Statutory Consultation 2022

Preliminary Environmental Information Report

Volume 3: Appendix 5.2

Preliminary Light Obtrusion Assessment

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1 INTRODUCTION

1.1 Project Background

1.1.1 Luton Rising (a trading name of London Luton Airport Limited (the Applicant)) is proposing to expand London Luton Airport (the airport) by submitting an application for development consent for works that will allow the airport to grow to accommodate 32 million passengers per annum (mppa) (the Proposed Development). A current planning permission (LBC ref: 12/01400/FUL), limits passenger throughput to 18 mppa.

1.1.2 As part of the Environmental Impact Assessment, this assessment has been undertaken to assess impacts as a result of external artificial lighting for the Main Application Site, as defined in **Chapter 2** in Volume 2 of the PEIR, and details any necessary light pollution mitigation measures to prevent nuisance to local communities or disruption to local sensitive wildlife.

1.1.3 This report provides a commentary on the effects of light obtrusion associated with the Proposed Development. The design of the Proposed Development will continue to evolve to reflect the outcomes of the consultation, and the process of information gathering as the assessment progresses until submission of the application for development consent. The information within this document is therefore preliminary and may be subject to change as assessment work continues.

1.2 Light Obtrusion

1.2.1 Consequences commonly associated with light obtrusion are the loss of dark night skies and views of the stars, perception of an unsatisfactory nocturnal environment and the harming of wild life habitats. Light obtrusion has also been shown to have detrimental effects on human health and can present serious physiological, and ecological impacts. Furthermore, light obtrusion can be a characteristic of energy waste and a contributor to climate change.

Light obtrusion characteristics

1.2.2 Light obtrusion characteristics are defined as follows and illustrated in **Inset 1.1** and **Inset 1.2**:

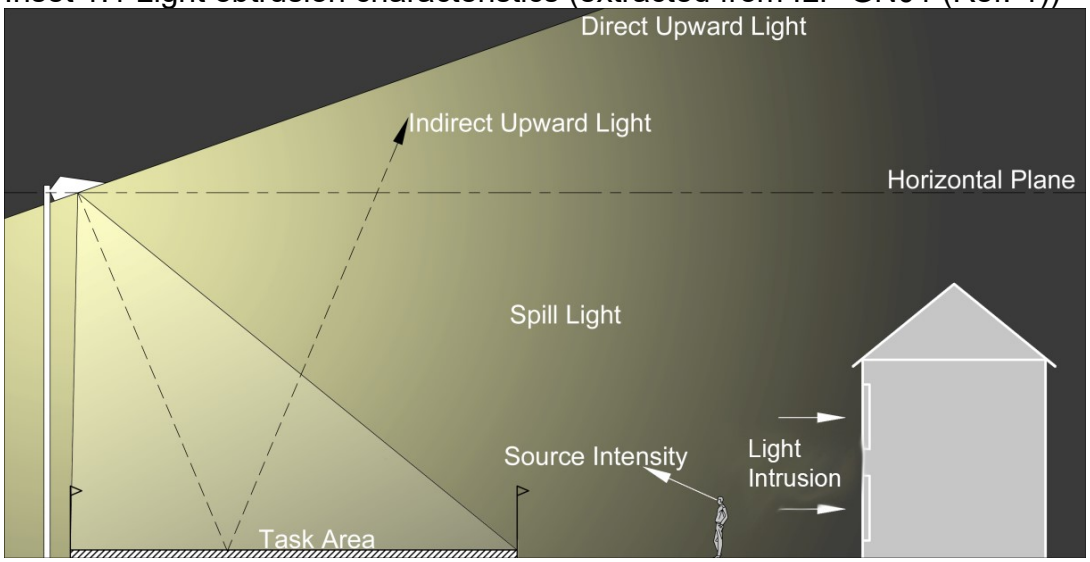
a. Light Intrusion: stray light beyond the task area onto neighbouring dwellings or sensitive receptors. Units: illuminance (E), measured in lux.

b. Source Intensity: how bright the light source appears to an observer. Units, Intensity (I), measured in candelas (cd).

c. Sky Glow: a combination of Direct Upward Light and Indirect Upward Light. This effect is often seen as a glow in the night sky (**Inset 1.2**) above towns and cities.

d. Façade Luminance: how bright an illuminated façade appears to the observer. Units: Luminance (L) measured in cd/m^2.

Inset 1.1 Light obtrusion characteristics (extracted from ILP GN01 (Ref. 1))



Inset 1.2 Sky glow example (Photograph by Todd Carlson (Ref. 2)

1.2.3 Excessive sky glow is the most obvious indication of light obtrusion and obscures a clear view of the night sky. It can also adversely affect the daily patterns of human and animal behaviour.

1.2.4 In many cases, light obtrusion can be reduced without detriment to the lighting task by correctly aiming floodlights, selecting more efficient floodlight optics or simply switching off any unnecessary external lighting.

1.2.5 The existing, or baseline, lighting conditions in the Study Area, as defined in **Section 4.1.2**, have been examined as described in **Sections 5.1** and **5.2** and

are reported in **Section 7**. This data has been used as a comparison with computer simulations on the proposed artificial lighting scheme to ensure that it does not adversely affect the nocturnal environment.

2 LEGISLATION, POLICY AND GUIDANCE

2.1.1 The following section identifies the legislation, planning policy and light obtrusion guidance that was used to frame this light obtrusion assessment.

2.2 Legislation

Environmental Protection Act

2.2.1 The Environmental Protection Act 1990 (Ref. 3) (Part III Statutory Nuisance and Clean Air, section 79 of Statutory nuisance and inspections therefor), gives local authorities the power to consider obtrusive artificial light as a statutory nuisance. The Environmental Protection Act states that:

> *"any artificial light emitted from premises so as to be prejudicial to health or a nuisance, constitutes "statutory nuisance" for the purpose of this Part, and it shall be the duty of every local authority to cause its area to be inspected from time to time to detect any statutory nuisances which ought to be dealt with under section 80 and, where a complaint of a statutory nuisance is made to it by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint."*

Clean Neighbourhood and Environmental Act

2.2.2 The Clean Neighbourhood and Environmental Act 2005 (Ref. 4) (section 102 of the Clean Neighbourhoods and Environmental Act 2005), gives local authorities the power to consider obtrusive artificial light as a statutory nuisance. The Act makes *"exterior light emitted from premises so as to be prejudicial to health or a nuisance"* a criminal offence. The Act does not apply to artificial light emitted from an airport (section 102, subsection 4). According to the Act section 102, subsection 5 *"airport has the meaning given by section 95 of the Transport Act 2000."*

Transport Act

2.2.3 The Transport Act 2000 (Ref. 5) (section 95, sections 93 and 94: interpretations). The Act gives the Secretary of State for Transport the authority to give directions indicating considerations to which the Civil Aviation Authority (CAA) is to have regard in deciding whether and how to exercise its function under sections 93 and 94.

