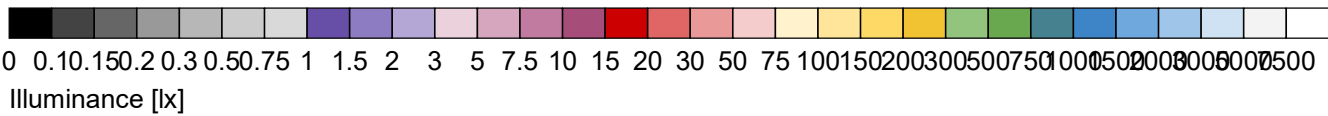
2 Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.2 Summary, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.2.1 Result overview, Spill



8 28 48 68 88 108 148 188 228 x [m]



General

Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Height (phot centre) [m]:	4.98 m
Maintenance factor	0.80
Total luminous flux	52690 lm
Total power	477 W
Total power per area (2000.92 m²)	0.24 W/m²

Illuminance

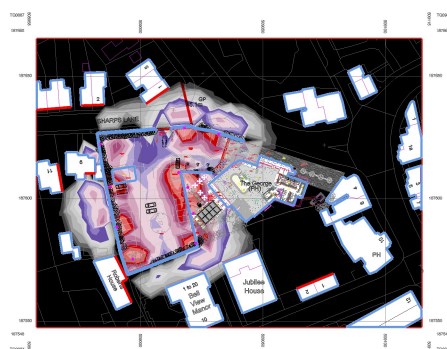
Average illuminance	$\bar{E}_m$	0.4 lx
Minimum illuminance	E_{min}	0 lx
Maximum illuminance	E_{max}	15.9 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	1:--- (---)
Diversity U_d	E_{min}/E_{max}	1:--- (---)

Type No. Make

1	10 x	ROBUS
		Order No. : RCM5040-04
		Luminaire name : Cosmic
		Equipment : 1 x LED 47.7 W / 5269 lm

RELUX®

2.2.2 Result overview, Car Park + Spillage



Calculation algorithm used	Average indirect fraction
Height of evaluation surface	0.00 m
Height (phot. centre) [m]:	4.98 m
Maintenance factor	0.80

Total luminous flux	52690 lm
Total power	477 W
Total power per area (2000.92 m ²)	0.24 W/m ²

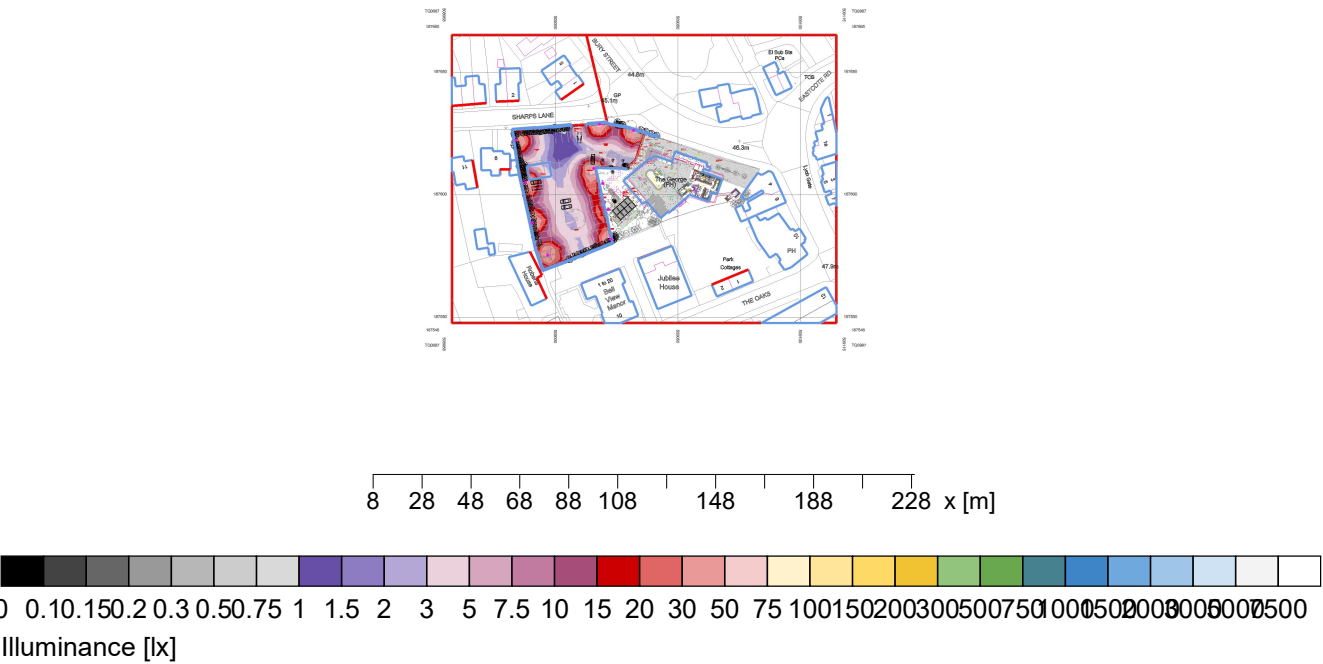
Average illuminance	$\bar{E}_m$	1.5 lx
Minimum illuminance	E_{min}	0 lx
Maximum illuminance	E_{max}	39.2 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	1:--- (---)
Diversity U_d	E_{min}/E_{max}	1:--- (---)

1 10 x

Order No. : RCM5040-04
Luminaire name : Cosmic
Equipment : 1 x LED 47.7 W / 5269 lm

2.2 Summary, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.2.3 Result overview, Evaluation area 1



General

Calculation algorithm used	Average indirect fraction
Height (phot centre)	4.98 m
Maintenance factor	0.80
Total luminous flux	42152.00 lm
Total power	381.6 W
Total power per area (2000.92 m²)	0.19 W/m² (1.61 W/m²/100lx)

Evaluation area 1

Reference plane 1.1

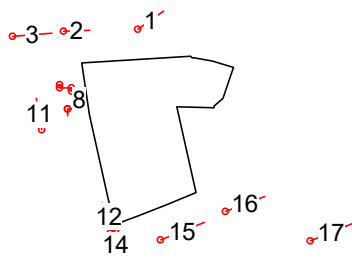
	Horizontal
$\bar{E}_m$	11.9 lx
E_{min}	1.1 lx
$E_{min}/\bar{E}_m (U_o)$	0.10
$E_{min}/E_{max} (U_d)$	0.02
Position	0.00 m

Type No. Make

1	8 x	ROBUS
		Order No. : RCM5040-04
		Luminaire name : Cosmic
		Equipment : 1 x LED 47.7 W / 5269 lm

2.2 Summary, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.2.4 Result overview, Vertical Measuring Planes (10)



Illuminance

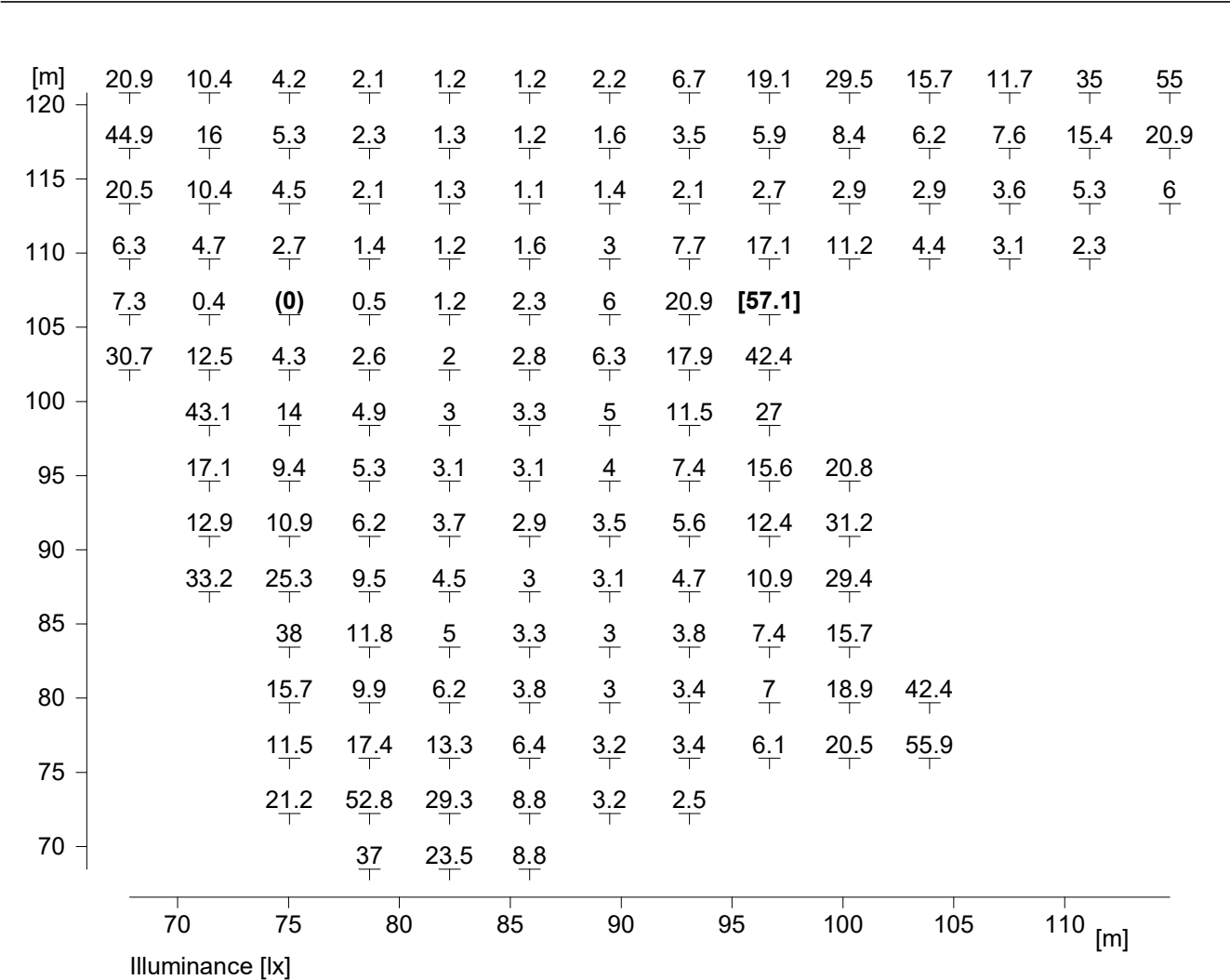
No.	Measuring surface	Grid	$\bar{E}_m$	E_{min}	E_{max}	U_o	U_d
10.1	1-5 Sharps Lane	19 x 8	0.25 lx	0.16 lx	0.4 lx	0.65	0.40
10.2	2 Sharps Lane	16 x 8	0.15 lx	0.08 lx	0.26 lx	0.54	0.32
10.3	8 Sharps Lane	24 x 8	0.03 lx	0 lx	0.07 lx	0.15	0.05
10.4	9 Sharps Lane - Wall 1	5 x 30	0.14 lx	0.01 lx	0.31 lx	0.07	0.03
10.5	9 Sharps Lane - Wall 2	5 x 9	0.15 lx	0.01 lx	1.12 lx	0.04	0.01
10.6	9 Sharps Lane - Wall 3	5 x 32	0.81 lx	0.24 lx	2.49 lx	0.30	0.10
10.7	9 Sharps Lane - Wall 4	7 x 17	1.7 lx	0.23 lx	8.42 lx	0.13	0.03
10.8	9 Sharps Lane - Wall 5	8 x 9	1.13 lx	0.36 lx	3.64 lx	0.32	0.10
10.9	9 Sharps Lane - Wall 6	6 x 9	0.26 lx	0.01 lx	0.46 lx	0.04	0.02
10.10	9 Sharps Lane - Wall 7	7 x 18	0.31 lx	0.17 lx	1.38 lx	0.55	0.12
10.11	11 Sharps Lane	8 x 20	0.06 lx	0 lx	0.31 lx	0.02	0.00
10.12	Roberts House - Wall 1	8 x 18	1.02 lx	0 lx	3.76 lx	0.00	0.00
10.13	Roberts House - Wall 2	6 x 13	0.01 lx	0 lx	0.01 lx	0.61	0.44
10.14	Roberts House - Wall 3	8 x 16	0.13 lx	0.01 lx	0.27 lx	0.06	0.03
10.15	Bell View Manor	22 x 9	0.69 lx	0.44 lx	1.07 lx	0.64	0.41
10.16	Jubilee House	19 x 9	0.46 lx	0.24 lx	1.05 lx	0.52	0.23
10.17	1-2 The Oaks	28 x 8	0.07 lx	0.03 lx	0.11 lx	0.40	0.26
Summary			0.42 lx	0 lx	8.42 lx	0.00	0.00



2 Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

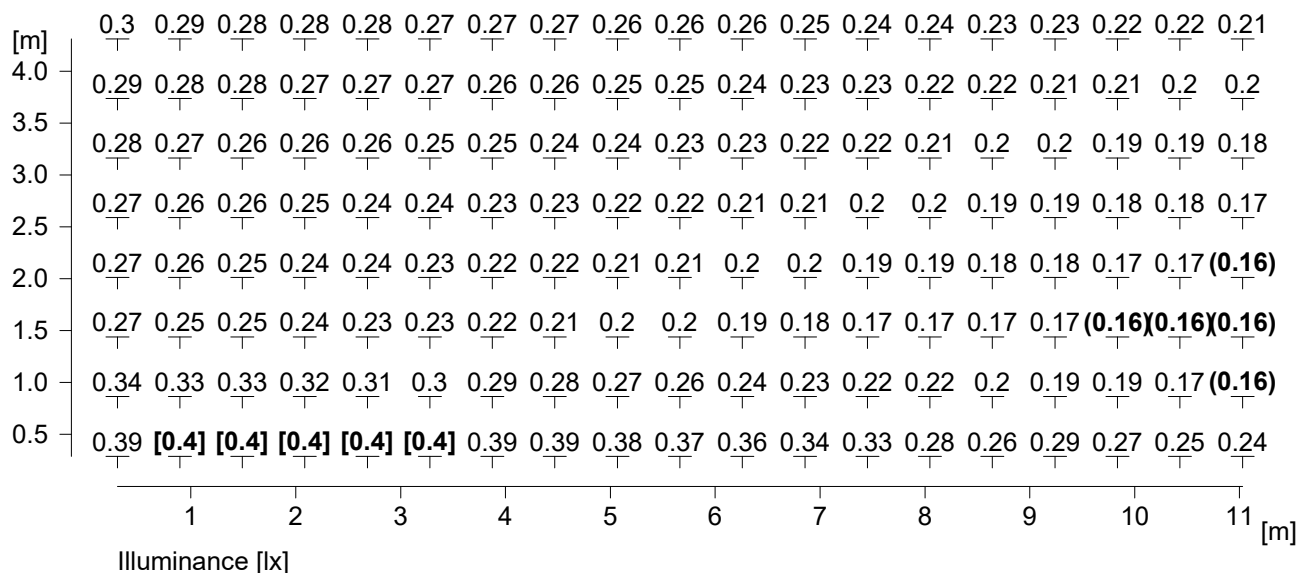
2.3.1 Table, Floor (E)



Average illuminance	$\bar{E}_m$	: 11.5 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 57.1 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: ---
Diversity U_d	E_{min}/E_{max}	: ---

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.2 Table, 1-5 Sharps Lane (E)

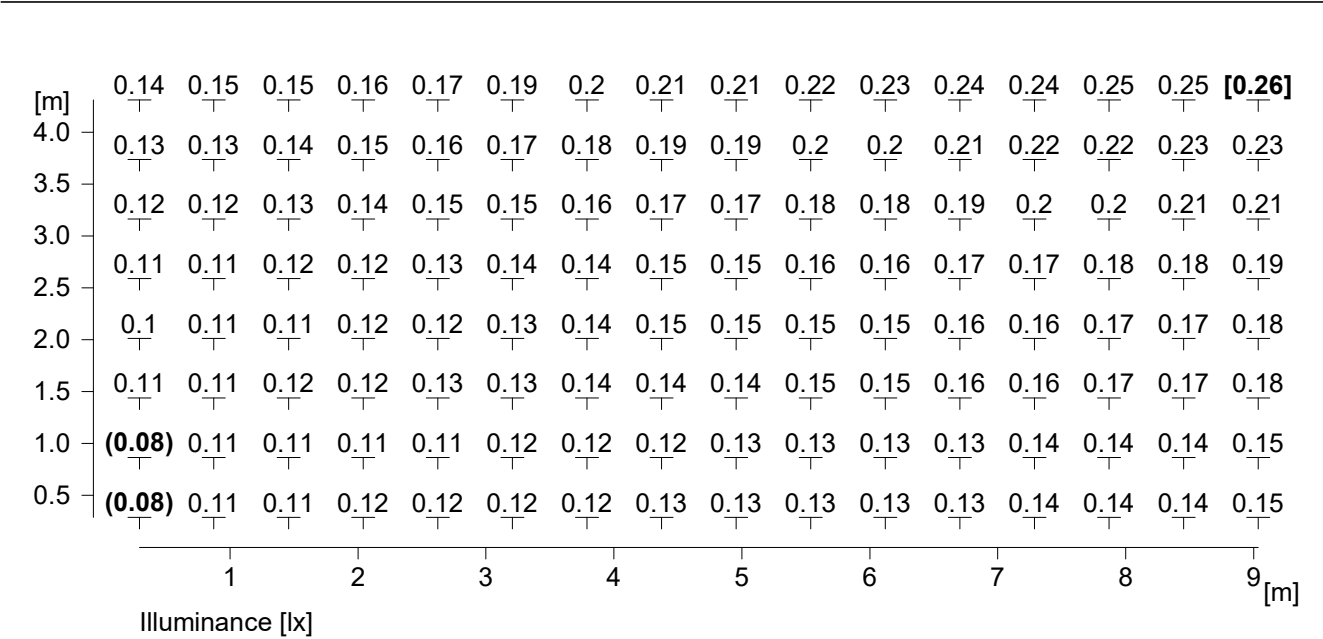


Average illuminance	$\bar{E}_m$	: 0.25 lx
Minimum illuminance	E_{min}	: 0.16 lx
Maximum illuminance	E_{max}	: 0.4 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.53 (0.65)
Diversity U_d	E_{min}/E_{max}	: 1 : 2.52 (0.40)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.3 Table, 2 Sharps Lane (E)