2.3 Planning and Aviation Policy

Airports National Policy Statement – June 2018

2.3.1 The Airports National Policy Statement (ANPS) published in June 2018 provides the primary basis for decision making on development consent

applications for a north west runway at Heathrow Airport. Paragraph 1.41 of the ANPS states that it does not have effect in relation to an application for development consent for an airport other than Heathrow, however it goes on to state that:

> "*Nevertheless, the Secretary of State considers that the contents of the Airports NPS will be both important and relevant considerations in the determination of such an application, particularly where it relates to London or the South East of England.*"

2.3.2 In December 2020, the Supreme Court determined the ANPS should not have been quashed by the Court of Appeal. The ANPS although primarily provided in relation to a new runway at Heathrow Airport, therefore remains a relevant consideration for other applications for airport infrastructure in London and the south east of England, including the Proposed Development. This assessment has followed the scope and methodologies defined through scoping, which considered the ANPS.

2.3.3 The ANPS (paragraph 5.230) states that:

> *"The construction and operation of airports infrastructure has the potential to create a range of emissions such as dust, odour, artificial light, smoke and steam. All have the potential to have a detrimental impact on amenity or cause a common law nuisance or statutory nuisance under Part III, Environmental Protection Act 1990. These may also be covered by pollution control or other environmental consenting regimes."*

2.3.4 The ANPS (paragraph 5.232) states that:

> *"For nationally significant infrastructure projects of the type covered by the Airports NPS, some impact on amenity for local communities is likely to be unavoidable. Impacts should be kept to a minimum and should be at a level that is acceptable."*

National Planning Policy Framework – July 2021

2.3.5 The National Planning Policy Framework will also be an important and relevant consideration in the determination of the Applicant's application for development consent. National Planning Practice Guidance supporting the framework encourages best practice design so as to limit the impact of light obtrusion on local amenity, intrinsically dark landscapes and nature conservation. Paragraph 185 states that:

> "*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the protentional sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: … c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation*".

2.4 Guidance

2.4.1 This light obtrusion assessment has been undertaken in line with the following documents:

a. Institute of Lighting Professionals (ILP) Guidance Note GN01 (2021): Guidance Notes for the Reduction of Obtrusive Light (Ref. 1).

b. ILP Guidance Note GN08 (2018): Bats and artificial lighting in the UK; Bats and the Built Environment series (Ref. 6).

c. ILP Professional Lighting Guide PLG 04 (2013): Guidance on Undertaking Environmental Lighting Impact Assessments (Ref. 7).

d. Commission Internationale de L'Eclairage (CIE) 150: Guide on the limitation of the effects of light obtrusion from Outdoor Lighting Installations (2017) (Ref. 8).

e. CIE 126: Guidelines for Minimising Sky Glow (1997) (Ref. 9).

f. CIE 136: Guide to the Lighting of Urban Areas (2000) (Ref. 10).

g. Chartered Institute of Building Services Engineers (CIBSE) LG6: The Exterior Environment (2016) (Ref. 11).

h. BS EN 12464 Part 2: Outdoor Lighting (2014) (Ref. 12).

i. CIBSE Environmental Considerations for Exterior Lighting (Factfile No.7:2019) (Ref. 13).

2.4.2 These guides provide the latest design advice for the appropriate illumination of external spaces and design limits for light obtrusion effects.

2.4.3 The ILP has published a guidance note GN01 (Ref. 1) that summarises CIE 150 (Ref. 8) and offers guidance for designers to ensure their lighting schemes reduce light obtrusion. Both guides have been referred to throughout this assessment. These two documents are the most authoritative, widely recognised and adopted best practice guides for the minimisation of light obtrusion.

2.4.4 ILP GN01 (Ref. 1) proposes lighting design limits against a set of defined environmental Zones E0 to E4. These are described in **Table 2.1**.

Table 2.1: Environmental designation

Environ. Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark	National Parks, Areas of Outstanding Natural Beauty etc

Environ. Zone	Surrounding	Lighting Environment	Examples
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations
E3	**Suburban**	**Medium district brightness**	**Small town centres or suburban locations**
E4	Urban	High district brightness	Town/city centres with high levels of night- time activity

2.4.5 The Main Application Site is within Zone E3.

2.4.6 The light obtrusion criteria defined in ILP GN01 (Ref. 1) for Zone E3 are described in **Table 2.2**. The limits for intensity of a light source from any given observer are described in terms of the intensity of the source considering visible area of the luminaire and distance to the luminaire.

2.4.7 Building Luminance obtrusive light limitation as referenced in ILP GN01 (Ref. 1), and summarised in **Table 2.2**, is applicable to buildings directly illuminated as a night-time feature as opposed to the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area. The Proposed Development is not proposed to have a night-time feature façade illumination; therefore, the Building Luminance limitation is not applicable for this assessment.

2.4.8 Light intrusion and source intensity have been assessed in this report from the viewpoints in **Table 4.1**.

Table 2.2: Guidance for limiting light obtrusion (ILP GN01 (Ref. 1))

Environmental Zones	Sky Glow ULR[1](Max %)	Sky Glow UFR[2] (ratio)	Light Intrusion Ev[3] (lux) Pre/Post-curfew	Average Building Luminance L[4] (cd/m^2) Pre-curfew
E0	0.0	n/a	0.0	0.0
E1	0.0	2.0	2.0 / 1.0	0.0
E2	2.5	5.0	5.0 / 1.0	5.0
E3	**5.0**	**8.0**	**10.0 / 2.0**	**10.0**
E4	15.0	12.0	25.0 / 5.0	15.0

Notes to table:

1. Max permitted % of luminaire flux emitted directly up into the sky. Requirement for each luminaire.

2. Max permitted % of luminaire flux emitted directly up into the sky. Requirement for scheme as a whole. The more conservative value for roads has been used.

3. Ev = Vertical illuminance (lux): measure of light reaching neighbouring facades. Requirement for each luminaire to each viewpoint.
4. L = Luminance (candelas per sq. metre): measure of how bright a surface appears Requirement for each building.

Table 2.3: Limits for light source intensity (cd) from observer positions

Zone	Curfew ?	$0<A_P \leq 0.002$	$0.002<A_P \leq 0.01$	$0.01<A_P \leq 0.03$	$0.03<A_P \leq 0.13$	$0.13<A_P<0.50$	$A_p > 0.5$
E0	Pre	0	0	0	0	0	0
	Post	0	0	0	0	0	0
E1	Pre	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
	Post	0	0	0	0	0	0
E2	Pre	0.57 d	1.3 d	2.5 d	5.0 d	10 d	7,500
	Post	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	500
E3	**Pre**	**0.86 d**	**1.9 d**	**3.8 d**	**7.5 d**	**15 d**	**10,000**
	Post	**0.29 d**	**0.63 d**	**1.3 d**	**2.5 d**	**5.1 d**	**1,000**
E4	Pre	1.4 d	3.1 d	6.3 d	13 d	26 d	25,000
	Post	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500

Notes to table:
1. 'd' is the distance between the observer and the glare source in metres
2. A_p is the apparent surface of the light source seen from the observer position
3. Upper limits for each Zone shall be taken as those with column Ap>0.5

2.4.9 The curfew is defined as a time after which stricter requirements for the control of light obtrusion will apply. This may be a condition of the use of lighting applied by the local planning authority. Typically, this may be around 23:00. However, the airport operates 24 hours a day and there is no lighting curfew imposed by the local authority at this point in time.

2.4.10 Light intrusion and source intensity have been assessed in this report from the viewpoints in **Table 4.1**.

3 STAKEHOLDER ENGAGEMENT

3.1.1 The Planning Inspectorate has been engaged as part of the assessment process to obtain background data, information and records concerning light obtrusion assets relating to the Main Application Site, and to develop the assessment scope and methodology. **Table 3.1** includes relevant comments received in the Scoping Opinion which is provided as **Appendix 1.3** in Volume 3 to the PEIR.

Table 3.1: Scoping Opinion comments in lighting

Comment from	Date	Summary of discussion	Response
Planning Inspectorate	16 May 2019	The Inspectorate notes the intention to produce a standalone lighting assessment; however, it is not clear from the Scoping Report where the lighting assessment will be located within the Environmental Statement (ES). The lighting assessment should be clearly signposted from the relevant aspect chapters in the ES, including (but not limited to) the Biodiversity, Landscape and Visual, and Cultural Heritage aspect chapters.	The lighting assessment has been produced as a standalone report and is appended to the PEIR where first referenced in **Chapter 5** and cross referenced where appropriate. A similar approach will be followed in the ES.

3.1.2 Stakeholder engagement has not been undertaken specifically regarding this light obtrusion assessment, however potential impacts of light have been discussed during engagement on other relevant environmental aspects including biodiversity, and landscape and visual impacts. Stakeholder engagement will continue prior to submission of the DCO application and will include meetings with the local authorities to discuss assessment findings and proposed mitigation.

4 ASSESSMENT METHODOLOGY

4.1 Main Application Site and Surroundings

4.1.1 The scope of the assessment is to establish the likely effects of the Proposed Development lighting installation on the surrounding area and the environment and verify that the correct illumination standards have been applied to the Main Application Site

4.1.2 The Study Area and surroundings of the Proposed Development for this assessment is defined as the three key aspects and in various locations:

a. the Main Application Site;
b. off-site car parks; and
c. highway interventions.

4.1.3 The objectives of the proposed lighting scheme, when fully designed, shall be:

a. to limit light obtrusion and the effects of sky glow, spill light/trespass light and glare to neighbouring land and properties and strategic road network; and

b. to provide adequate lighting for access and safety requirements.

Viewpoints

4.1.4 Baseline nocturnal lighting conditions were recorded at selected viewpoints around the Main Application Site. The viewpoints selected have been informed by the Landscape and Visual Impact Assessment (LVIA) reported in **Chapter 14** of Volume 2 to this PEIR.

4.1.5 **Figure 14.8** shows all viewpoints of the LVIA and is provided in **Appendix C** for reference. For the purpose of the lighting obtrusion assessment 25 viewpoints have been selected and surveyed. Selection was made based on clear viewing towards the Main Application Site, and proximity of viewpoints to receptors sensitive to light obtrusion.

4.1.6 The viewpoints visited during the survey are described in **Table 4.1**. The reference number used for the light obtrusion viewpoints follows the same reference numbers to the LVIA, for consistency of locations.

Table 4.1: List of lighting survey viewpoints and locations

VP Ref	Grid Ref (Easting, Northing, AOD)	Location Ref	Viewpoint Direction
VP02	515707.8610, 224358.9610, 149.46	Footpath near Ley Green	South west
VP05	510758.649, 218183.799, 153.70	Warren Drive, Luton Hoo Estate	North east
VP06	507450.625, 221332.483, 168.05	Dallow Downs	East
VP08	512077.530, 222678.5499, 159.20	Crawley Green Road	South
VP10a	513182.548, 222457.763, 151.10	Footpath (Offley 01)	South west
VP10b	513278.097, 222380.552, 150.94	Footpath (Offley 02)	South west
VP13	512485.557, 222150.281, 153.30	Wigmore Valley Park	South east
VP13 (continued)	512485.557, 222150.281, 153.30	Wigmore Valley Park	South west
VP14	511775.616, 222198.803, 154.23	Raynham Way	South east

VP Ref	Grid Ref (Easting, Northing, AOD)	Location Ref	Viewpoint Direction
VP15	511203.831, 221850.747, 145.42	Polzeath Close	South east
VP16	510663.847, 221842.382, 158.58	Powdrills Field	East
VP18	510694.662, 219683.579, 109.55	The Luton Drive	North east
VP19	510731.775, 218659.485, 140.52	Luton Hoo Parkland	North east
VP20	512336.142, 220099.179, 157.60	Footpath (Hyde 5A)	North west
VP21	511867.082, 220197.744, 158.88	Footpath (Hyde 4B)	North
VP22	511602.632, 220237.820, 155.87	Footpath (Hyde 4B)	North east
VP27	513197.655, 220494.455, 155.21	Bridleway (Hyde 3A)	North west
VP28	513714.244, 221661.595, 135.84	Footpath (Kings Walden 43)	West
VP31	514578.093, 222346.401, 150.18	Footpath (Kings Walden 09)	South west
VP32	514829.157, 222704.071, 153.71	Darley Road, near Breachwood Green	South west
VP33	514783.536, 222110.122, 150.68	Footpath (Kings Walden 07)	South west
VP34	515042.438, 221838.358, 146.76	Footpath (Kings Walden 06)	West
VP35	514868.018, 221287.885, 111.49	Footpath (Chiltern Way)	West
VP36	511032.734, 221677.115, 123.35	Vauxhall Way	South east
VP37	509672.893, 220184.355, 127.07	Cuttenhoe Road	North east
VP38	511298.335, 221962.522, 157.16	Mistletoe Hill	South east
VP40	511419.165, 222907.336, 158.23	Someries Hill	South east

Ecology and bats

4.1.7 Several vertical calculation planes (grids) have been used around the Main Application Site to measure illuminance levels around the perimeter of the Site resulting from the current proposed lighting design. The vertical planes extend up to 40 meters above ground level to enable a visualisation of the effects of illumination at the various heights at which different bat species fly. **Inset 4.1** shows all 23 of the grids used for this assessment; **Appendix E** to this report provided further details and modelling results.

Inset 4.1 Vertical Calculation Planes.

4.1.8 In addition to the vertical planes described above, a horizontal calculation plane representing ground level has been used to measure illuminance across the Main Application Site.

4.2 Baseline conditions

4.2.1 Luminance measurements were recorded looking towards the Main Application Site and illumination measurements were recorded at each viewpoint in the vertical plane facing the Main Application Site at camera level and at 2 meters above ground.