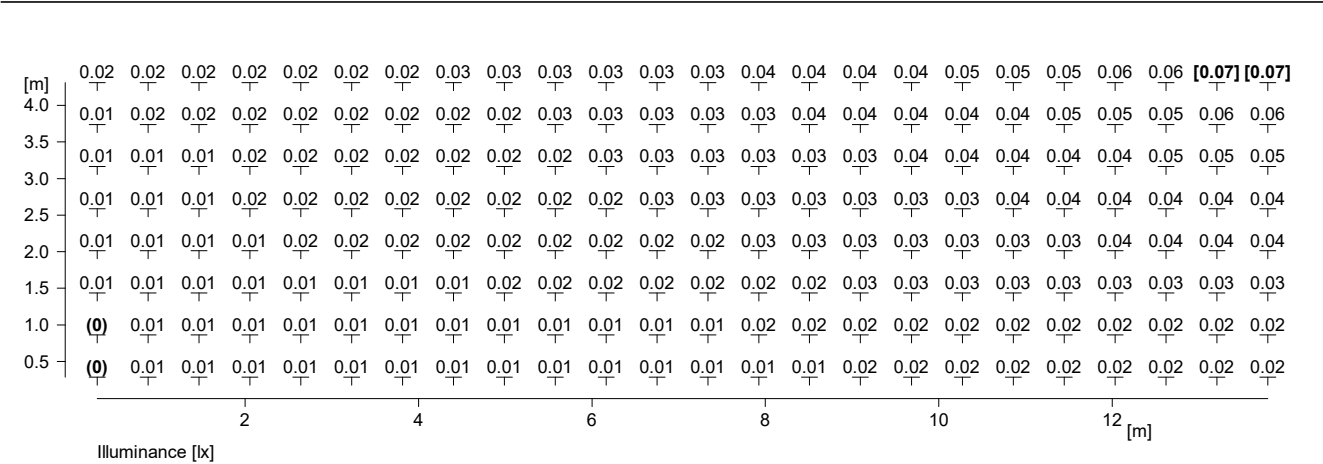


Average illuminance	$\bar{E}_m$	: 0.15 lx
Minimum illuminance	E_{min}	: 0.08 lx
Maximum illuminance	E_{max}	: 0.26 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.84 (0.54)
Diversity U_d	E_{min}/E_{max}	: 1 : 3.09 (0.32)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

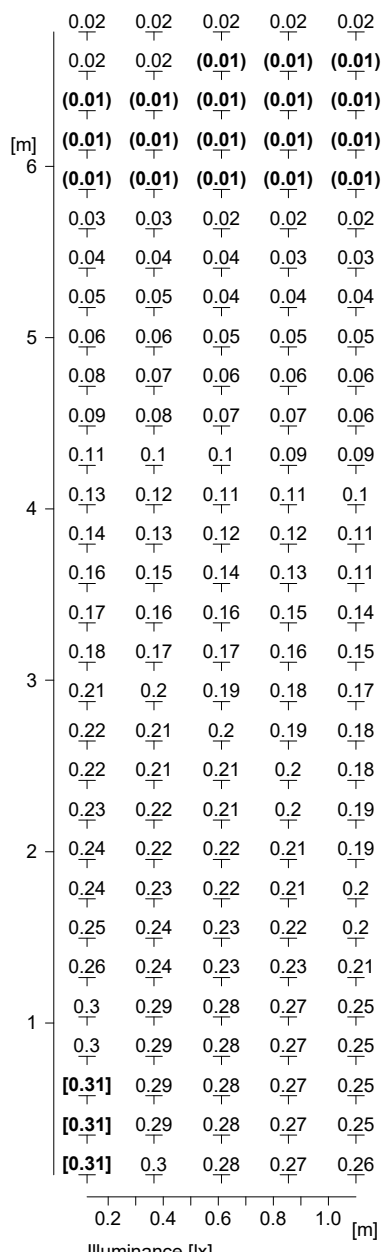
2.3.4 Table, 8 Sharps Lane (E)



Average illuminance	$\bar{E}_m$	: 0.03 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 0.07 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 6.50 (0.15)
Diversity U_d	E_{min}/E_{max}	: 1 : 18.42 (0.05)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.5 Table, 9 Sharps Lane - Wall 1 (E)



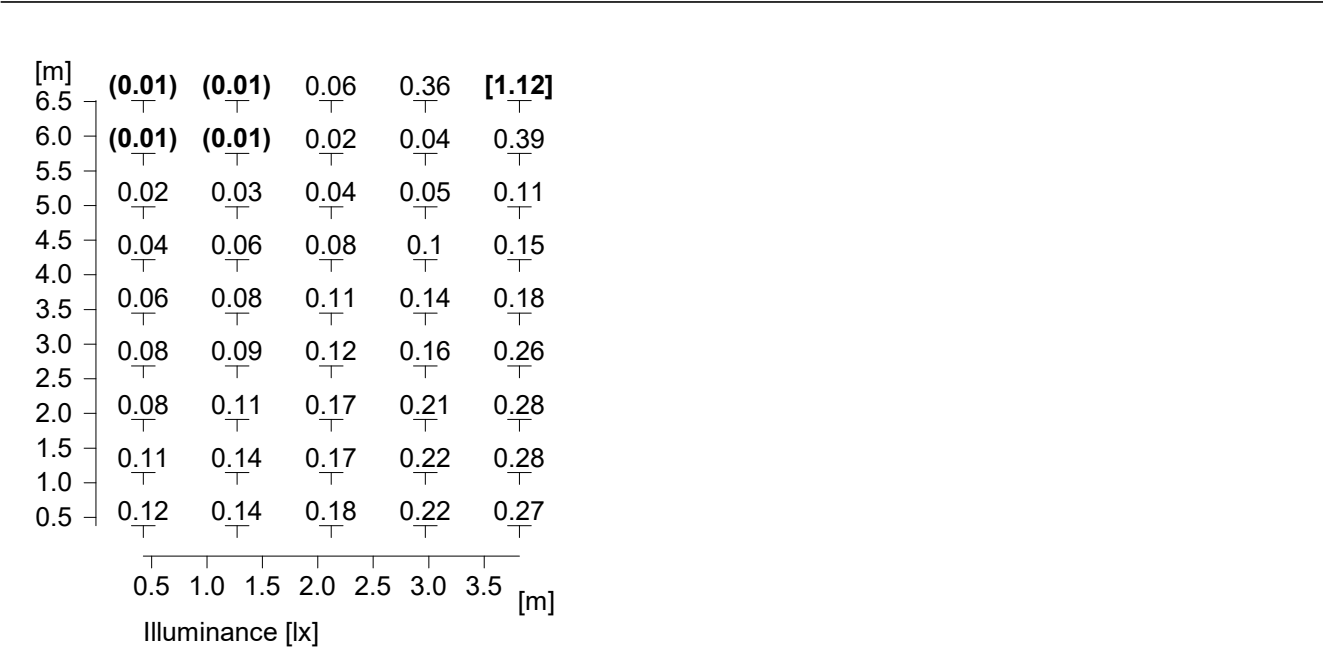
Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.14 lx
 E_{min} : 0.01 lx
 E_{max} : 0.31 lx
 $E_{min}/\bar{E}_m$: 1 : 14.77 (0.07)
 E_{min}/E_{max} : 1 : 32.19 (0.03)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

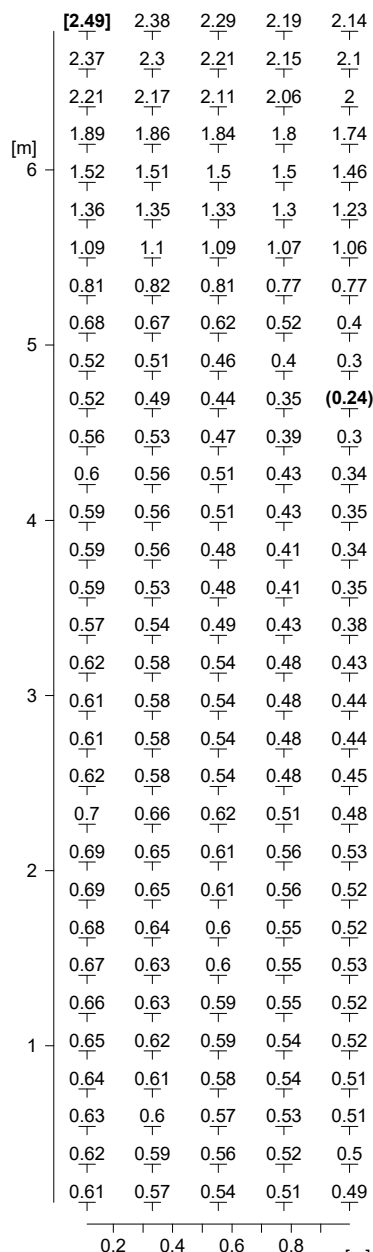
2.3.6 Table, 9 Sharps Lane - Wall 2 (E)



Average illuminance	$\bar{E}_m$	: 0.15 lx
Minimum illuminance	E_{min}	: 0.01 lx
Maximum illuminance	E_{max}	: 1.12 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 25.58 (0.04)
Diversity U_d	E_{min}/E_{max}	: 1 : 192.95 (0.01)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.7 Table, 9 Sharps Lane - Wall 3 (E)

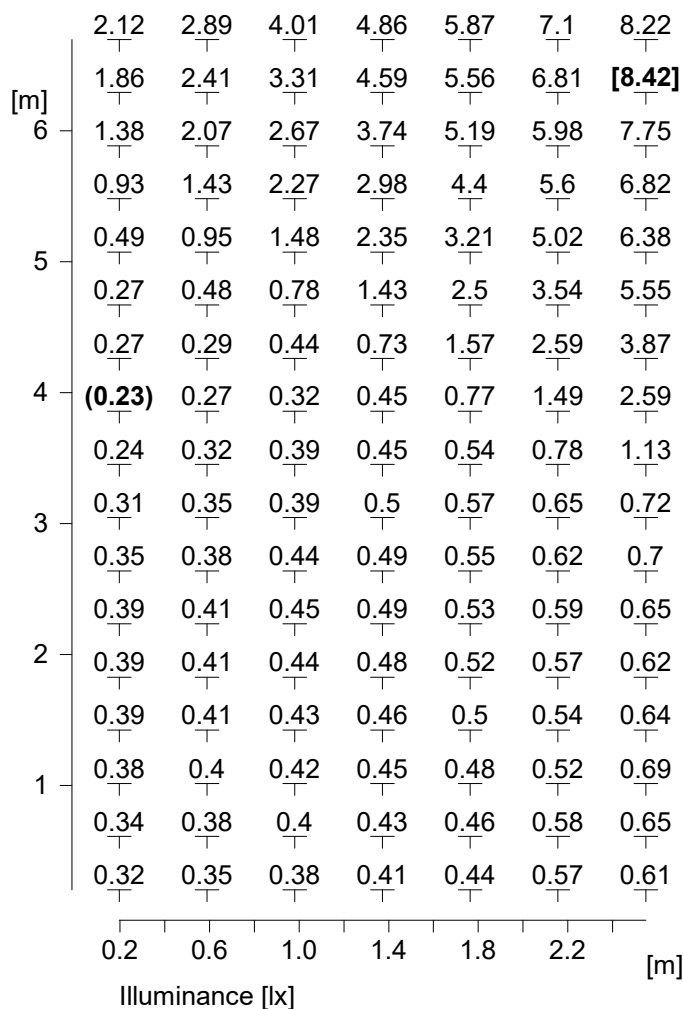


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.81 lx
 E_{min} : 0.24 lx
 E_{max} : 2.49 lx
 $E_{min}/\bar{E}_m$: 1 : 3.33 (0.30)
 E_{min}/E_{max} : 1 : 10.22 (0.10)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.8 Table, 9 Sharps Lane - Wall 4 (E)



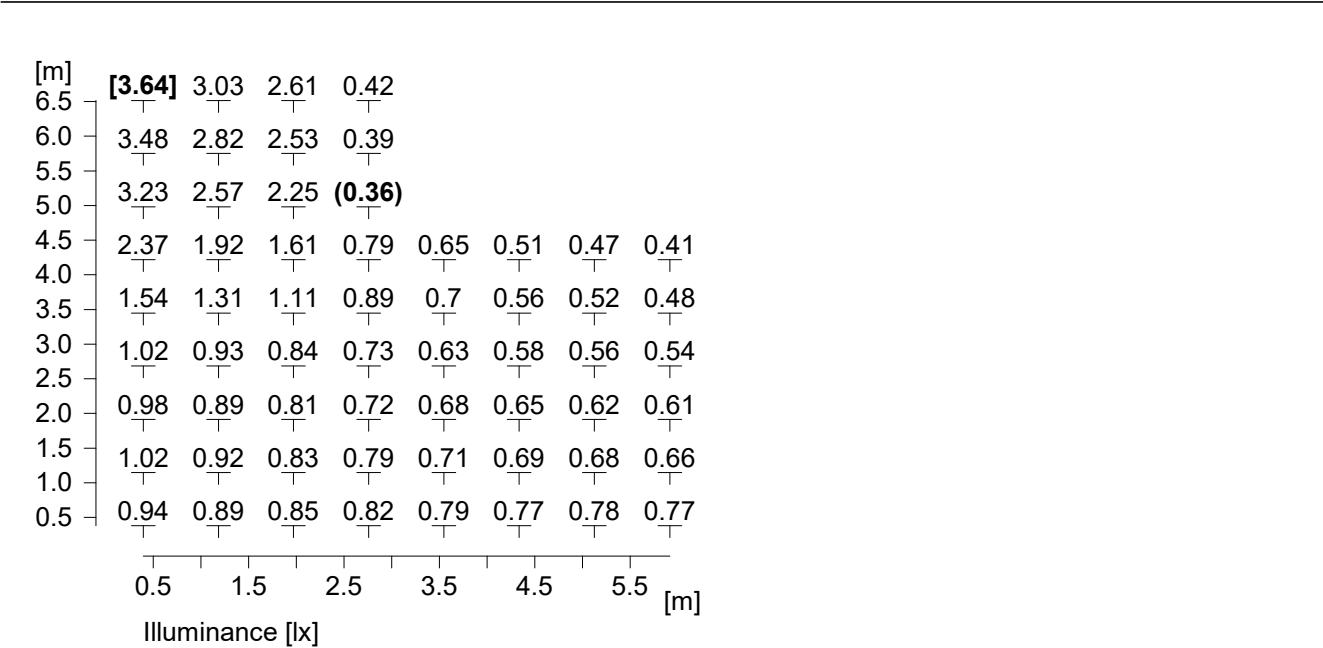
Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 1.7 lx
 E_{min} : 0.23 lx
 E_{max} : 8.42 lx
 $E_{min}/\bar{E}_m$: 1 : 7.56 (0.13)
 E_{min}/E_{max} : 1 : 37.43 (0.03)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.9 Table, 9 Sharps Lane - Wall 5 (E)