4.2.2 Digital photographs were taken at each viewpoint to create a calibrated High dynamic range (HDR) image to present the luminance profile of the nocturnal scene.

4.2.3 HDR imaging was used to reproduce a greater dynamic range of luminosity than was possible with standard digital imaging or photographic techniques. HDR images can be digitised, calibrated and interrogated for luminance information. This technique is ideal for nocturnal landscape photography, where

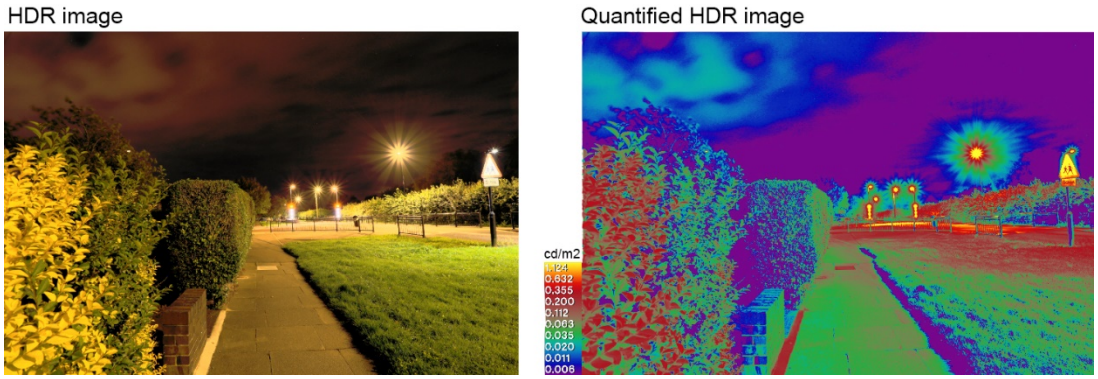
high levels of contrast are often experienced, and for capturing the nocturnal luminance profile of the scene. Further details on this process are provided in **Appendix A**.

4.2.4 The HDR images are created using specialist lighting software (Radiance). The objective of these luminance profile images is therefore to provide a baseline statement that can be compared against 3D simulations of the proposed lighting in the Main Application Site when viewed from those locations.

4.2.5 Examples of these HDR images can be seen in **Inset 4.2.**

4.2.6 HDR images from all viewpoints can be found in **Appendix B**.

Inset 4.2 Example of HDR image (left) and quantified HDR image (right)



4.2.7 Photographs were taken from each viewpoint to record the extent of the existing nocturnal lighting conditions at the Main Application Site. The following methodology was used to create a HDR image, the resultant HDR image was calibrated with luminance measurements recorded at each viewpoint:

a. Camera aperture was fixed at (f-11) ISO set at 400, for low lighting conditions.

b. White balance was set to manual, no contrast adjustment, no saturation adjustment, no sharpness adjustment.

c. Photographs were taken at different exposure times; due to the dark surroundings the exposure times were 1/8s, 1/4s, 0.5s, 1s, 2s, 4s, 8s, 15s and 30s.

d. Images were processed by Radiance software to create a single image where each pixel is exposed for visibility, i.e. an HDR image.

e. Images were calibrated using the on-site luminance measurements to create a falsecolour representation of the scene.

4.3 Assessment

Lighting Design Strategy

4.3.1 The lighting design strategy assessed consists of two parts:

a. Landside lighting strategy, 'Exterior Lighting Strategy Stage 3C Report', **Appendix F**.

b. Apron lighting strategy, 'Proposed Flood Lighting', **Appendix G**.

Methodology

4.3.2 This section sets out the methodology for the assessment of likely significant effects relating to light obtrusion from the Proposed Development. The light obtrusion assessment provides a prediction of the changes in lighting conditions that could arise as a result of the operation of the lighting proposals.

4.3.3 The lighting strategy was simulated and analysed using Radiance simulation software, to examine possible obtrusive light effects. The objective is to illustrate that light obtrusion compliance is possible or to identify where likely significant effects might occur.

4.3.4 The simulation enables the lighting strategy to be examined in terms of the relevant guidance and provides accurate predictions, including:

a. verification of the correct illumination standards have been applied;

b. the effect of the lighting scheme on any sensitive receptors nearby;

c. the potential for light obtrusion effects and mitigation opportunities; and

d. comparison of the Proposed Development with the HDR images from the baseline survey to assess the impact.

4.3.5 Light obtrusion is assessed at each viewpoint described in **Table 4.1** and shown in **Appendix C**.

4.3.6 The simulation comprised the following steps:

a. use of 3D OS MasterMap model of the existing site and surroundings;

b. use of the Proposed Development layout;

c. use of existing viewpoints, including elevation relative to Main Application Site;

d. insert the lighting design strategy for Apron and Landside (floodlight coordinates, orientation data and photometric data) into the lighting simulation model; and

e. apply the virtual viewpoints described in **Table 4.1** to analyse the model for light obtrusion.

4.3.7 The simulation was used to examine the lighting design in terms of the relevant guidance and provide accurate predictions on the following light obtrusion characteristics:

a. source intensity visible from the sensitive receptor's locations; and

b. light intrusion experienced by each sensitive receptor

Significance criteria

4.3.8 The significance of the effects is based on the magnitude of change (or impact) as result of the Proposed Development and the importance of the affected receptor/receiving environment. Magnitude/scale of change is assessed on a scale of High, Medium, Low or Very Low. Further details regarding the evaluation criteria are provided below. The importance of the affected receptor/receiving environment is assessed, in line with the PLG04 Guide to Lighting Impact Assessments (Ref. 7), on a scale of Very High, High, Medium, or Low.

Sensitivity of Receptors

4.3.9 The criteria for receptor sensitivity are described in **Table 4.2.**

Table 4.2: Sensitivity of receptor to light obtrusion

Receptor Sensitivity	Typical Example	Commentary
Very High	Protected habitats e.g. bat roosts	Receptor has negligible ability to absorb change without fundamentally altering its present character and is of very high environmental value/importance.
High	Unprotected nocturnal wildlife habitat. Heritage and listed buildings.	Receptor has low ability to absorb change without fundamentally altering its present character and is of high environmental value/importance.
Medium	Dwelling	Receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value/importance.
Low	Commercial and Industrial Premises	The receptor is tolerant/resistant to change without detriment to its character, is low environmental value/importance.

Magnitude of Effect

4.3.10 To determine the magnitude/scale of the change in lighting levels at the sensitive receptors, the following criteria have been evaluated using professional judgement:

a. type of lighting installation during construction and operation;

b. the distance between the proposed lighting installations and the sensitive receptors;
c. type of view (e.g. direct, intermittent or restricted);
d. any existing and proposed screening;
e. satisfaction of ILP GN01 (Ref. 1) guidance; and
f. likelihood of statutory nuisance.

4.3.11 The magnitude of the environmental effect is expressed in terms of deviation from the ILP GN01 (Ref. 1) recommendations (**Table 4.3**). The Main Application Site is considered to be in Zone E3 light obtrusion limits (**Table 2.1**).

Table 4.3: Determining the magnitude of an environmental impact

Impact Magnitude	Definition	Magnitude Quantified
High	Total loss or major alteration to key features of the baseline conditions which will be fundamentally changed.	All light obtrusion characteristics above Zone E4 recommended limits.
Medium	Loss or alteration to one or more key features of the baseline conditions which will be fundamentally changed.	One or more light obtrusion characteristics exceed the Zone E3 limits by more than 20%
Low	Minor shift away from baseline conditions. Changes arising from the alteration will be detectable; the underlying character of the baseline condition will be similar.	No light obtrusion characteristics exceed the Zone E3 limits by more than 20%.
Very low	Very little change from baseline conditions. Change is barely distinguishable, approximating to a “no change” situation.	Light obtrusion characteristics unchanged or below Zone E3 limits.

4.3.12 The interaction of sensitivity and magnitude are considered to determine the significance of an environmental effect on the scale described in **Table 4.4.**

Table 4.4: Determining the significance of an environmental effect

Receptor Sensitivity Table 4.2)	Impact Magnitude (Table 4.3)			
	High	Medium	Low	Very low
Very High	Major	Moderate	Moderate	Minor
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible

4.3.13 As a general rule, major and moderate effects are considered to be significant, whilst minor and negligible effects are considered to be not significant; however, professional judgment may be applied.

5 ASSUMPTIONS AND LIMITATIONS

5.1 Site Survey

5.1.1 The atmospheric conditions may marginally affect the recorded luminance measurements made. Based on the conditions recorded on during the site surveys these effects are considered immaterial.

5.2 Computation and Modelling

5.2.1 The ray-tracing software is considered to be highly accurate, however, assumptions/simplification must be incorporated into the model in terms of existing surface reflectivity factors.

5.2.2 Trees and other organic planting are excluded from this analysis (and are not required as a part of the ILP GN01 (Ref. 1) based analysis), meaning that the assessment presents the worst-case scenario. It is anticipated that obtrusive light in some situations may be mitigated by existing trees, foliage or other vegetation.

5.2.3 The lumen maintenance factor applied to the calculation is MF=1 and represents the installation performing at maximum (100%) output on day one of the installation.

5.3 Construction

5.3.1 Construction lighting will follow the requirements stated in the Draft Code of Construction Practice (Draft CoCP) provided as **Appendix 4.2** in Volume 3 of the PEIR.

5.4 Operation

5.4.1 During the operational phase of the Proposed Development, it has been assumed that the lighting specification in terms of column heights, light fittings and luminaire design will be selected to provide minimal light spill and glare.

5.4.2 The assessment presented in this report is based on the lighting strategy produced for the purpose of this assessment. The lighting performance assumptions (car parks, road class, usage, illuminance levels, etc.) can be found in **Appendix F** and **Appendix G**.

6 BASELINE CONDITIONS

6.1 Data Gathering/Survey

6.1.1 Measurements were recorded in accordance with the guidelines of ILP GN01 (Ref. 1).

6.1.2 Light measurements were taken using the following calibrated test equipment:

a. Minolta T10 illuminance meter;

b. Minolta LS110 luminance meter; and

c. Canon EOS 6D SLR digital camera.

6.2 Existing Conditions

6.2.1 A quantitative and visual survey of the existing lighting around the Main Application Site and its surroundings was undertaken on 25 and 26 February 2019 from 19:30 to 01:00. The winter was chosen to provide more hours of darkness to complete the survey within. The recorded ambient conditions were:

a. temperature from 5 to 16°C;

b. clear sky for the first night, cloud cover for the second night; and

c. slight mist, good visibility.

6.3 Survey Measurements

6.3.1 The measured values of vertical and horizontal plane illuminance and peak luminance at the selected viewpoints are provided in **Table 6.1** below.

Table 6.1: Survey measurements

VP Ref	Location	Visual Receptor	Luminance (cd/m^2)	Maximum Illuminance (lux)		
				Vertical at camera level	Vertical at 2m above ground	Horizontal at 2m above ground
VP02	Footpath near Ley Green	Residential	0.1 (skyglow)	0.0	0.0	0.0
VP05	Warren Drive, Luton Hoo Estate	Heritage	0.1 (skyglow)	0.0	0.0	0.0
VP06	Dallow Downs	Residential	0.1 (skyglow)	0.1	0.2	0.0

VP Ref	Location	Visual Receptor	Luminance (cd/m^2)	Maximum Illuminance (lux)		
				Vertical at camera level	Vertical at 2m above ground	Horizontal at 2m above ground
VP08	Crawley Green Road	Residential	0.2 (skyglow) 0.6 (road)	4.3	3.5	1.8
VP10a	Footpath (Offley 01)	Residential	0.2 (skyglow)	0.0	0.0	0.0
VP10b	Footpath (Offley 02)	Commercial	0.2 (skyglow)	0.0	0.0	0.0
VP13	Wigmore Valley Park	Commercial	0.2 (skyglow)	0.7	1.0	0.5
VP14	Raynham Way	Residential	0.3 (skyglow)	0.6	0.5	6.9
VP15	Polzeath Close	Residential	0.2 (skyglow) 0.3 (road)	1.6	1.4	1.1
VP16	Powdrills Field	Residential	0.2 (skyglow)	0.1	0.1	0.0
VP18	The Luton Drive	Heritage	0.1 (skyglow)	0.0	0.0	0.0
VP19	Luton Hoo Parkland	Heritage	0.1 (skyglow)	0.0	0.0	0.0
VP20	Footpath (Hyde 5A) Someries Castle	Residential	0.1 (skyglow)	0.1	0.2	0.0
VP21	Footpath (Hyde 4B) Someries Castle	Heritage	0.1 (skyglow)	0.1	0.1	0.0
VP22	Footpath (Hyde 4B)	Heritage	0.1 (skyglow)	0.1	0.2	0.0
VP27	Bridleway (Hyde 3A)	Residential	0.1 (skyglow)	0.0	0.0	0.0
VP28	Footpath (Kings Walden 43)	Residential	0.1 (skyglow)	0.0	0.0	0.0
VP31	Footpath (Kings Walden 09)	Residential	0.1 (skyglow)	0.0	0.0	0.0

VP Ref	Location	Visual Receptor	Luminance (cd/m^2)	Maximum Illuminance (lux)		
				Vertical at camera level	Vertical at 2m above ground	Horizontal at 2m above ground
VP32	Darley Road, near Breachwood Green	Residential	0.07 (skyglow)	0.0	0.0	0.0
VP33	Footpath (Kings Walden 07)	Residential	0.1 (skyglow)	0.1	0.1	0.1
VP34	Footpath (Kings Walden 06)	Residential	0.1 (skyglow)	0.0	0.0	0.0
VP35	Footpath (Chiltern Way)	Residential	0.1 (skyglow)	0.0	0.0	0.0
VP36	Vauxhall Way	Residential	0.3 (skyglow)	16.4	20.6	62.6
VP37	Cuttenhoe Road	Residential	0.2 (skyglow) 0.9	14.7	15.1	18.2
VP38	Mistletoe Hill	Residential	0.2 (facade)	3.1	3.1	1.3
VP40	Someries Hill	Residential	0.2 (skyglow)	0.1	0.1	0.0

6.4 General Observations

6.4.1 The nocturnal artificial lighting around and in close proximity to the Main Application Site comprises road and street lighting in context with urban and sub-urban environment, and vehicle lights along the local roads.