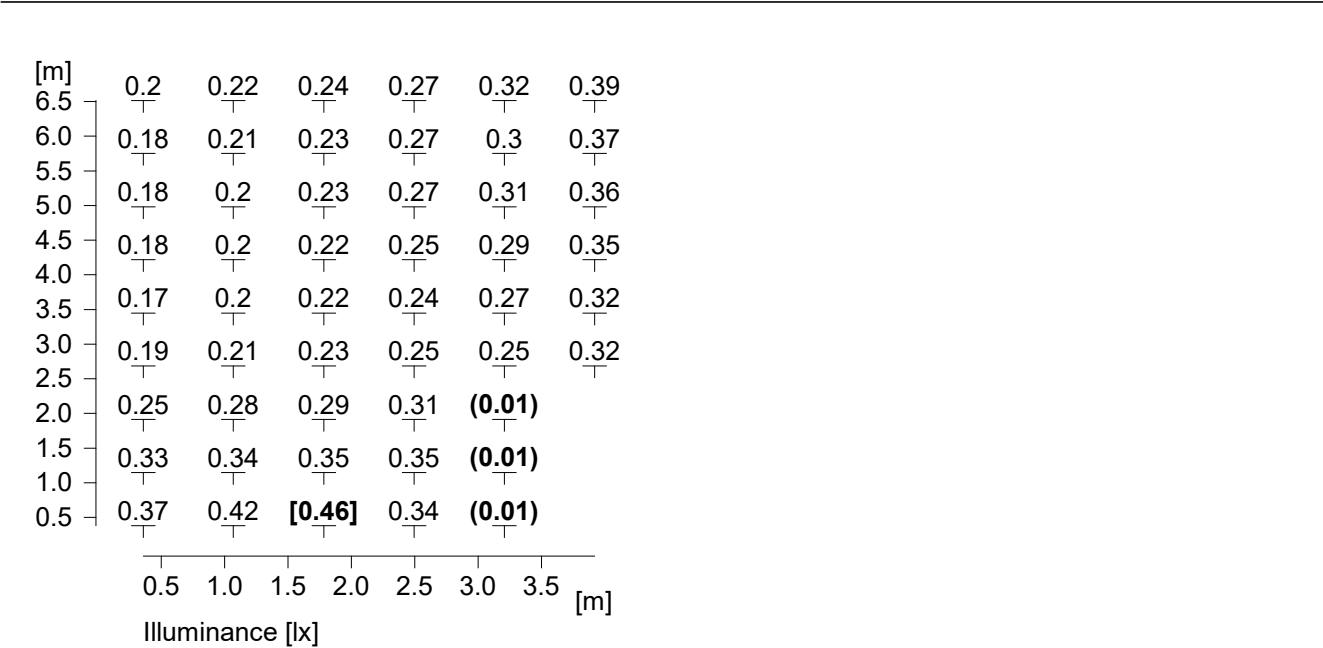


Average illuminance	$\bar{E}_m$	: 1.13 lx
Minimum illuminance	E_{min}	: 0.36 lx
Maximum illuminance	E_{max}	: 3.64 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 3.15 (0.32)
Diversity U_d	E_{min}/E_{max}	: 1 : 10.13 (0.10)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

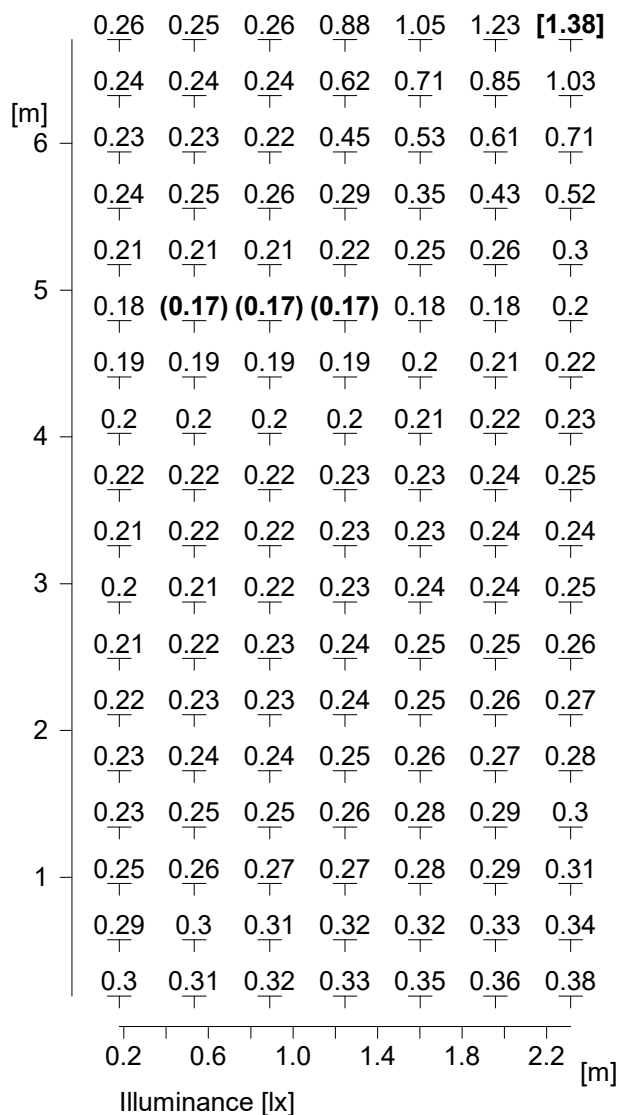
2.3.10 Table, 9 Sharps Lane - Wall 6 (E)



Average illuminance	$\bar{E}_m$	: 0.26 lx
Minimum illuminance	E_{min}	: 0.01 lx
Maximum illuminance	E_{max}	: 0.46 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 23.41 (0.04)
Diversity U_d	E_{min}/E_{max}	: 1 : 41.58 (0.02)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

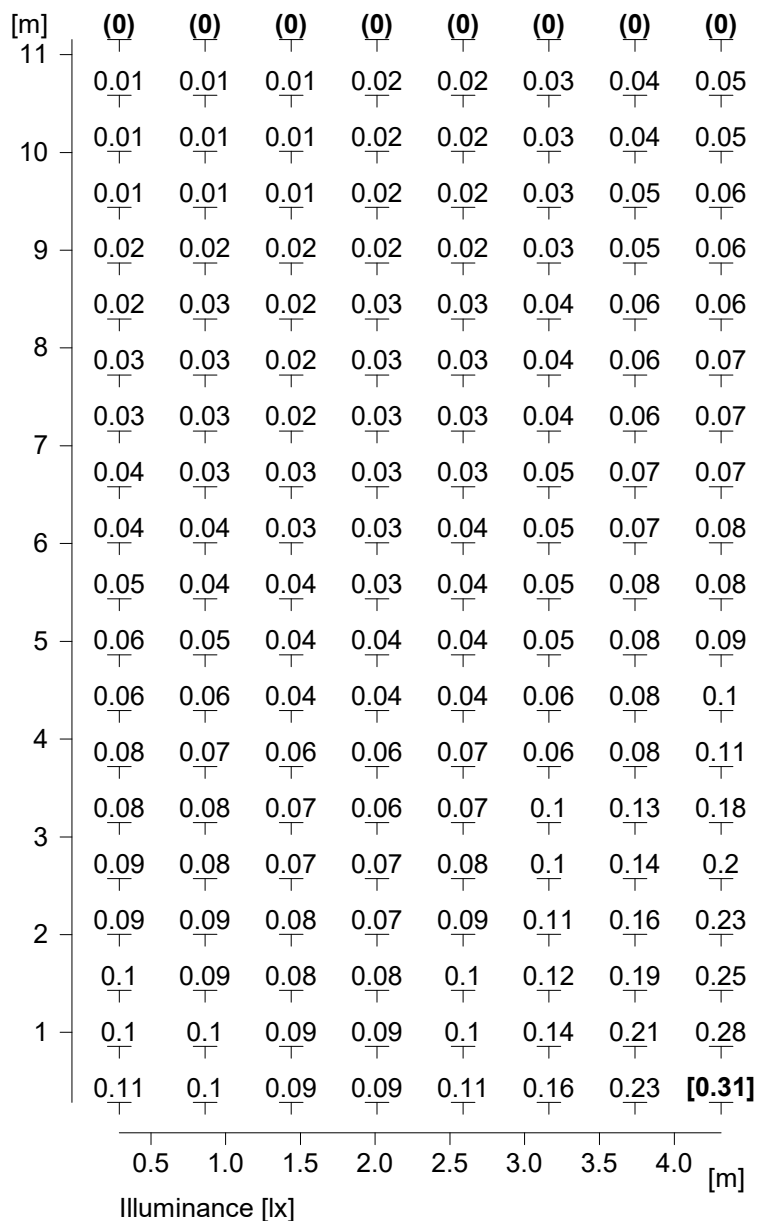
2.3.11 Table, 9 Sharps Lane - Wall 7 (E)



Average illuminance	$\bar{E}_m$	: 0.31 lx
Minimum illuminance	E_{min}	: 0.17 lx
Maximum illuminance	E_{max}	: 1.38 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.80 (0.55)
Diversity U_d	E_{min}/E_{max}	: 1 : 8.15 (0.12)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

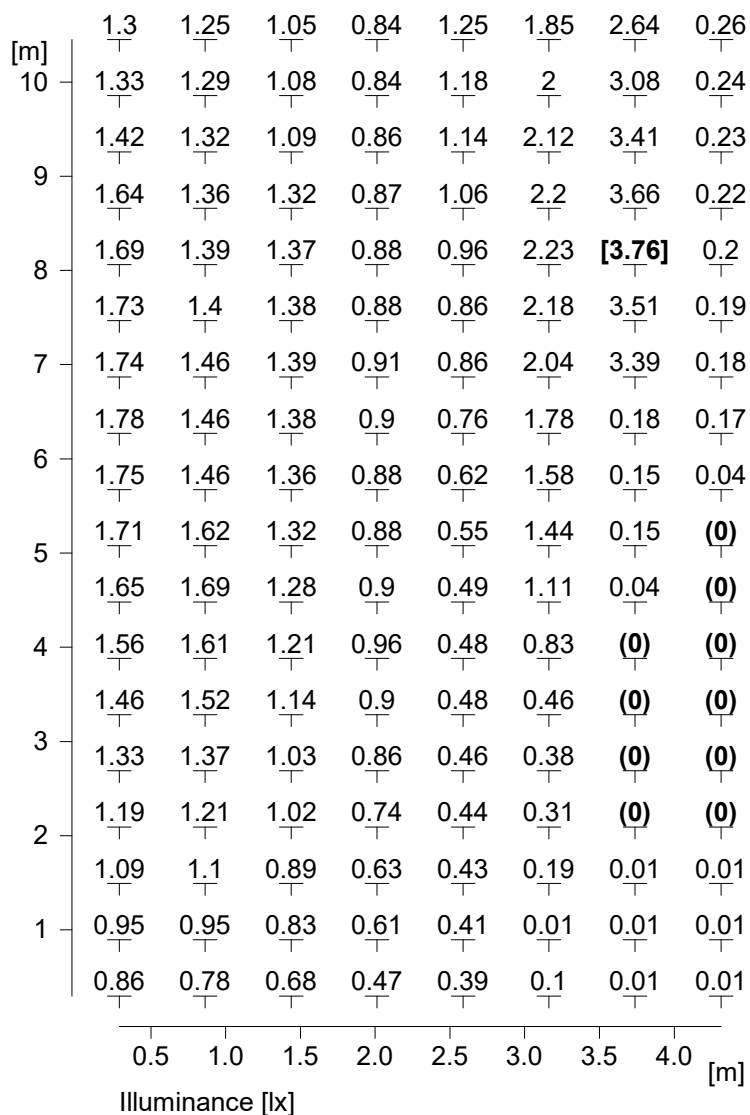
2.3.12 Table, 11 Sharps Lane (E)



Average illuminance	$\bar{E}_m$	: 0.06 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 0.31 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 61.28 (0.02)
Diversity U_d	E_{min}/E_{max}	: 1 : 296.13 (0.00)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

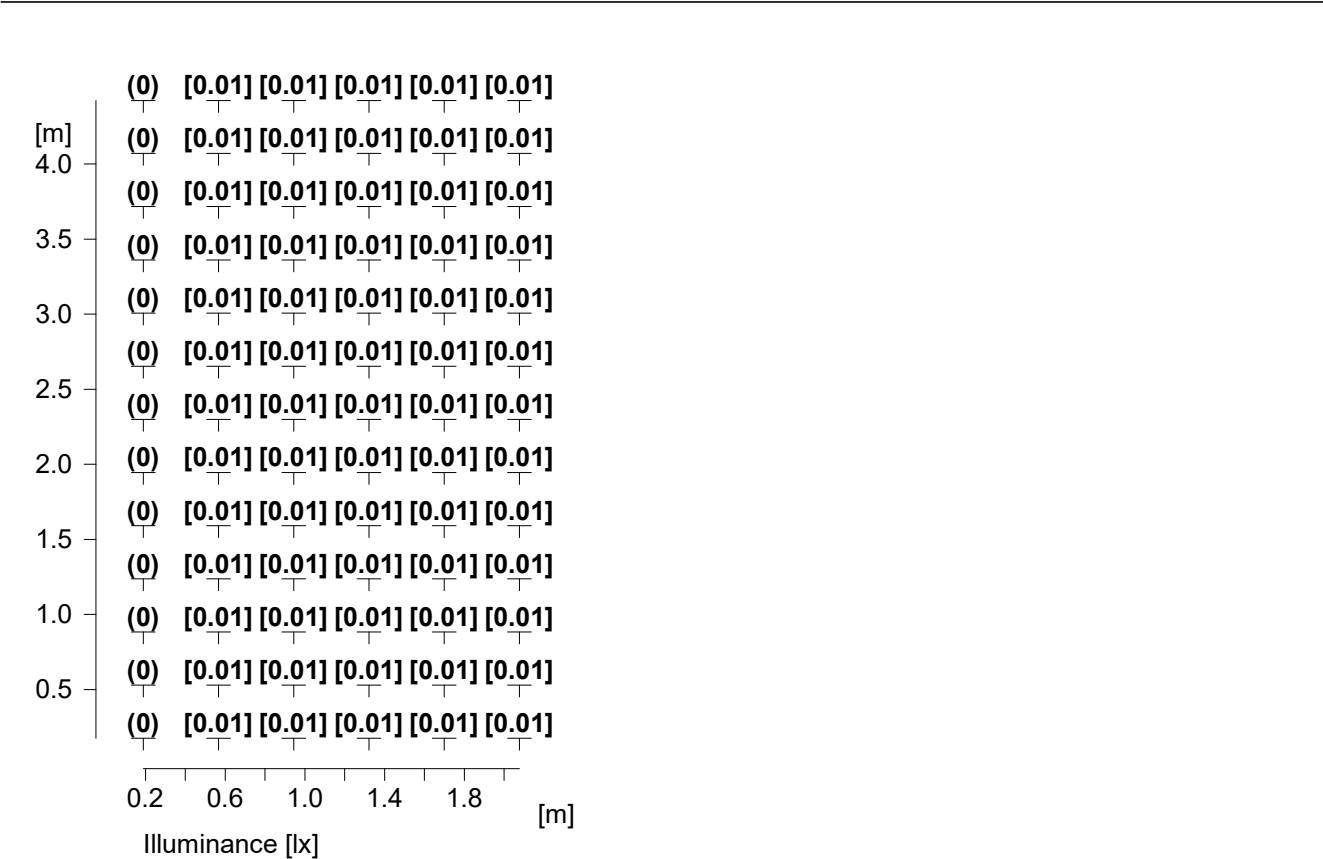
2.3.13 Table, Roberts House - Wall 1 (E)



Average illuminance	$\bar{E}_m$	: 1.02 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 3.76 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1005.84 (0.00)
Diversity U_d	E_{min}/E_{max}	: 1 : 3698.17 (0.00)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

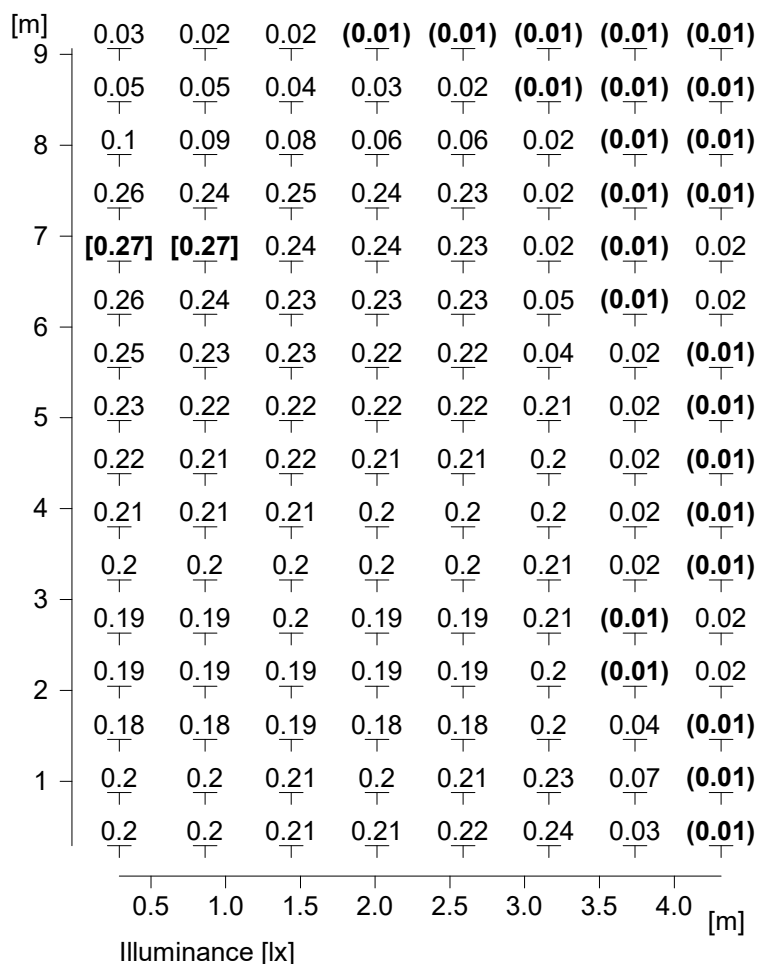
2.3.14 Table, Roberts House - Wall 2 (E)