6.4.2 On the second night of the survey, it was also observed that there was little or no noticeable moonlight throughout the survey due to cloud cover.

6.4.3 Sky glow was observed above the local area from all viewpoints as can be seen in the viewpoint photographs. It was considered that the magnitude of sky glow observed is typical of any urban and sub-urban location in the region.

6.4.4 Observations from various viewpoints and commentary to these locations can be found in **Table 6.2**.

6.5 Viewpoint Observations

6.5.1 With reference to **Appendix B**, **Table 6.2** below describes the observations that were made from each survey viewpoint.

Table 6.2: Survey viewpoint observations

VP Ref	Location	Observations
VP02	Footpath near Ley Green	Sky glow to the north east of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion.
VP05	Warren Drive, Luton Hoo Estate	Sky glow to the south west of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP06	Dallow Downs	Sky glow to the west of the Main Application Site (from Luton town and the Main Application Site) was observed and was the main source of light obtrusion. Street-lighting from Luton town was visible in the nocturnal environment.
VP08	Crawley Green Road	Street lighting on Crawley Green Road was the main source of light obtrusion. Sky glow was observed to the north of the Main Application Site (from the Main Application Site and Luton town). Light sources from apron stands lighting and street-lighting were visible in the nocturnal environment.
VP10a	Footpath (Offley 01)	Sky glow to the north east of the Main Application Site (from the Main Application Site and Luton town) was observed. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP10b	Footpath (Offley 02)	As per description for VP 10a above.
VP13	Wigmore Valley Park	Sky glow to the north east of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of

VP Ref	Location	Observations
		light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were highly visible in the nocturnal environment.
VP14	Raynham Way	Sky glow to the north of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting car parks and apron stands lighting were visible in the nocturnal environment.
VP15	Polzeath Close	Street lighting on Polzeath Close was the main source of light obtrusion. Sky glow was observed to the north west of the Main Application Site (from the Main Application Site and Luton town). Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP16	Powdrills Field	Sky glow to the north west of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP18	The Luton Drive	Sky glow to the south west of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from aviation light signals were visible in the nocturnal environment.
VP19	Luton Hoo Parkland	Sky glow to the south west of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP20	Footpath (Hyde 5A)	Sky glow to the south/south west of the Main Application Site (from the Main Application Site and Luton town) was

VP Ref	Location	Observations
		observed and was the main source of light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP21	Footpath (Hyde 4B) Someries Castle	As per description above.
VP22	Footpath (Hyde 4B) Someries Castle	
VP27	Bridleway (Hyde 3A)	
VP28	Footpath (Kings Walden 43)	Sky glow to the east of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting, car parks and apron stands lighting were visible in the nocturnal environment.
VP31	Footpath (Kings Walden 09)	As per description above.
VP32	Darley Road, near Breachwood Green	
VP33	Footpath (Kings Walden 07)	
VP34	Footpath (Kings Walden 06)	
VP35	Footpath (Chiltern Way)	Sky glow to the east of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting were visible in the nocturnal environment.
VP36	Vauxhall Way	Street lighting on Vauxhall Way was the main source of light obtrusion. Sky glow was observed to the west of the Main Application Site (from the Main Application Site and Luton town). Light sources from street-lighting and car parks were visible in the nocturnal environment.
VP37	Cutenhoe Road	Street lighting on Cutenhoe Road was the main source of light obtrusion. Sky glow was observed to the west of the

VP Ref	Location	Observations
		Main Application Site (from the Main Application Site and Luton town). Light sources from street-lighting were visible in the nocturnal environment.
VP38	Mistletoe Hill	Street lighting on Mistletoe Hill was the main source of light obtrusion. Sky glow was observed to the west of the Main Application Site (from the Main Application Site and Luton town). Light sources from street-lighting were visible in the nocturnal environment.
VP40	Someries Hill	Sky glow to the north of the Main Application Site (from the Main Application Site and Luton town) was observed and was the main source of light obtrusion. Light sources from street-lighting were visible in the nocturnal environment.

6.6 Key Findings

6.6.1 The baseline survey showed that:

a. there is a significant source of light obtrusion emanating from the Main Application Site when viewed from all directions;

b. some of the roads are not illuminated;

c. very low illuminance levels (<1lux) were recorded at viewpoints located approximately 200m from the Main Application Site;

d. higher illuminance levels (>1lux) were recorded around viewpoints where street lighting was present;

e. in some instances the local topography and woodlands screens the residential receptors from Luton town and the Main Application Site;

f. the Main Application Site is relatively bright and is considered to be within Zone 3 (medium district brightness areas, small town centre or urban location); and

g. skyglow from Luton town was clearly visible from some viewpoints and is a great contributor to the surrounding environment.

Sensitive Receptors

6.6.2 The receptors surrounding the Main Application Site are identified below and include:

a. towns and districts;

b. local farms;

c. parks/woodland;
d. heritage assets;
e. commercial properties; and
f. residential properties.

7 EMBEDDED AND GOOD PRACTICE MITIGATION

7.1 Embedded Mitigation

7.1.1 The lighting scheme includes the embedded mitigation described below:

a. apron stands masts height limited to 25 meters;
b. apron stands floodlighting upward tilt no more than 0° from horizontal;
c. a horizontal cut off and no tilt on other luminaires; and
d. shielding by structure on car parks.

7.2 Good Practice Mitigation

Construction

7.2.2 The Draft CoCP describes measures to minimise and manage light obtrusion during the construction phases. This will be updated and implemented by the appointed contractor during the construction works to manage and mitigate adverse risks to sensitive receptors from light obtrusion risks.

7.2.3 The use of temporary works lighting shall be minimised in terms of frequency and duration wherever possible. Security and task lighting shall be limited and of short duration. The following measures shall be implemented to minimise risk of adverse effects on residents and wild life:

a. Confine lighting to the task area (using horizontal cut-off optics and zero floodlight tilt angles).
b. Orientate floodlights away from any dwellings.
c. Use lower power security lighting where possible (and ensure minimal horizontal/vertical light spill).
d. Observe a curfew when practicable (although this is not possible during 24/7 working patterns).
e. Plant lighting needs to be shielded from view by the neighbouring dwellings and sensitive habitats.
f. Use the site cabins etc, to provide shielding of the lighting from beyond construction sites.

7.2.4 Particular attention shall be paid to the likelihood of sky glow and light intrusion beyond each construction site. When the lighting is used it shall be visually checked from likely sensitive receptors (e.g. nearby residential properties) and

any necessary adjustments made to ensure its visibility and intensity is reduced to a minimum.

7.2.5 The contractor shall keep a record of all lighting installed on the construction sites, which shall be available on request to show that all fixtures comply with the above conditions. Where this is not possible it shall be recorded why and what actions have been implemented to minimise effects.

8 PRELIMINARY ASSESSMENT

8.1 Construction

8.1.1 The requirements set out in the **Draft CoCP** will be implemented during construction, as such the lighting assessment for construction concludes that for all the viewpoints considered in this assessment, the significance of the effects is **negligible**.

8.2 Operation

8.2.1 Using the methodology provided in **Section 4**, a simulation was used to predict the performance of the lighting scheme described in **Appendix G** and **Appendix H.**

8.2.2 This provides accurate predictions on the following light obtrusion characteristics:

a. For each viewpoint:
   i. Source intensity visible from each viewpoint (candelas, cd); and
   ii. Light spill onto each viewpoint (lumens/m2, lux).
b. For each luminaire:
   i. Upward Light Ratio (ULR, %).
c. For the overall scheme:
   i. Upward Flux Ratio (UFR, ratio).
d. Ecology and bats:
   i. Illuminance onto boundaries (lux)

8.2.3 The data presented in this section considers all the lighting operating at 100% output and is a worst-case scenario.

Results - Viewpoints

8.2.4 The calculation results of light obtrusion on viewpoints are provided in **Table 8.1** below. Key points shown by the results include:

a. The brightness (source intensity) perceived by the observers from each viewpoint location is less than the respective thresholds for each luminaire for all but four viewpoints. For these four viewpoints limits are exceeded only in the post-curfew condition:

i. All four viewpoints experience limits exceeded by one luminaire within the Fire Training facility, and so is unlikely to be in operation post-curfew or for long periods of time.
ii. One viewpoint also experiences limits exceeded by two road luminaires. The luminaires are of standard road lighting design. Furthermore, the sensitivity of the receptor is low (non-residential).

b. The light intrusion onto all sensitive receptors (viewpoints) is less than 10.0 lux, the maximum recommendation value for Environmental Zone E3 pre-curfew, and less than 2.0 lux, the maximum recommendation value for Environmental Zone E3 post-curfew according to ILP GN01 (Ref. 1), for all viewpoints.

Table 8.1: Obtrusive light recommendations and results output

VP Ref	Calculation Results				
	Light Intrusion Ev (lux)		Number of Luminaires Exceeding Source Intensity (cd), out of 4186 luminaires		
	Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Notes
VP02	<1.0	<1.0	0	0	-
VP05	<1.0	<1.0	0	0	-
VP06	<1.0	<1.0	0	0	-
VP08	<1.0	<1.0	0	0	-
VP10a	<1.0	<1.0	0	0	-
VP10b	<1.0	<1.0	0	0	-
VP13	1.2	1.2	0	3	One luminaire in fire training facility Two on adjacent road
VP14	<1.0	<1.0	0	0	-
VP15	<1.0	<1.0	0	1	Luminaire in fire training facility
VP16	<1.0	<1.0	0	1	Luminaire in fire training facility
VP18	<1.0	<1.0	0	0	-
VP19	<1.0	<1.0	0	0	-
VP20	<1.0	<1.0	0	0	-
VP21	<1.0	<1.0	0	0	-
VP22	<1.0	<1.0	0	0	-
VP27	<1.0	<1.0	0	0	-
VP28	<1.0	<1.0	0	0	-

VP Ref	Calculation Results				
	Light Intrusion Ev (lux)		Number of Luminaires Exceeding Source Intensity (cd), out of 4186 luminaires		
	Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Notes
VP31	<1.0	<1.0	0	0	-
VP32	<1.0	<1.0	0	0	-
VP33	<1.0	<1.0	0	0	-
VP34	<1.0	<1.0	0	0	-
VP35	<1.0	<1.0	0	0	-
VP36	<1.0	<1.0	0	1	Luminaire in fire training facility
VP37	<1.0	<1.0	0	0	-
VP38	<1.0	<1.0	0	0	-
VP40	<1.0	<1.0	0	0	-

Results – Each Luminaire

8.2.5 All luminaires have an ULR below the recommended target of 5% and therefore comply with guidance limits.

Results – Overall Scheme

8.2.6 The overall scheme has a UFR of 3.4 which is below the recommended target of 8 and therefore complies with guidance.

Results – Ecology and bats

8.2.7 The calculation results of light obtrusion on bats, as summarised in **Table 8.2** and presented on the drawings in **Appendix D** and **Appendix E**, indicate that:

a. The maximum illuminance levels on the vertical planes around apron stand, roads and surface car park locations area exceeds 10 lux on one grid (Grid No. 40) however this is where the site boundary crosses an illuminated road, hence this scenario is unavoidable. Otherwise, all values are below 4 lux.

b. The maximum illuminance levels on the vertical planes around decked car park locations (Grid Nos. 1-3) exceed the 10 lux threshold and the area of occurrence is from ground level up to 36 meters above ground level.

Table 8.2: Vertical Illuminance on planes

Grid No.	Maximum Illuminance on the grid (lux)	Area of occurrence on the grid (From ground level up to 40m above ground level)	Main source of lighting (in close proximity to the grid)
1	14.8	From ground level up to 16m above ground	Roads, surface and decked car parks
2	13.5	From ground level up to 36m above ground	Roads, surface and decked car parks
3	14.4	From ground level up to 36m above ground	Roads, surface and decked car parks
4	0.4	From ground level up to 36m above ground	Roads and surface car parks
5	0.6	From ground level up to 16m above ground	Training Area
6	0.4	From ground level up to 16m above ground	Training Area
7	0.6	From ground level up to 32m above ground	Training Area
8	3.3	From ground level up to 24m above ground	Training Area
9	0.4	From ground level up to 28m above ground	Roads and surface car parks
10	0.3	From ground level up to 28m above ground	Roads and surface car parks
11	0.2	From ground level up to 8m above ground	Roads and surface car parks
12	0.3	From ground level up to 8m above ground	Roads and surface car parks
13	0.5	From ground level up to 4m above ground	Roads and surface car parks
14	0.5	From ground level up to 4m above ground	Roads
15	0.4	From ground level up to 4m above ground	Roads