Average illuminance	$\bar{E}_m$	: 0.01 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 0.01 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.65 (0.61)
Diversity U_d	E_{min}/E_{max}	: 1 : 2.28 (0.44)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.15 Table, Roberts House - Wall 3 (E)



Average illuminance	$\bar{E}_m$	: 0.13 lx
Minimum illuminance	E_{min}	: 0.01 lx
Maximum illuminance	E_{max}	: 0.27 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 16.58 (0.06)
Diversity U_d	E_{min}/E_{max}	: 1 : 33.90 (0.03)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.16 Table, Bell View Manor (E)

[m]	0.56	0.56	0.54	0.53	0.51	0.5	0.49	0.48	0.46	0.45	(0.44)	(0.44)	0.48	0.52	0.55	0.56	0.59	0.65	0.76	0.84	0.92	[1.07]
6.5	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.71	0.7	0.68	0.67	0.66	0.66	0.66	0.67	0.68	0.7	0.71	0.75	0.79	0.84	0.87
6.0	0.79	0.82	0.83	0.84	0.86	0.87	0.87	0.87	0.85	0.85	0.83	0.83	0.82	0.78	0.78	0.79	0.79	0.79	0.79	0.8	0.8	0.8
5.5	0.65	0.67	0.69	0.7	0.72	0.73	0.74	0.75	0.75	0.76	0.75	0.75	0.75	0.71	0.7	0.7	0.71	0.7	0.69	0.68	0.67	0.66
5.0	0.58	0.6	0.62	0.65	0.66	0.68	0.69	0.7	0.7	0.71	0.72	0.72	0.72	0.69	0.7	0.7	0.69	0.69	0.68	0.68	0.67	0.66
4.5	0.58	0.59	0.61	0.61	0.63	0.64	0.65	0.66	0.67	0.67	0.68	0.69	0.7	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.66	0.66
4.0	0.6	0.6	0.62	0.62	0.63	0.64	0.65	0.65	0.66	0.67	0.67	0.68	0.68	0.67	0.67	0.68	0.67	0.68	0.68	0.67	0.67	0.66
3.5	0.62	0.63	0.64	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.69	0.69	0.7	0.68	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.67
3.0	0.64	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.69	0.69	0.7	0.7	0.71	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.69	0.69
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Average illuminance	$\bar{E}_m$	: 0.69 lx
Minimum illuminance	E_{min}	: 0.44 lx
Maximum illuminance	E_{max}	: 1.07 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.57 (0.64)
Diversity U_d	E_{min}/E_{max}	: 1 : 2.45 (0.41)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.17 Table, Jubilee House (E)

[m]	1.05	0.95	0.88	0.95	0.88	0.82	0.76	0.7	0.65	0.61	0.63	0.59	0.55	0.52	0.49	0.45	0.42	0.4	0.38
6.5	0.9	0.84	0.8	0.76	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.41	0.4	0.38	0.36	0.35
6.0	0.66	0.63	0.62	0.6	0.58	0.56	0.54	0.51	0.49	0.47	0.44	0.42	0.41	0.4	0.38	0.37	0.35	0.34	0.33
5.5	0.59	0.58	0.56	0.56	0.54	0.52	0.5	0.47	0.45	0.43	0.42	0.41	0.39	0.38	0.37	0.35	0.34	0.33	0.32
5.0	0.56	0.55	0.53	0.52	0.5	0.48	0.47	0.45	0.43	0.42	0.41	0.39	0.38	0.37	0.35	0.34	0.33	0.31	0.3
4.5	0.55	0.53	0.52	0.49	0.47	0.46	0.44	0.43	0.41	0.4	0.39	0.38	0.36	0.35	0.34	0.32	0.31	0.3	0.29
4.0	0.53	0.51	0.49	0.47	0.46	0.44	0.43	0.41	0.4	0.39	0.37	0.36	0.35	0.34	0.32	0.31	0.29	0.28	0.27
3.5	0.52	0.49	0.47	0.45	0.44	0.43	0.41	0.4	0.39	0.37	0.36	0.35	0.33	0.32	0.31	0.29	0.28	0.27	0.25
3.0	0.49	0.48	0.47	0.45	0.43	0.42	0.4	0.39	0.37	0.36	0.34	0.33	0.32	0.3	0.29	0.28	0.26	0.25	(0.24)
2.5																			
2.0																			
1.5																			
1.0																			
0.5																			
		2		4		6		8		10		12		14					
	Illuminance [lx]																		

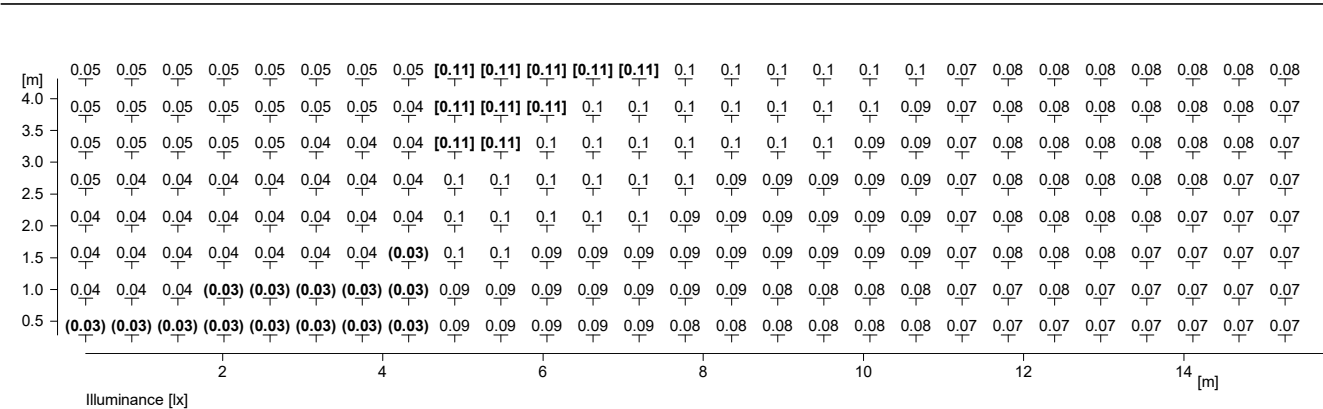


Average illuminance	$\bar{E}_m$	: 0.46 lx
Minimum illuminance	E_{min}	: 0.24 lx
Maximum illuminance	E_{max}	: 1.05 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.93 (0.52)
Diversity U_d	E_{min}/E_{max}	: 1 : 4.40 (0.23)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.18 Table, 1-2 The Oaks (E)



Part1

Average illuminance	$\bar{E}_m$	: 0.07 lx
Minimum illuminance	E_{min}	: 0.03 lx
Maximum illuminance	E_{max}	: 0.11 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 2.50 (0.40)
Diversity U_d	E_{min}/E_{max}	: 1 : 3.83 (0.26)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.18 Table, 1-2 The Oaks (E)

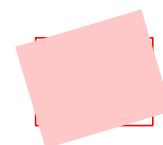
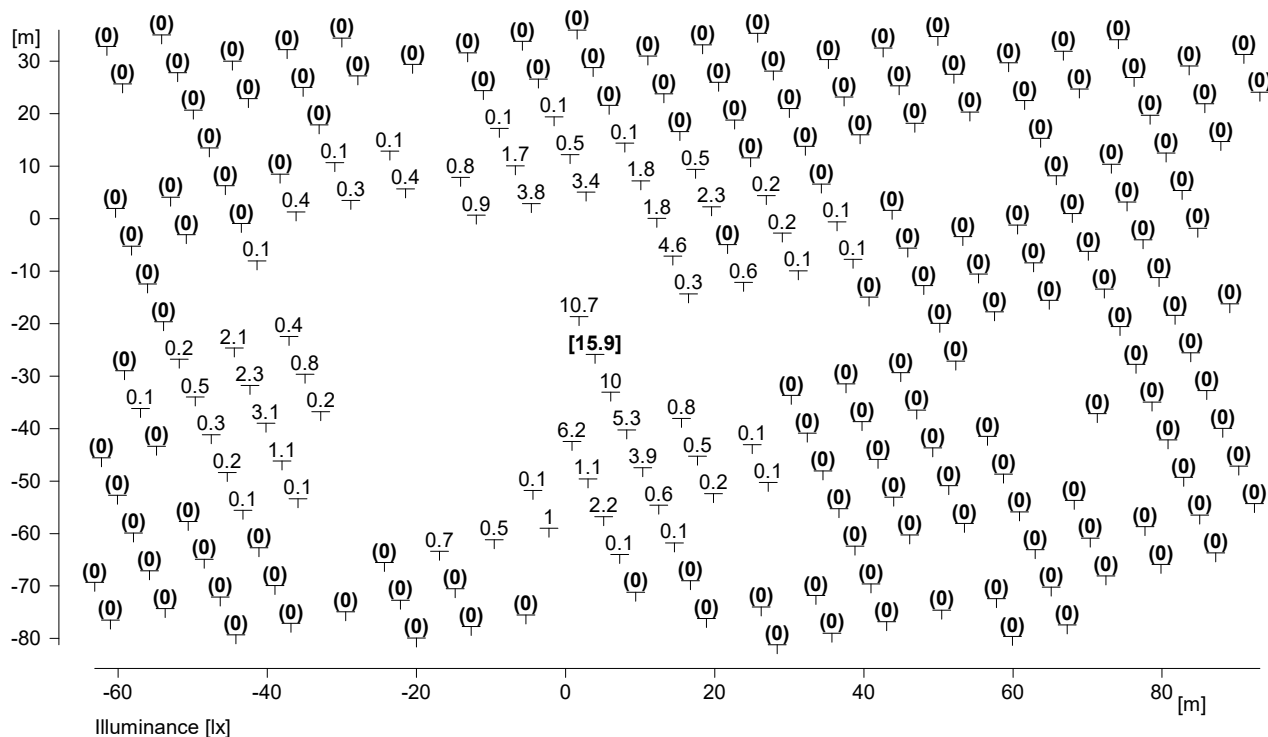
0.07
0.07
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Part2

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

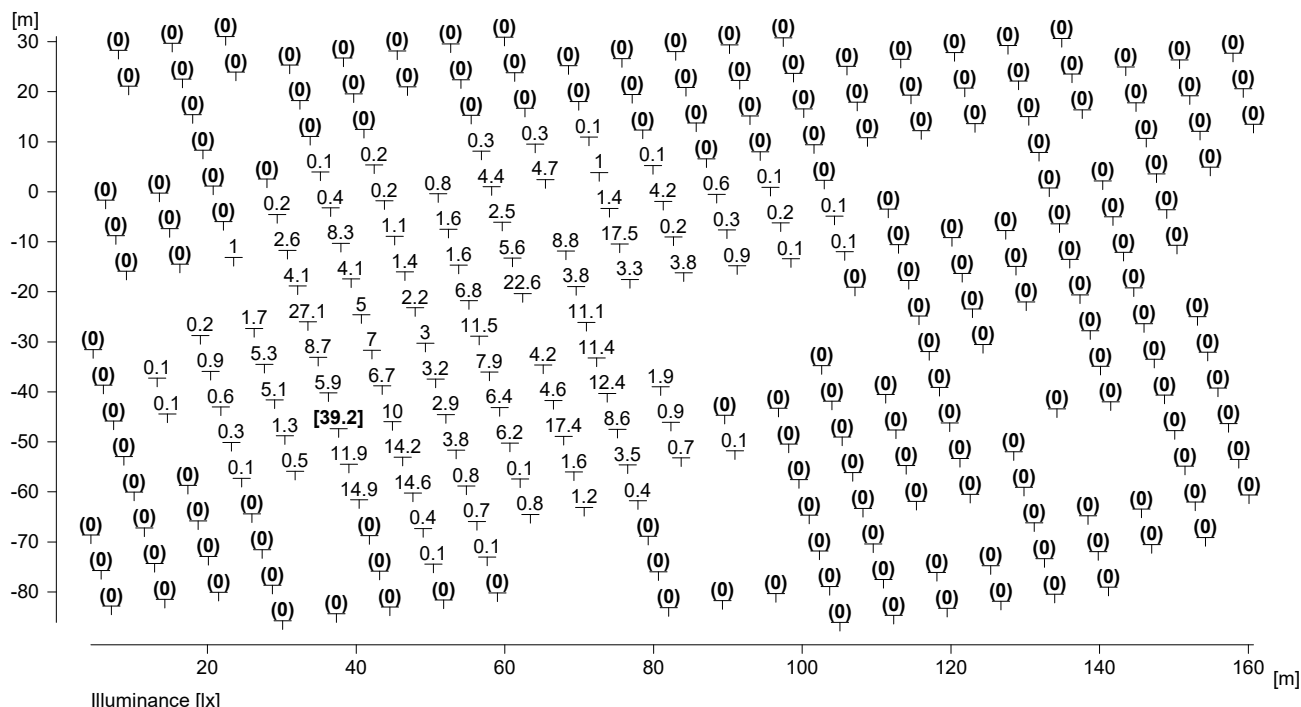
2.3.19 Table, Spill (E)



Height reference plane		: 0.00 m
Average illuminance	$\bar{E}_m$	: 0.4 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 15.9 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: ---
Diversity U_d	E_{min}/E_{max}	: ---

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

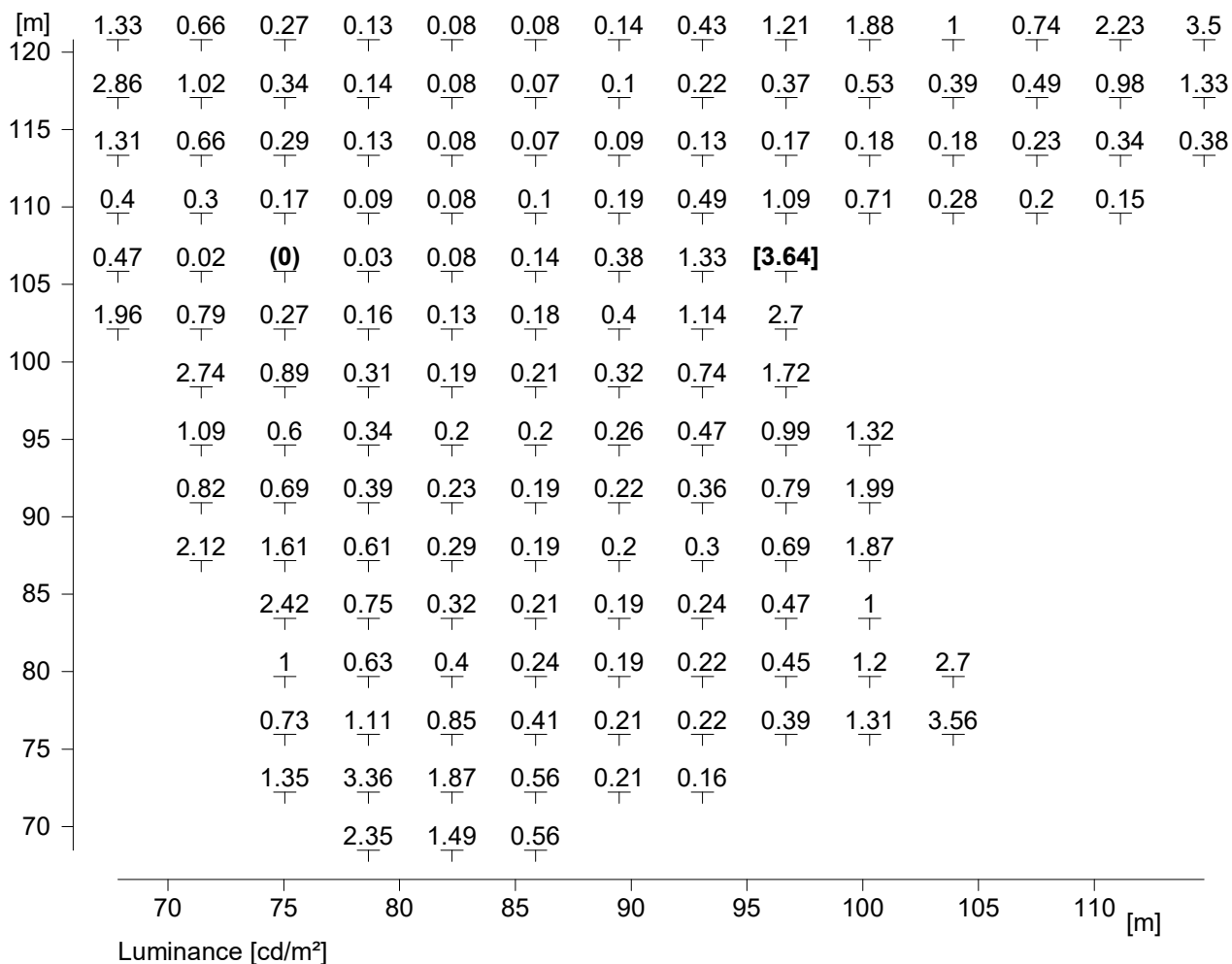
2.3.20 Table, Car Park + Spillage (E)



Height reference plane	: 0.00 m
Average illuminance	$\bar{E}_m$: 1.5 lx
Minimum illuminance	E_{min} : 0 lx
Maximum illuminance	E_{max} : 39.2 lx
Uniformity U_o	$E_{min}/\bar{E}_m$: ---
Diversity U_d	E_{min}/E_{max} : ---

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

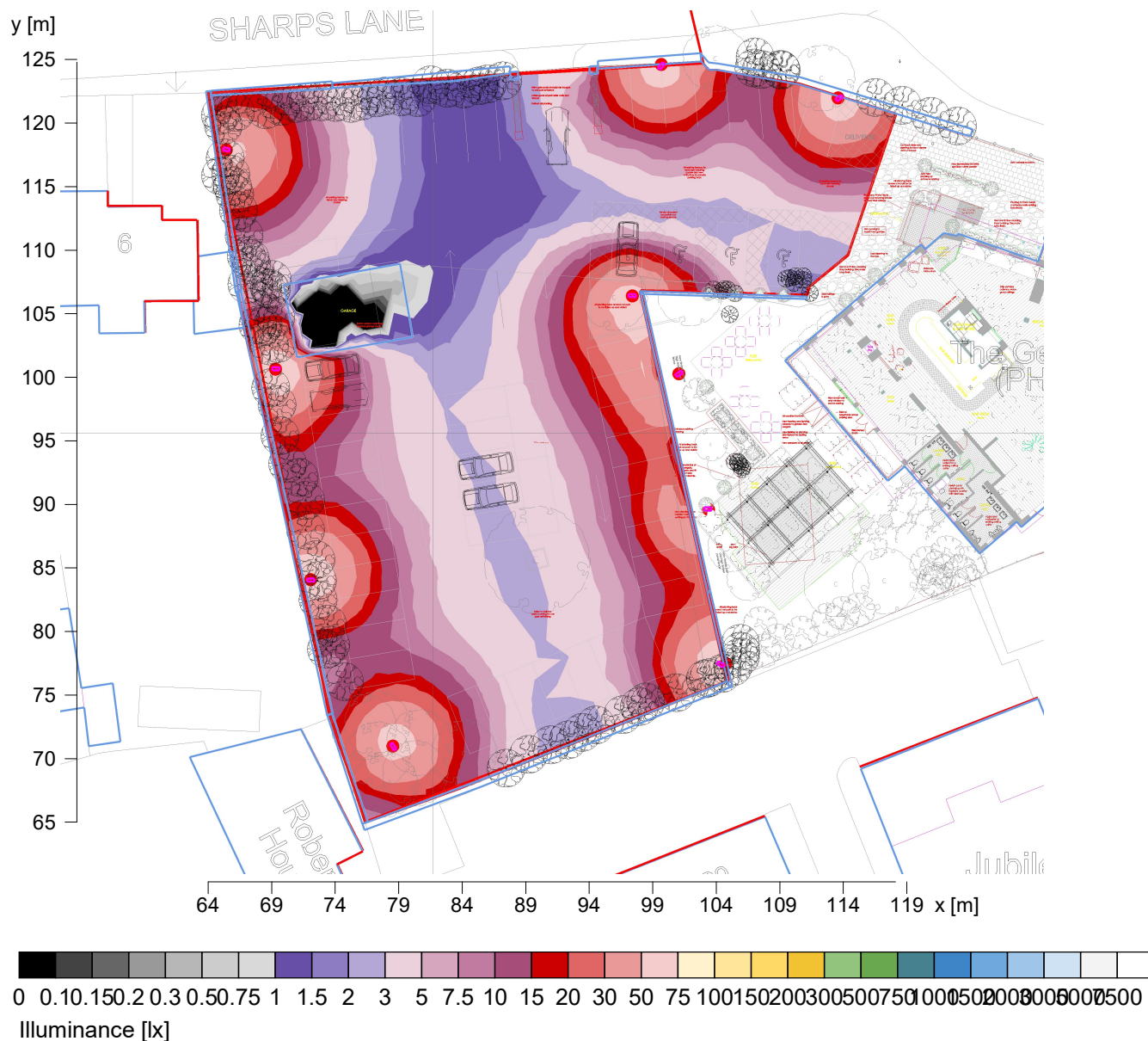
2.3.21 Table, Floor (L)



Average luminance $\bar{L}_m$: 0.73 cd/m²
 Minimum luminance L_{min} : 0 cd/m²
 Maximum luminance L_{max} : 3.64 cd/m²

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.22 Pseudo colours, Floor (E)

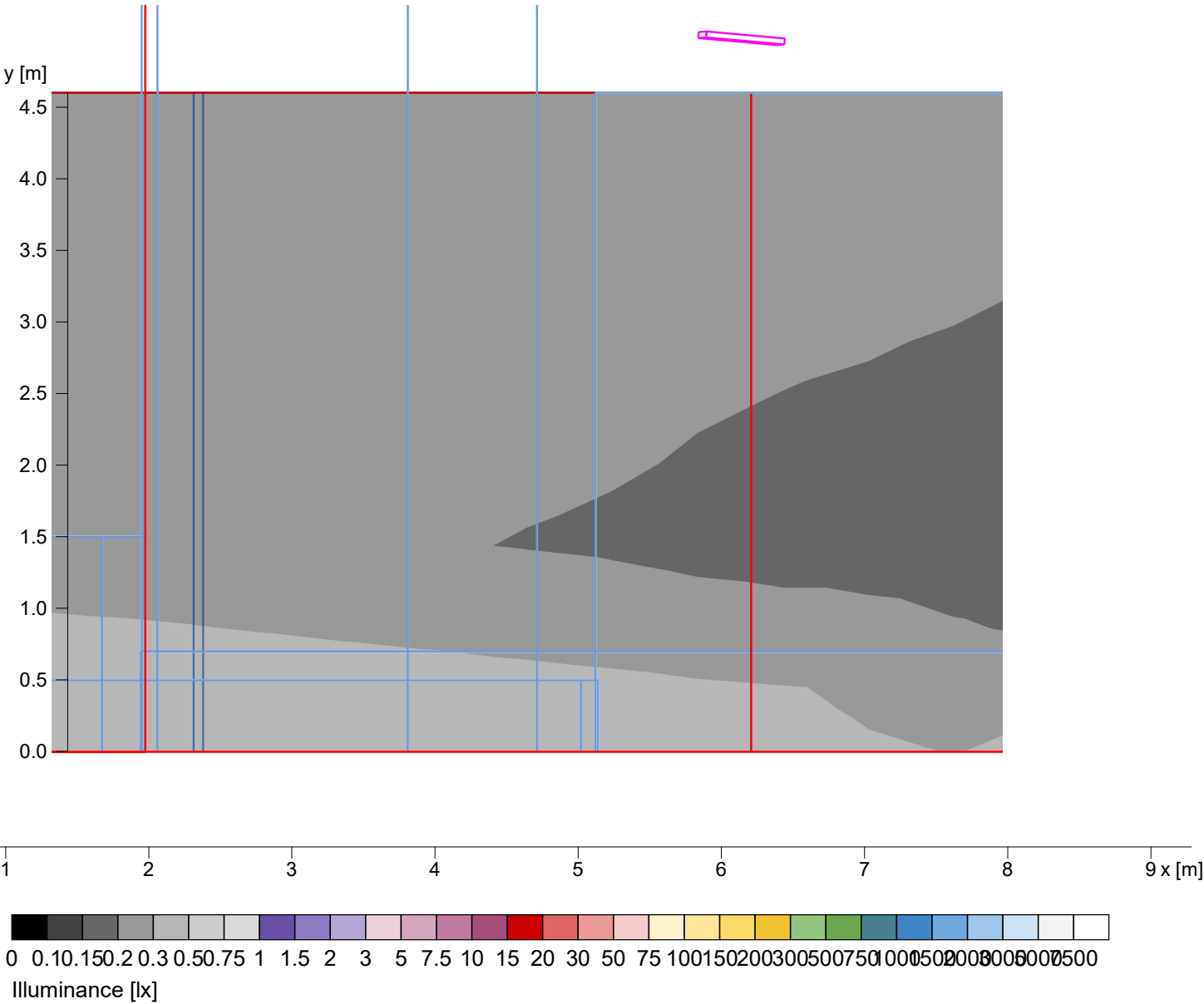


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 11.5 lx
 E_{min} : 0 lx
 E_{max} : 57.1 lx
 $E_{min}/\bar{E}_m$: ---
 E_{min}/E_{max} : ---

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

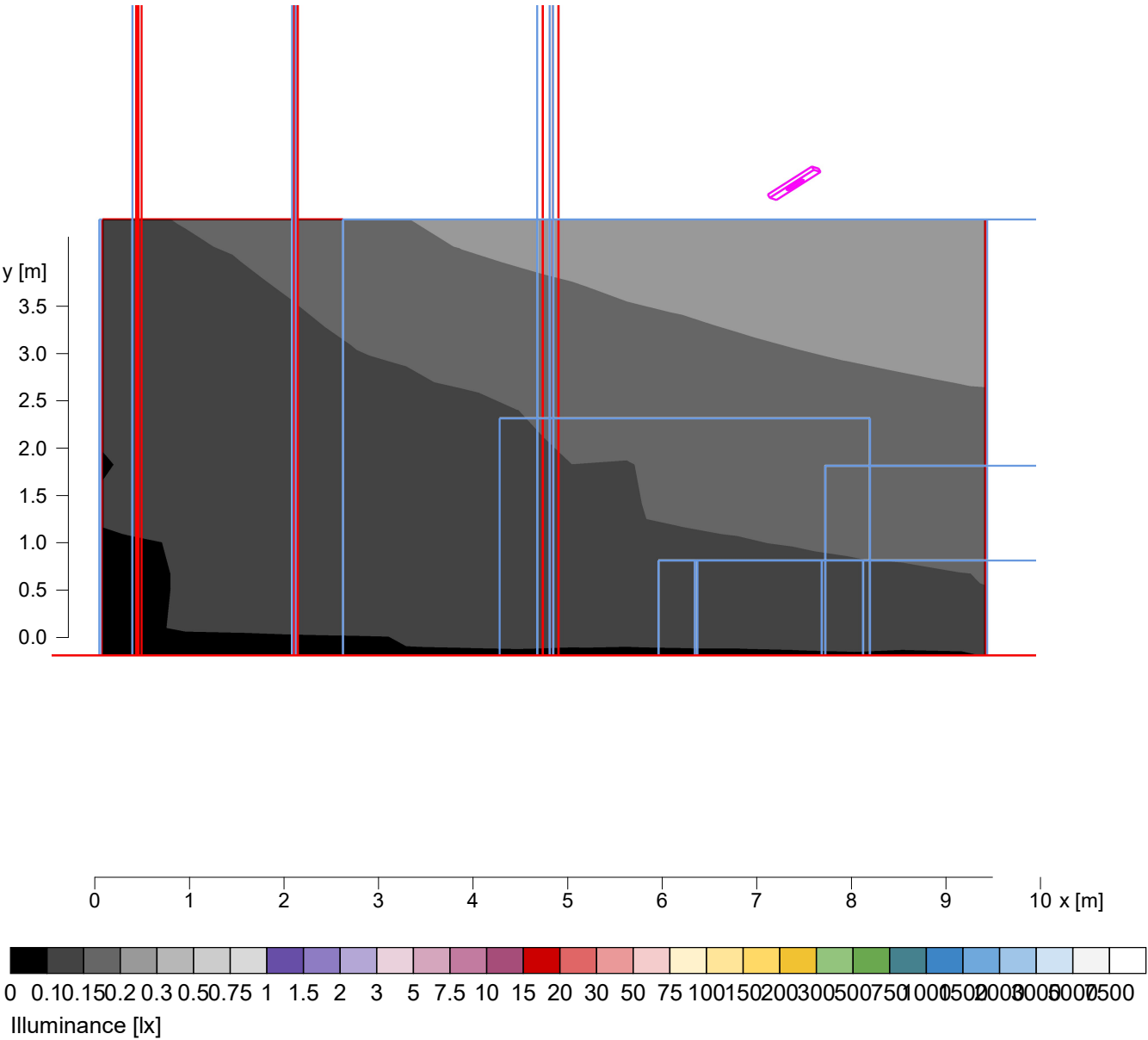
2.3.23 Pseudo colours, 1-5 Sharps Lane (E)



Average illuminance	$\bar{E}_m$	: 0.25 lx
Minimum illuminance	E_{min}	: 0.16 lx
Maximum illuminance	E_{max}	: 0.4 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.53 (0.65)
Diversity U_d	E_{min}/E_{max}	: 1 : 2.52 (0.40)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.24 Pseudo colours, 2 Sharps Lane (E)

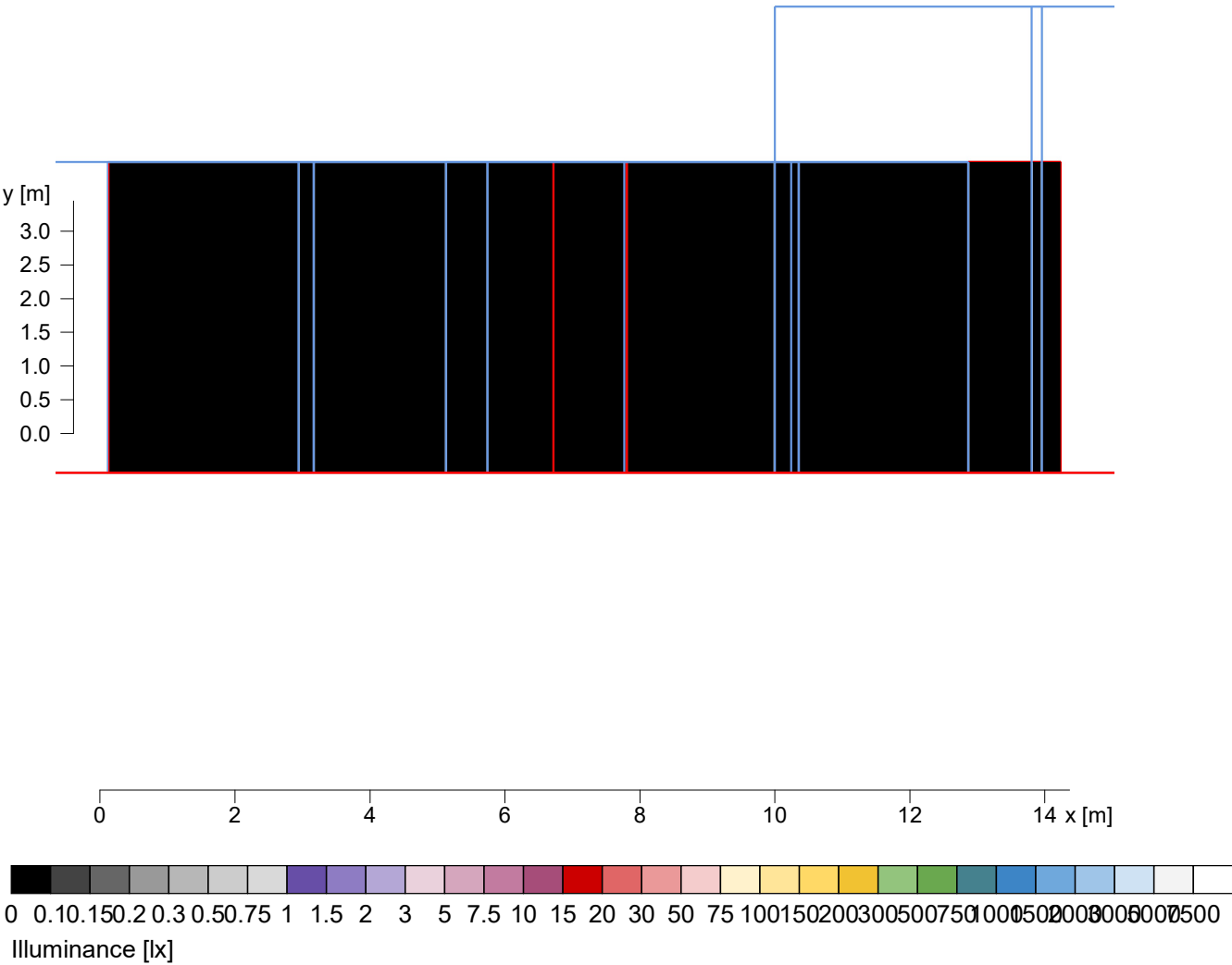


Average illuminance	$\bar{E}_m$	: 0.15 lx
Minimum illuminance	E_{min}	: 0.08 lx
Maximum illuminance	E_{max}	: 0.26 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.84 (0.54)
Diversity U_d	E_{min}/E_{max}	: 1 : 3.09 (0.32)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.25 Pseudo colours, 8 Sharps Lane (E)



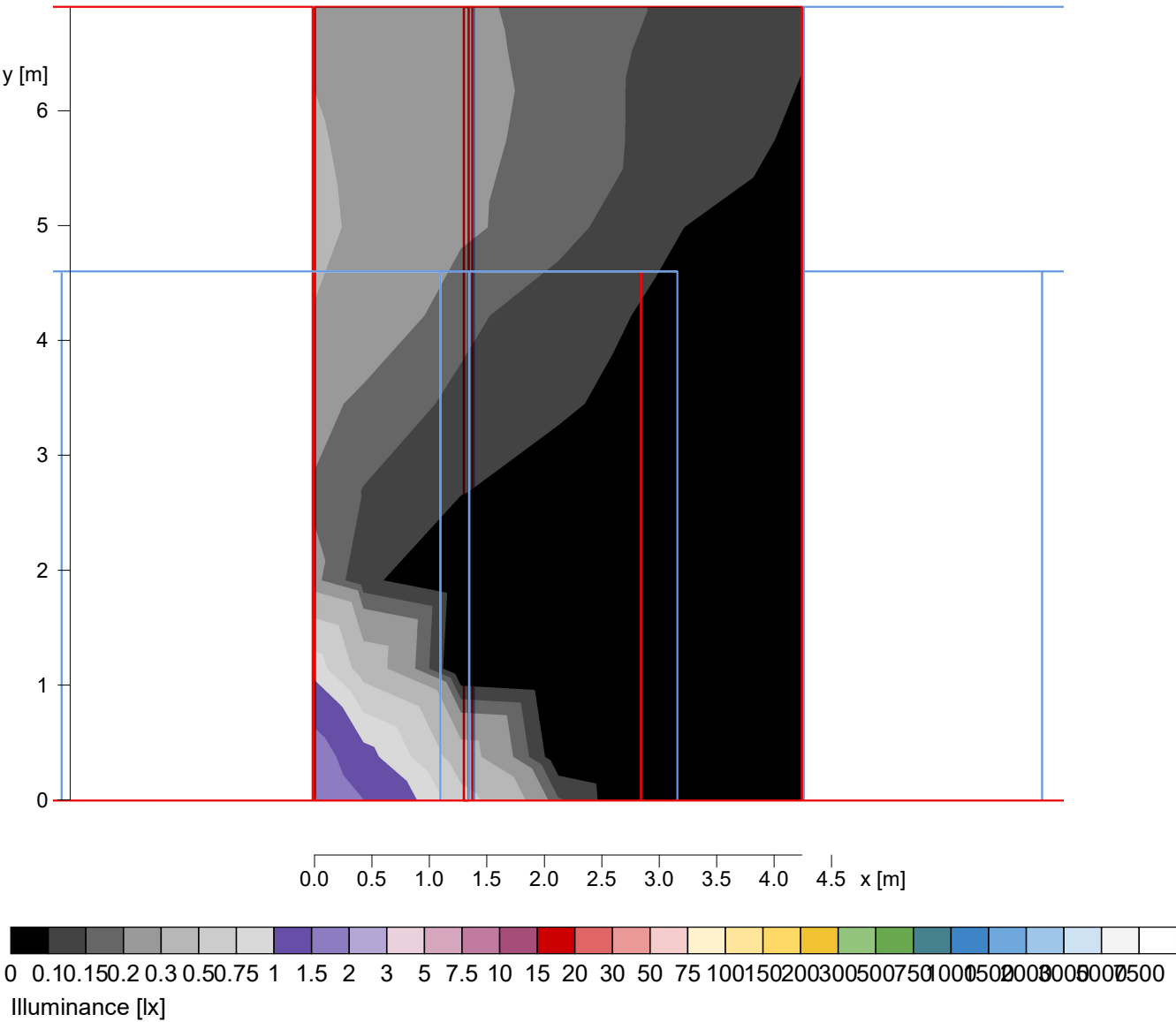
Average illuminance	$\bar{E}_m$	: 0.03 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 0.07 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 6.50 (0.15)
Diversity U_d	E_{min}/E_{max}	: 1 : 18.42 (0.05)

2.3.26 Pseudo colours, 9 Sharps Lane - Wall 1 (E)

$\bar{E}_m$	: 0.14 lx
E_{min}	: 0.01 lx
E_{max}	: 0.31 lx
$E_{min}/\bar{E}_m$	: 1 : 14.77 (0.07)
E_{min}/E_{max}	: 1 : 32.19 (0.03)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.27 Pseudo colours, 9 Sharps Lane - Wall 2 (E)



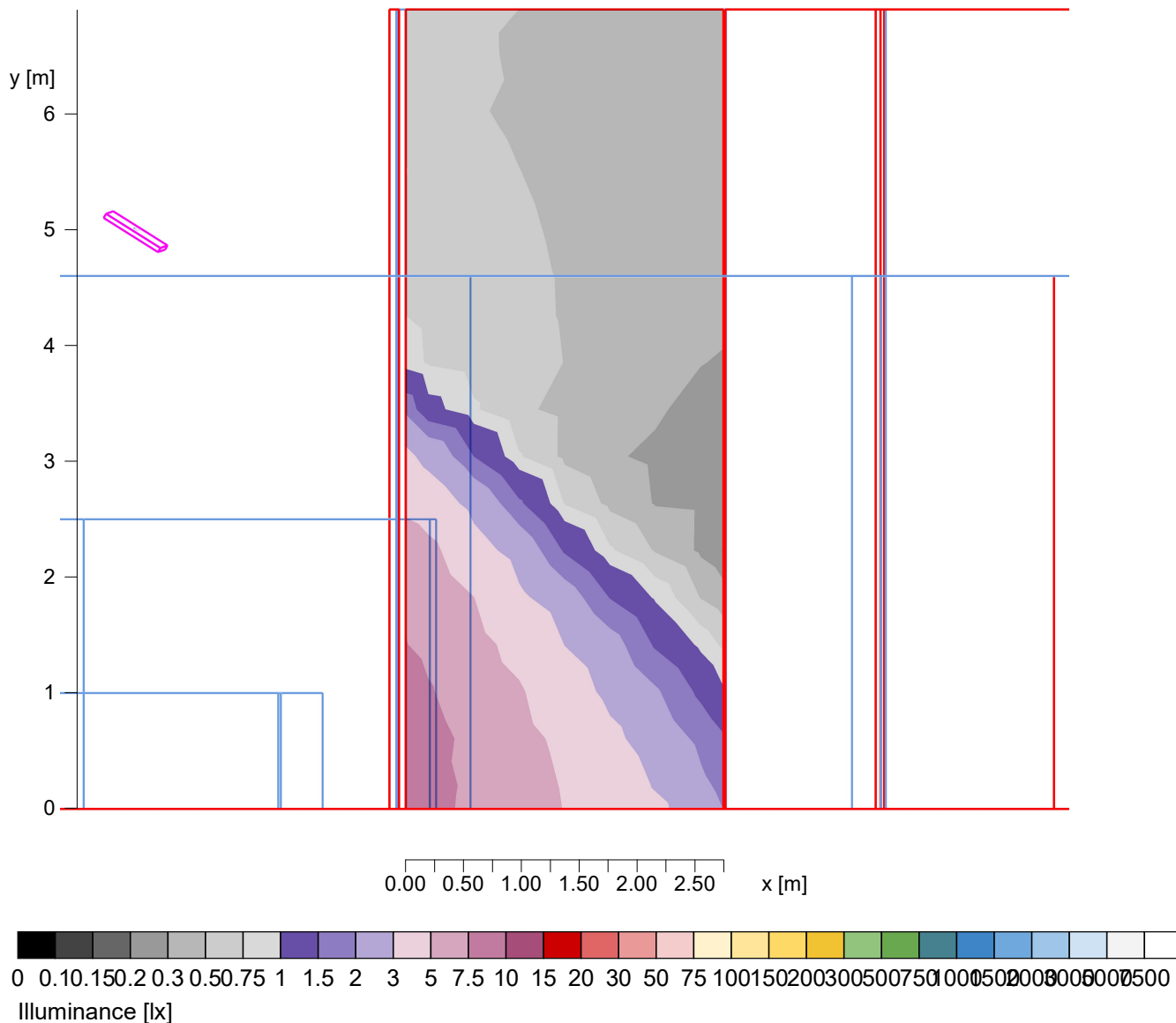
Average illuminance	$\bar{E}_m$	: 0.15 lx
Minimum illuminance	E_{min}	: 0.01 lx
Maximum illuminance	E_{max}	: 1.12 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 25.58 (0.04)
Diversity U_d	E_{min}/E_{max}	: 1 : 192.95 (0.01)

2.3.28 Pseudo colours, 9 Sharps Lane - Wall 3 (E)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.29 Pseudo colours, 9 Sharps Lane - Wall 4 (E)

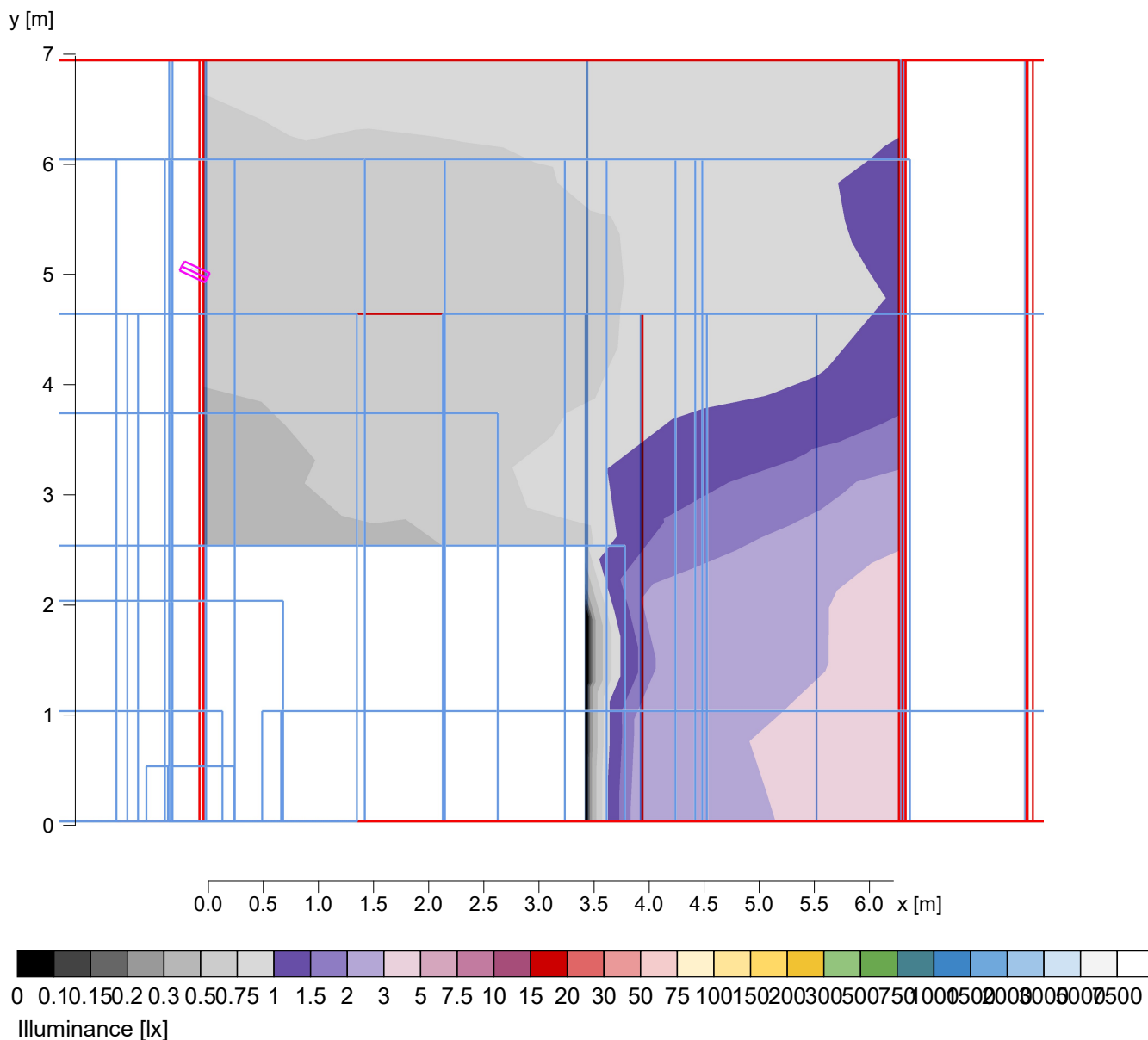


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 1.7 lx
 E_{min} : 0.23 lx
 E_{max} : 8.42 lx
 $E_{min}/\bar{E}_m$: 1 : 7.56 (0.13)
 E_{min}/E_{max} : 1 : 37.43 (0.03)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.30 Pseudo colours, 9 Sharps Lane - Wall 5 (E)

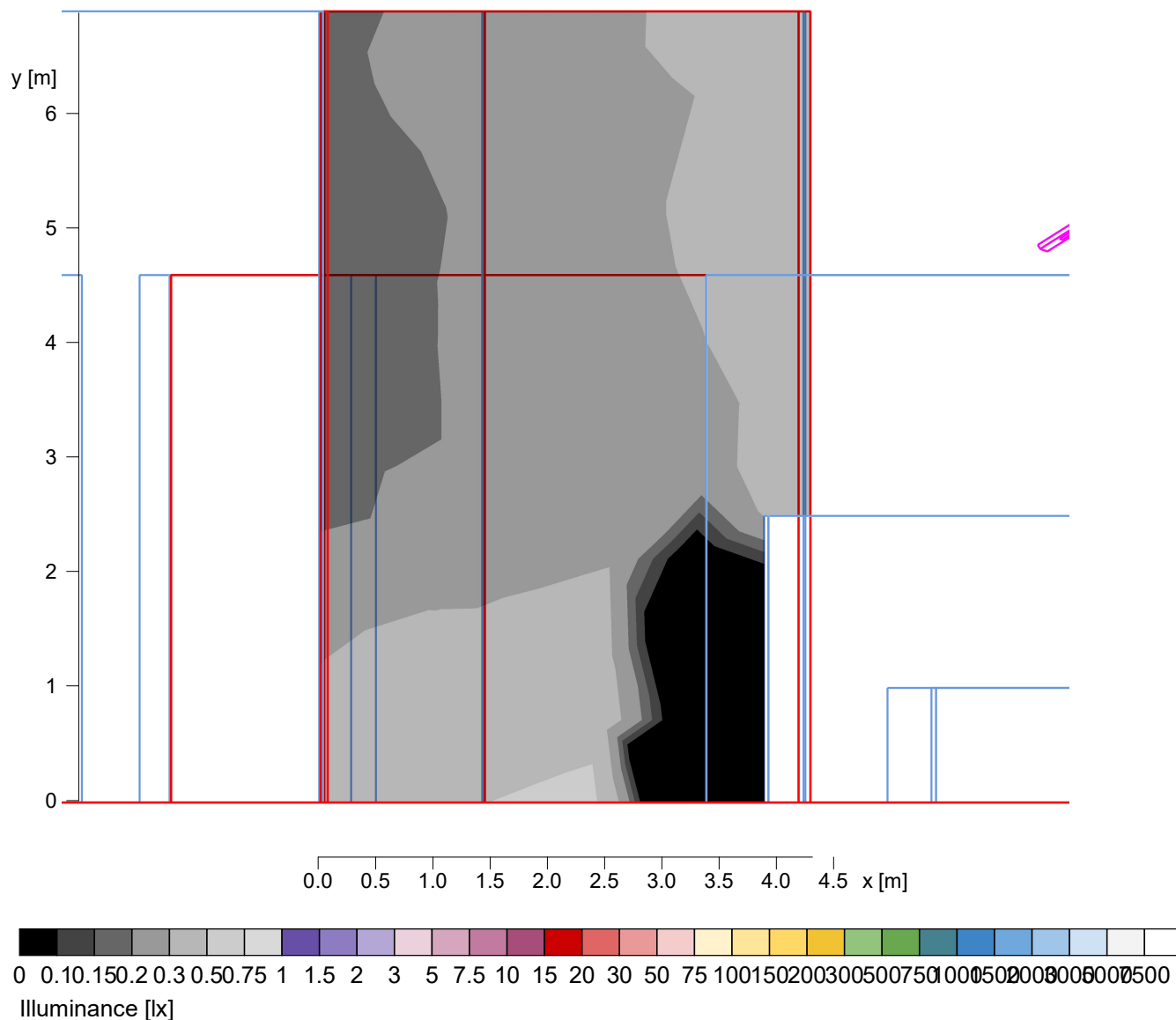


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 1.13 lx
 E_{min} : 0.36 lx
 E_{max} : 3.64 lx
 $E_{min}/\bar{E}_m$: 1 : 3.15 (0.32)
 E_{min}/E_{max} : 1 : 10.13 (0.10)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.31 Pseudo colours, 9 Sharps Lane - Wall 6 (E)

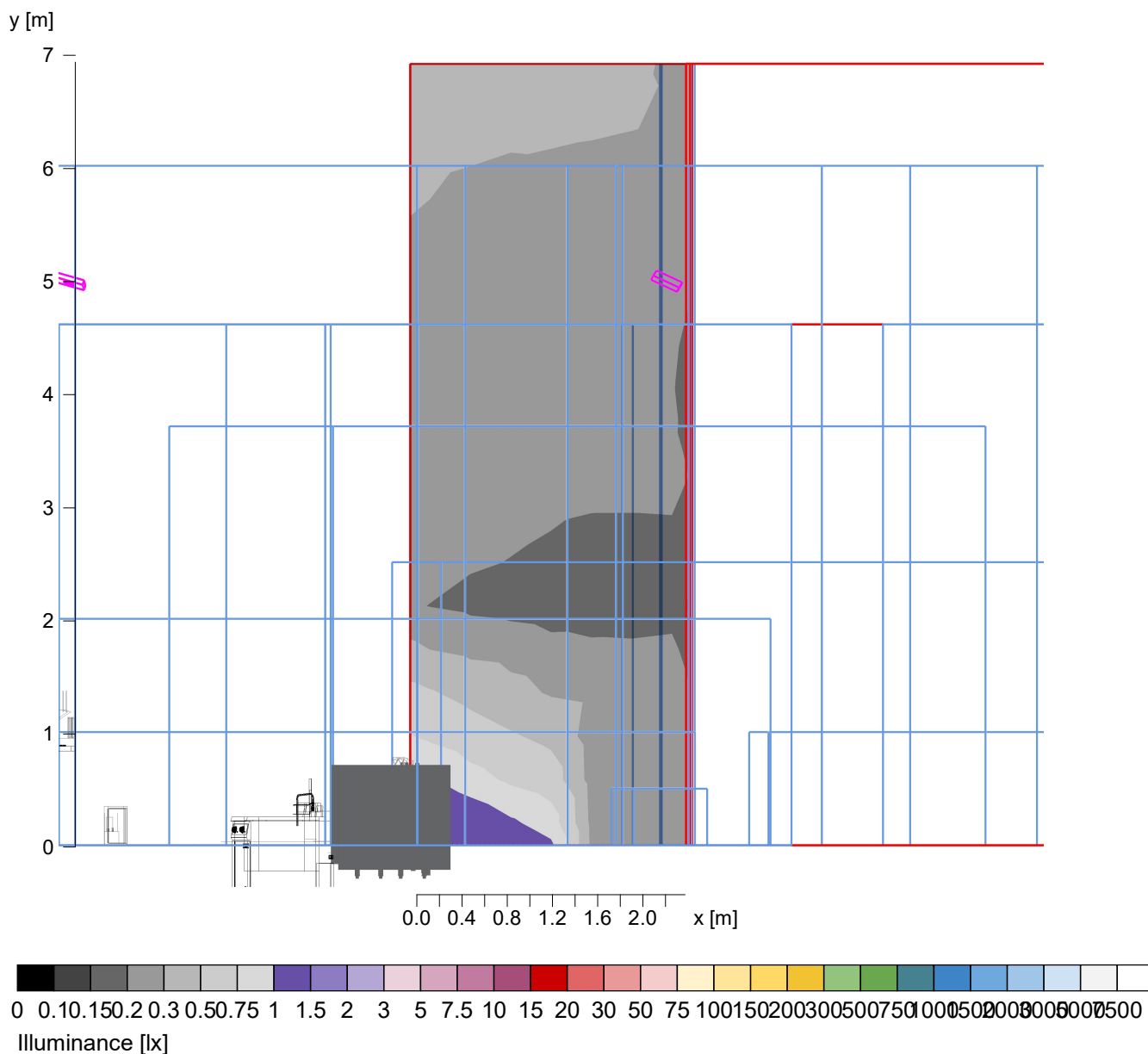


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.26 lx
 E_{min} : 0.01 lx
 E_{max} : 0.46 lx
 $E_{min}/\bar{E}_m$: 1 : 23.41 (0.04)
 E_{min}/E_{max} : 1 : 41.58 (0.02)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.32 Pseudo colours, 9 Sharps Lane - Wall 7 (E)

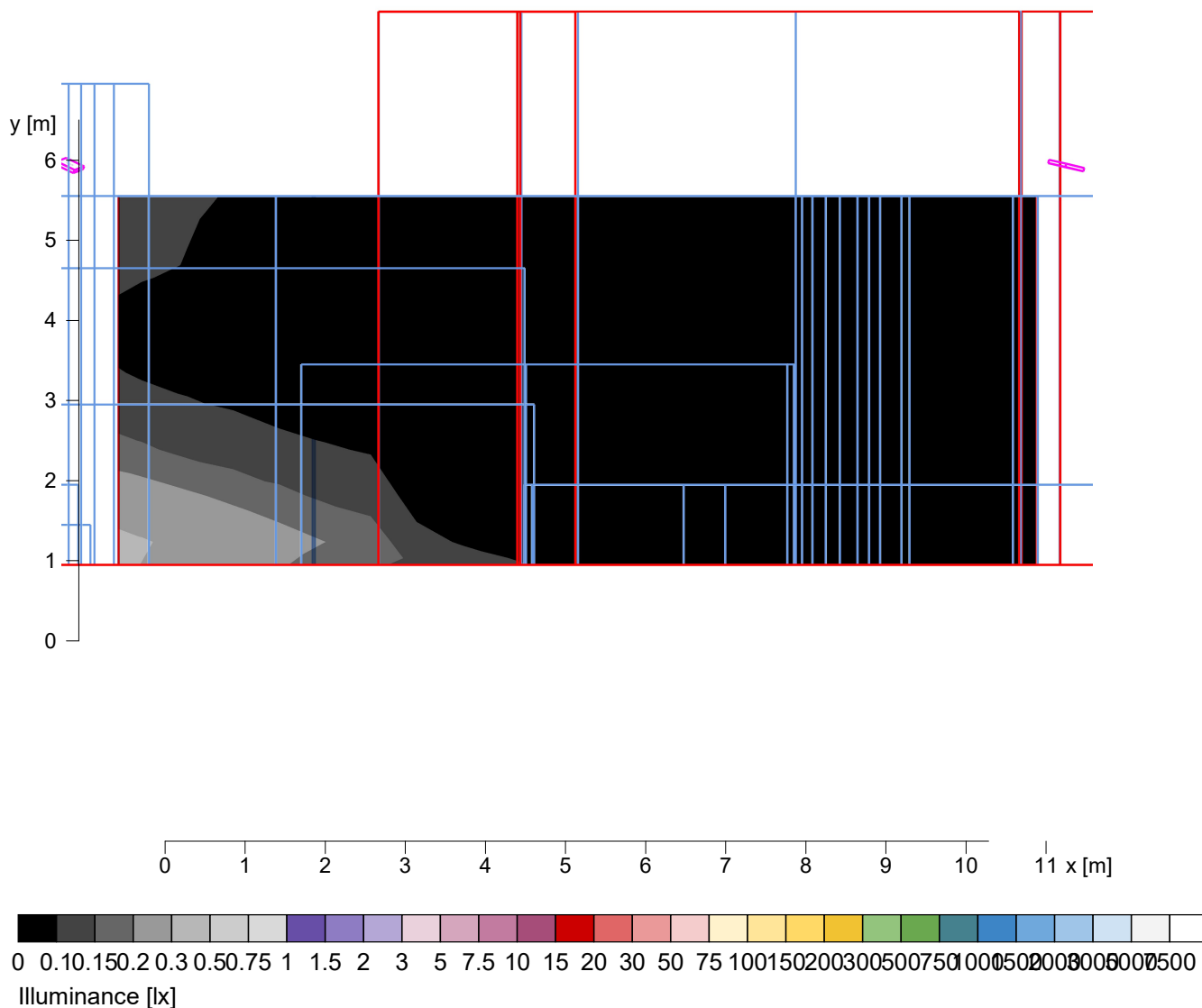


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.31 lx
 E_{min} : 0.17 lx
 E_{max} : 1.38 lx
 $E_{min}/\bar{E}_m$: 1 : 1.80 (0.55)
 E_{min}/E_{max} : 1 : 8.15 (0.12)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.33 Pseudo colours, 11 Sharps Lane (E)

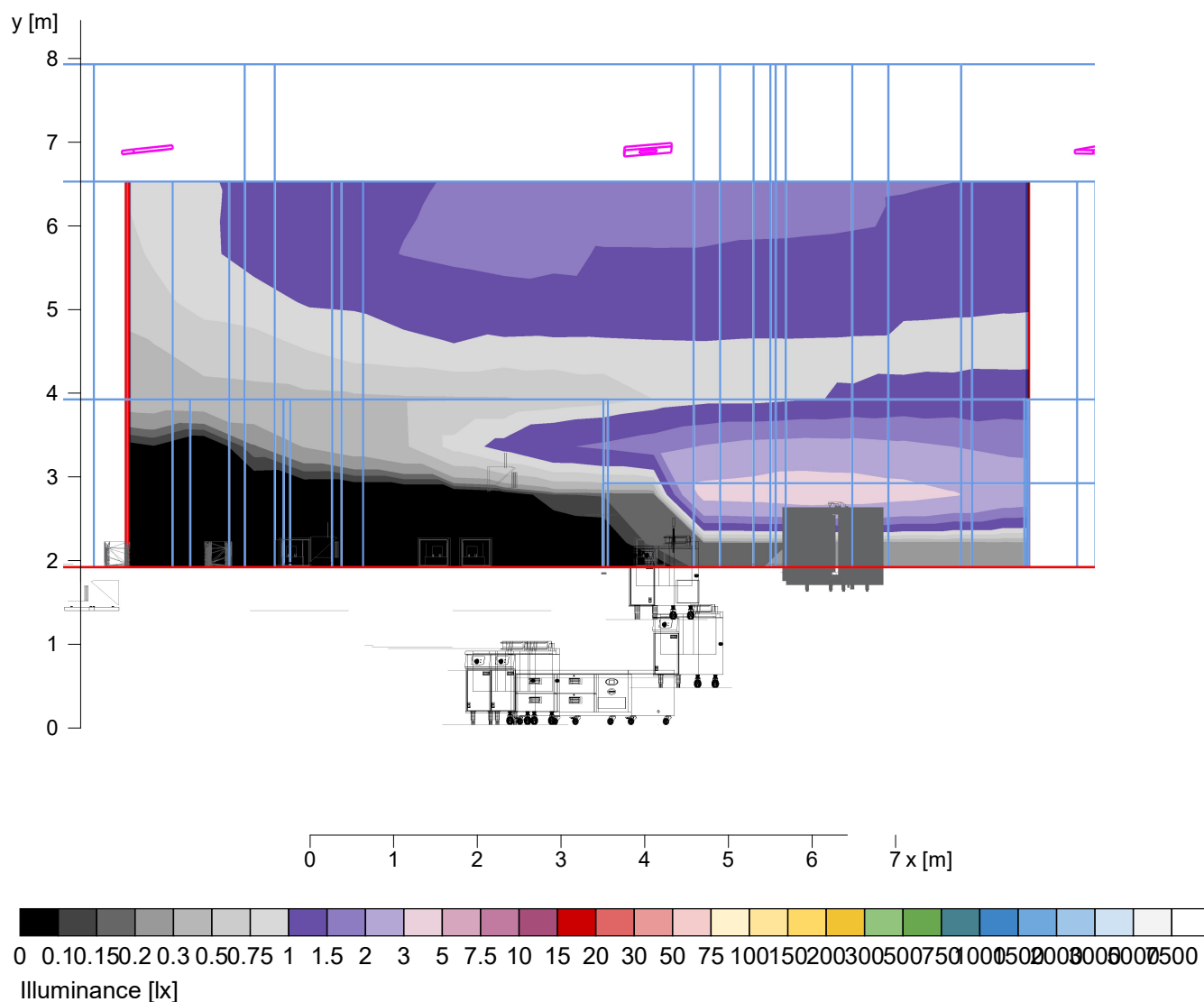


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.06 lx
 E_{min} : 0 lx
 E_{max} : 0.31 lx
 $E_{min}/\bar{E}_m$: 1 : 61.28 (0.02)
 E_{min}/E_{max} : 1 : 296.13 (0.00)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.34 Pseudo colours, Roberts House - Wall 1 (E)

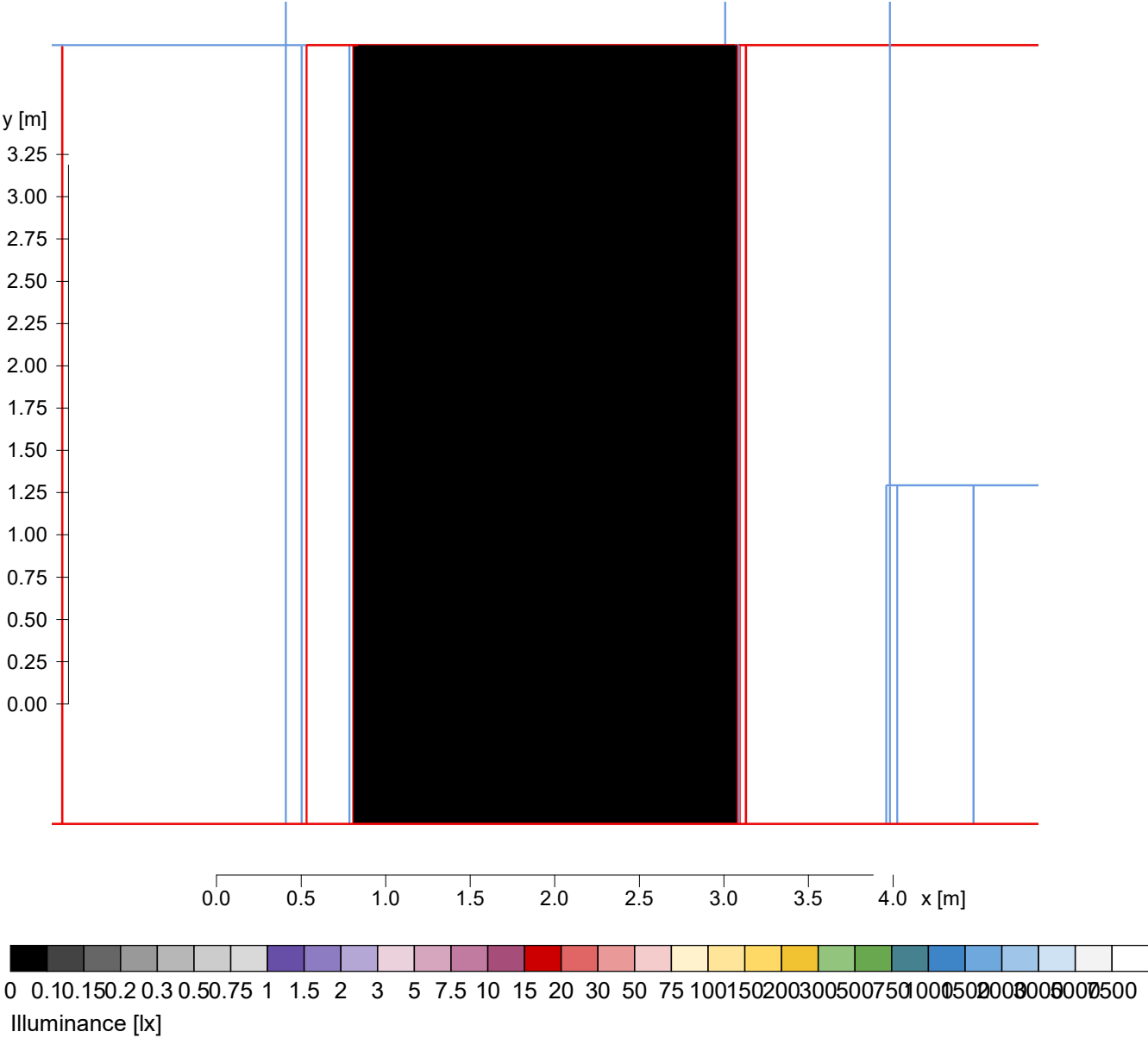


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 1.02 lx
 E_{min} : 0 lx
 E_{max} : 3.76 lx
 $E_{min}/\bar{E}_m$: 1 : 1005.84 (0.00)
 E_{min}/E_{max} : 1 : 3698.17 (0.00)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

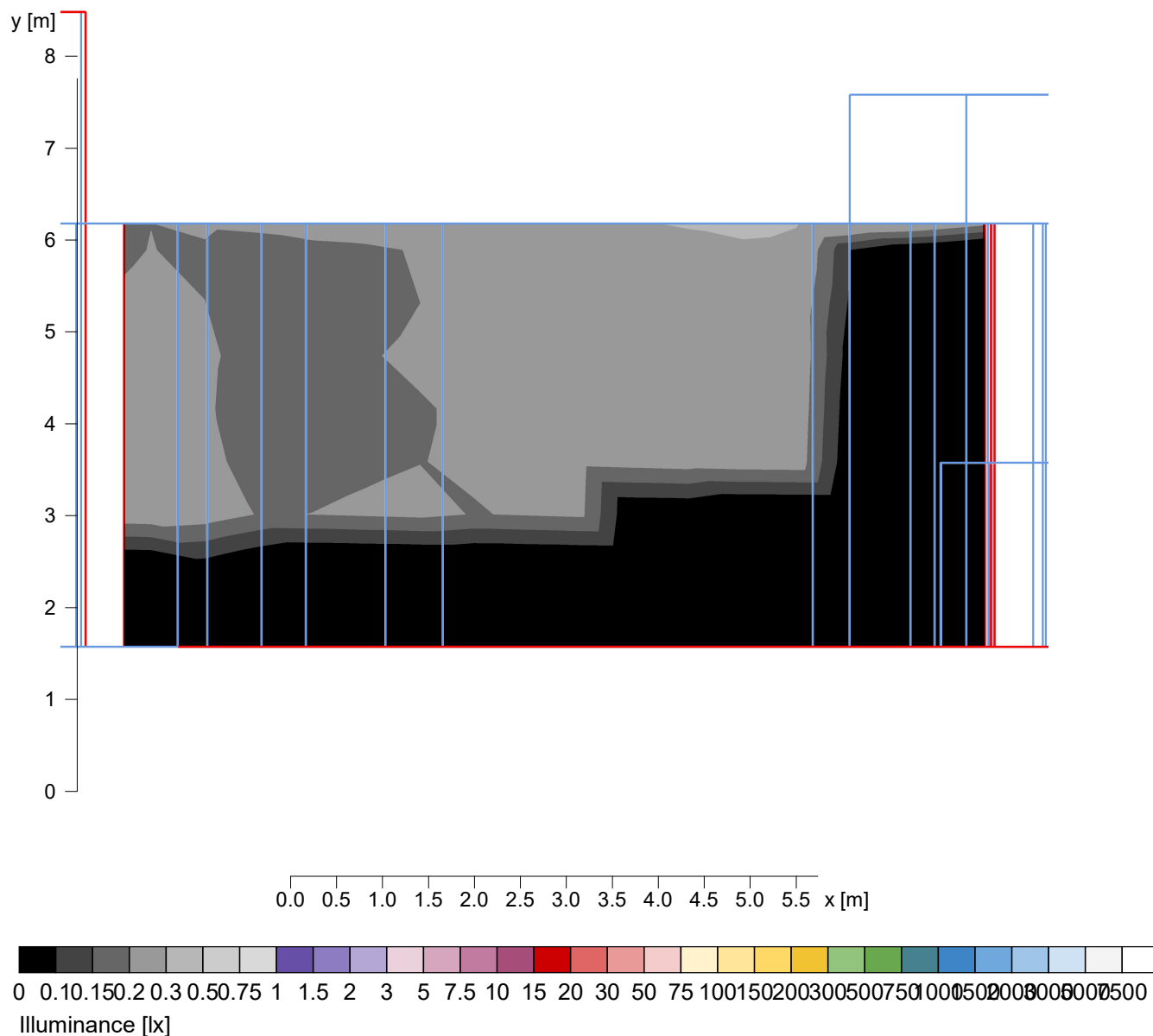
2.3.35 Pseudo colours, Roberts House - Wall 2 (E)



Average illuminance	$\bar{E}_m$	: 0.01 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 0.01 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 1.65 (0.61)
Diversity U_d	E_{min}/E_{max}	: 1 : 2.28 (0.44)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.36 Pseudo colours, Roberts House - Wall 3 (E)



Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

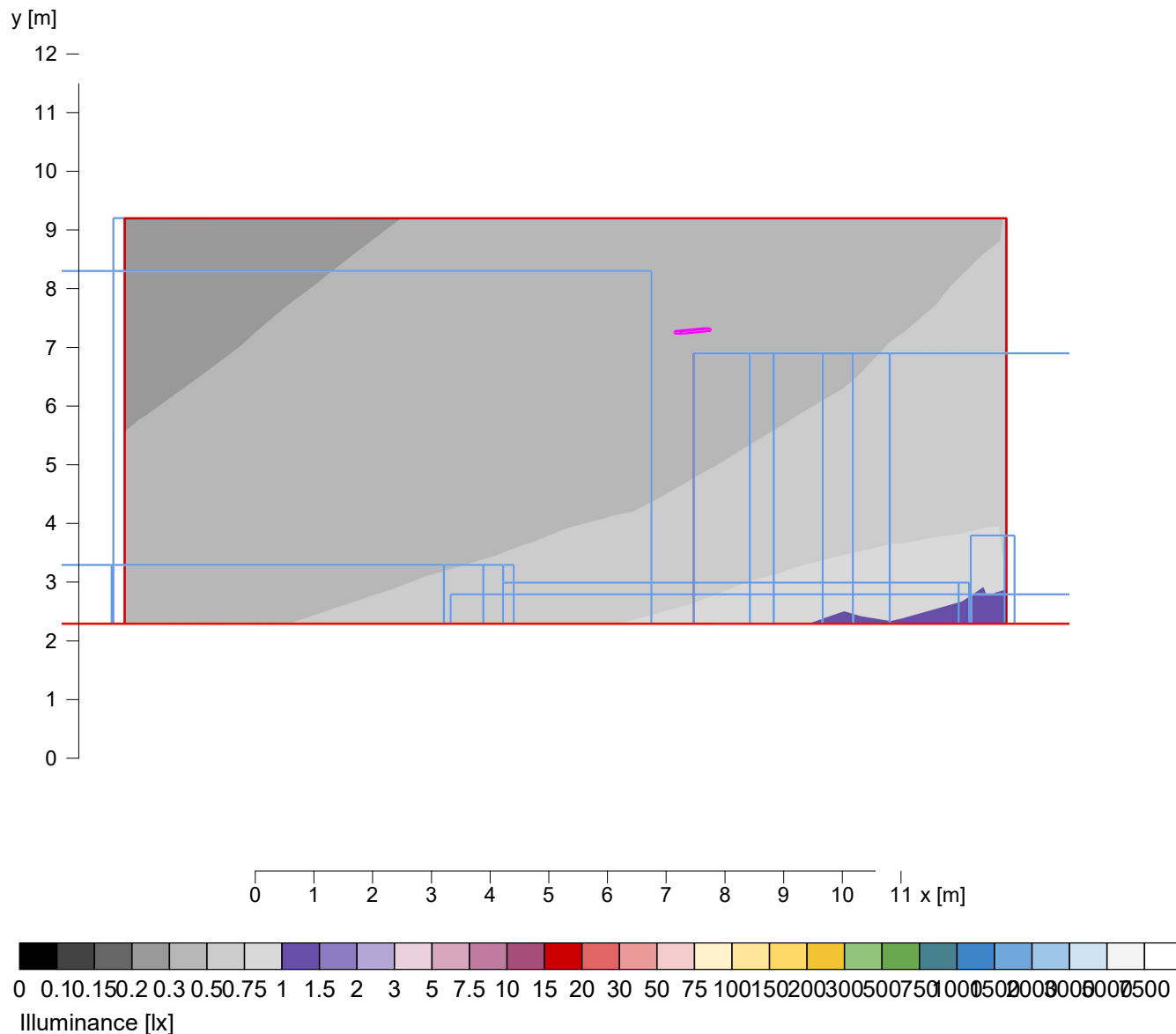
$\bar{E}_m$: 0.13 lx
 E_{min} : 0.01 lx
 E_{max} : 0.27 lx
 $E_{min}/\bar{E}_m$: 1 : 16.58 (0.06)
 E_{min}/E_{max} : 1 : 33.90 (0.03)

2.3.37 Pseudo colours, Bell View Manor (E)



2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.38 Pseudo colours, Jubilee House (E)

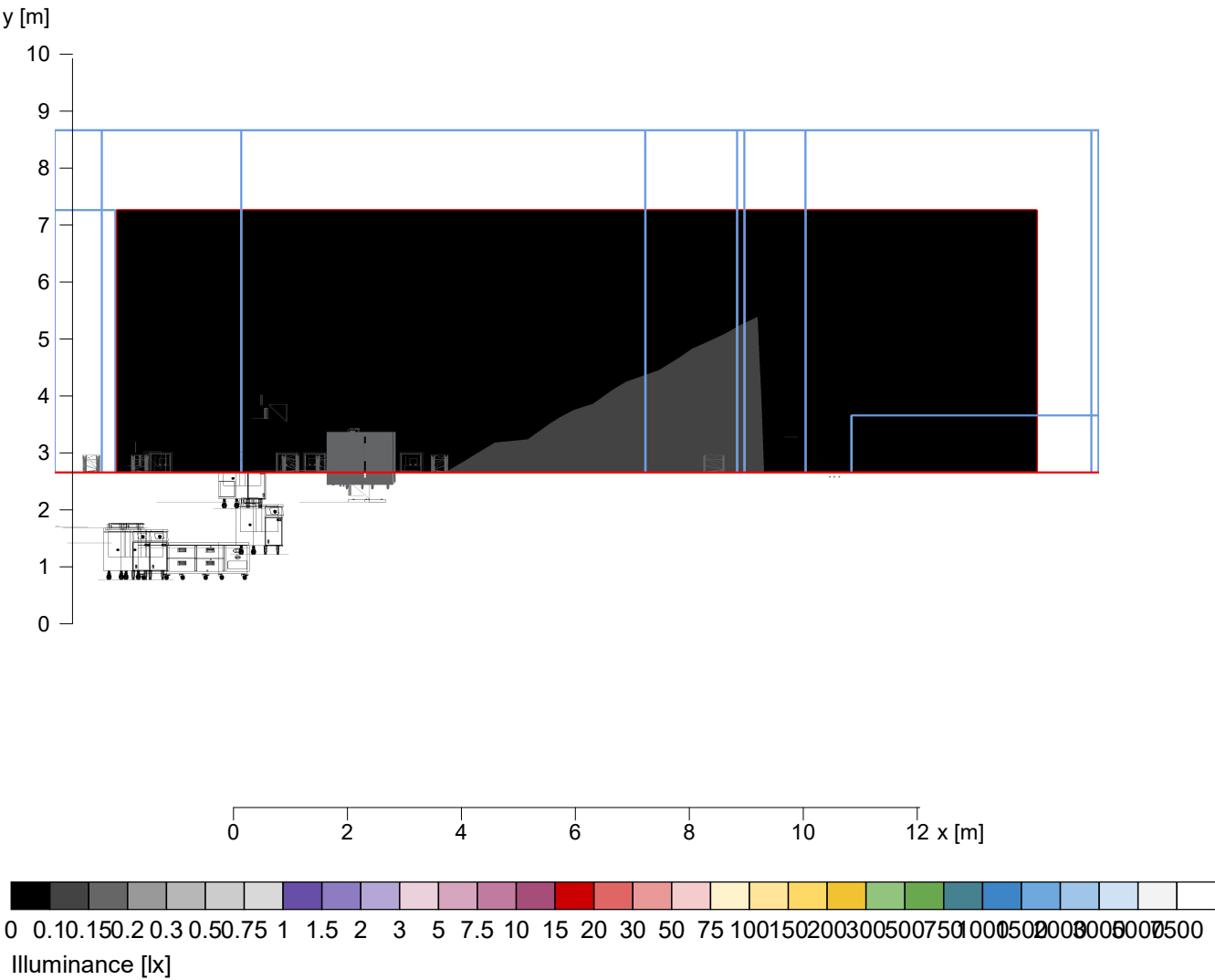


Average illuminance
 Minimum illuminance
 Maximum illuminance
 Uniformity U_0
 Diversity U_d

$\bar{E}_m$: 0.46 lx
 E_{min} : 0.24 lx
 E_{max} : 1.05 lx
 $E_{min}/\bar{E}_m$: 1 : 1.93 (0.52)
 E_{min}/E_{max} : 1 : 4.40 (0.23)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

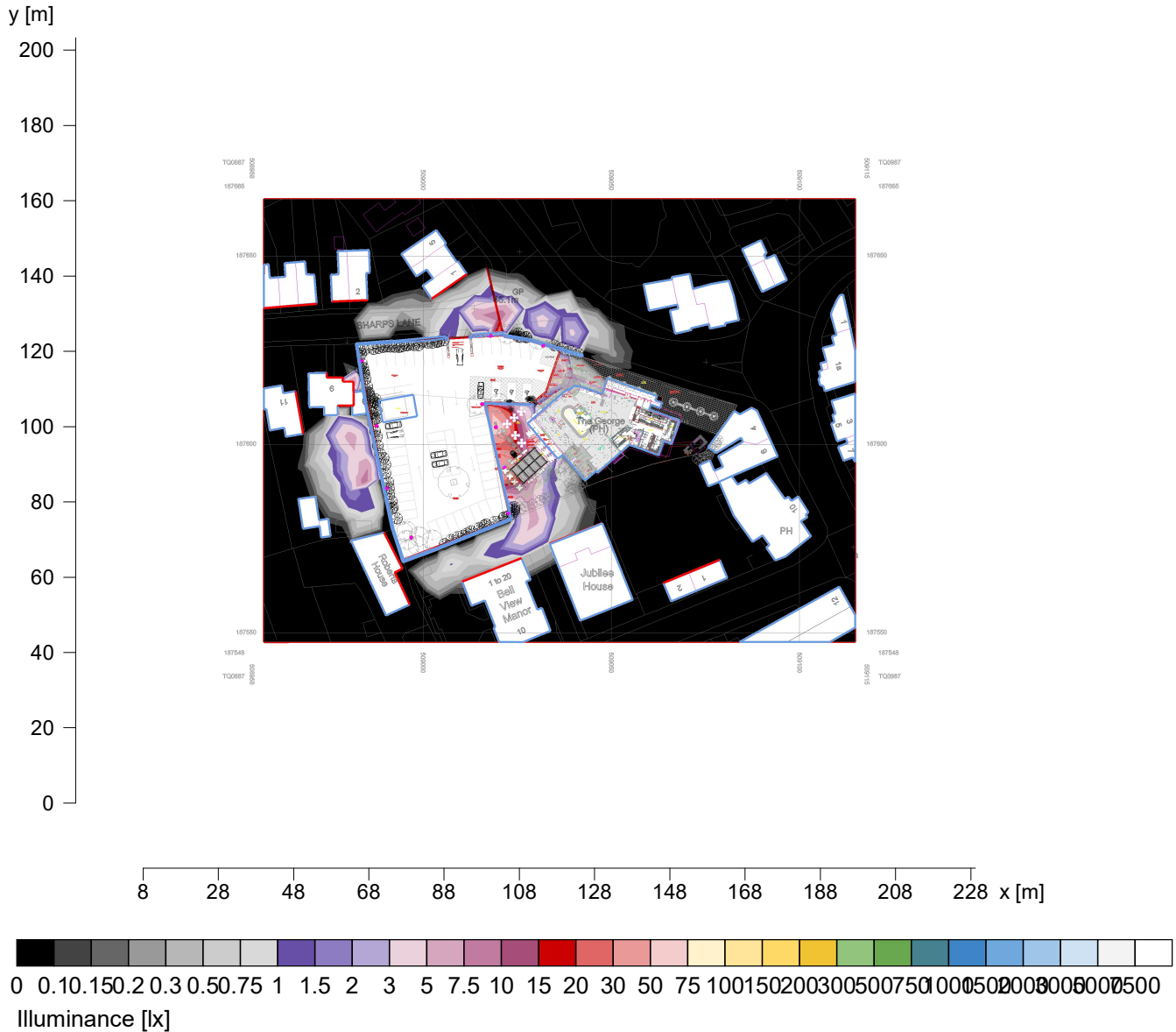
2.3.39 Pseudo colours, 1-2 The Oaks (E)



Average illuminance	$\bar{E}_m$	: 0.07 lx
Minimum illuminance	E_{min}	: 0.03 lx
Maximum illuminance	E_{max}	: 0.11 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: 1 : 2.50 (0.40)
Diversity U_d	E_{min}/E_{max}	: 1 : 3.83 (0.26)

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.40 Pseudo colours, Spill (E)



Height reference plane		: 0.00 m
Average illuminance	$\bar{E}_m$	: 0.4 lx
Minimum illuminance	E_{min}	: 0 lx
Maximum illuminance	E_{max}	: 15.9 lx
Uniformity U_o	$E_{min}/\bar{E}_m$	: ---
Diversity U_d	E_{min}/E_{max}	: ---

2.3 Calculation results, Exterior 1 -Tilt 5 Angle (Robus Cosmic)

2.3.42 3D luminance, View 1