Grid No.	Maximum Illuminance on the grid (lux)	Area of occurrence on the grid (From ground level up to 40m above ground level)	Main source of lighting (in close proximity to the grid)
16	0.6	From ground level up to 4m above ground	Roads
17	0.6	From ground level up to 4m above ground	Roads
18	0.5	From ground level up to 24m above ground	Roads and surface car parks
19	0.9	From ground level up to 8m above ground	Roads and surface car parks
20	1.9	From ground level up to 12m above ground	Roads
21	1.6	From ground level up to 12m above ground	Roads and surface car parks
22	1.6	From ground level up to 8m above ground	Roads and surface car parks
23	4.6	From ground level up to 16m above ground	Roads and surface car parks
24	3.2	From ground level up to 12m above ground	Apron stands
25	0.6	From ground level up to 12m above ground	Roads and surface car parks
26	1.3	From ground level up to 12m above ground	Road and fuel farm
27	2.1	From ground level up to 12m above ground	Road and fuel farm
28	0.9	From ground level up to 12m above ground	Road and fuel farm
29	0.6	From ground level up to 12m above ground	Roads and surface car parks
30	1.8	From ground level up to 4m above ground	Roads and surface car parks
31	3.8	From ground level up to 16m above ground	Roads

Grid No.	Maximum Illuminance on the grid (lux)	Area of occurrence on the grid (From ground level up to 40m above ground level)	Main source of lighting (in close proximity to the grid)
32	1.2	From ground level up to 12m above ground	Roads
33	1.5	From ground level up to 8m above ground	Roads
34	1.5	From ground level up to 40m above ground	Roads
35	1.4	From ground level up to 24m above ground	Roads
36	1.8	From ground level up to 12m above ground	Roads and surface car parks
37	2.7	From ground level up to 12m above ground	Roads and surface car parks
38	5.0	From ground level up to 20m above ground	Roads, decked and surface car parks
39	8.9	From ground level up to 24m above ground	Roads, decked and surface car parks
40	62.0	From ground level up to 12m above ground	Roads
41	0.6	From ground level up to 12m above ground	Roads
42	0.7	0m at ground level	Roads and surface car parks
43	0.6	From ground level up to 16m above ground	Roads and surface car parks
44	0.6	From ground level up to 12m above ground	Roads
45	0.6	From ground level up to 12m above ground	Roads
46	0.5	From ground level up to 12m above ground	Roads
47	0.5	From ground level up to 4m above ground	Roads

Results and Environmental Impact

Viewpoints

8.2.8 **Table 8.3** below presents the results of the assessment for each sensitive receptor in relation to ILP GN01 (Ref. 1) (source intensity, sky glow and light intrusion), and applies the methodology described in **Section 4** to each sensitive receptor to determine the significance of the environmental effect.

Table 8.3: Assessment results and environmental impact

VP Ref	Receptor	ILP Guidance met (Yes/No)	Magnitude	Receptor Sensitivity	Description of effect and significance
VP02	Residential	Yes	Very low	Medium	Negligible
VP05	Heritage	Yes	Very low	High	Negligible
VP06	Residential	Yes	Very low	Medium	Negligible
VP08	Residential	Yes	Very low	Medium	Negligible
VP10a	Residential	Yes	Very low	Medium	Negligible
VP10b	Commercial	Yes	Very low	Low	Negligible
VP13	Commercial	No	Very low	Low	Negligible
VP14	Residential	Yes	Very low	Medium	Negligible
VP15	Residential	No	Very low	Medium	Negligible
VP16	Residential	No	Very low	Medium	Negligible
VP18	Heritage	Yes	Very low	High	Negligible
VP19	Heritage	Yes	Very low	High	Negligible
VP20	Residential	Yes	Very low	Medium	Negligible
VP21	Heritage	Yes	Very low	High	Negligible
VP22	Heritage	Yes	Very low	High	Negligible
VP27	Residential	Yes	Very low	Medium	Negligible
VP28	Residential	Yes	Very low	Medium	Negligible
VP31	Residential	Yes	Very low	Medium	Negligible
VP32	Residential	Yes	Very low	Medium	Negligible
VP33	Residential	Yes	Very low	Medium	Negligible
VP34	Residential	Yes	Very low	Medium	Negligible
VP35	Residential	Yes	Very low	Medium	Negligible
VP36	Residential	No	Very low	Medium	Negligible
VP37	Residential	Yes	Very low	Medium	Negligible
VP38	Residential	Yes	Very low	Medium	Negligible
VP40	Residential	Yes	Very low	Medium	Negligible

8.2.9 As described in **Table 8.3** above, all of the high sensitivity receptors assessed meet ILP GN01 (Ref. 1) guidance on source intensity, sky glow and light intrusion. Four viewpoints (VP13, VP15, VP16 and VP36) do not meet ILP Guidance as described in **paragraph 8.2.4a**, but due to the very low magnitude of effect, and the medium sensitivity the predicted effects are considered negligible. Therefore, for all the viewpoints considered, the predicted effects are **negligible**, which are **not significant**.

Ecology and bats

8.2.10 The results on horizontal and vertical illuminance reported in this assessment are available to the ecologist undertaking the ecology impact assessment.

8.2.11 Any impacts in relation to bats is assessed and reported in **Chapter 8** Biodiversity in Volume 2 of the PEIR.

9 CUMULATIVE EFFECTS

9.1.1 A search was undertaken to identify other developments applications and allocations. Local authorities planning portals (Luton Borough Council, North Hertfordshire District Council and Central Bedfordshire) were used to search for current planning applications. Local development plans, policies and programmes were reviewed to determine present and future potential interactions with the Proposed Development. This information was limited, however identified to emerging developments that may impact the EIA.

9.1.2 **Appendix 20.1** and **20.2** in Volume 3 to the PEIR provide long and short lists of other developments considered in the cumulative assessment of the PEIR. With the following three exceptions, the other development proposals provide no lighting information and therefore without further information and lighting studies the assessment of potential cumulative effects is not possible.

9.1.3 The exceptions include:

a. Millbrook Power and 17/00283/FUL– for each, the recommendations provided on the lighting is very high-level, and no lighting assessment has been identified for these developments.

b. 16/01401/OUTEIA - A lighting assessment has been prepared for this development which concludes that the effect of the development is not considered to be significant. Therefore, it is unlikely that this development will have a significant cumulative effect.

Construction and Operation

9.1.4 As detailed above, there is a lack of detailed information provided for construction and operational lighting of other developments. Therefore, an assessment of cumulative effects is not possible.

9.1.5 As reported in this document, the Proposed Development is not expected to result in a significant impact on its surroundings. Given the scale and distance of other developments, and assuming they are designed and constructed to

similar lighting standards as the Proposed Development, it is unlikely to result in significant cumulative effects.

GLOSSARY AND ABBREVIATIONS

Term	Definition
ANPS	Airports National Policy Statement: new runway capacity and infrastructure at airports in the south-east of England
CAA	Civil Aviation Authority - An independent specialist aviation regulator.
HDR	High dynamic range image - An image with a greater range of luminosity than that which is possible with standard photographic techniques.
ULR	Upward Light Ratio - The proportion of luminaire luminous flux that is emitted above the horizontal plane, expressed as a percentage of total luminaire luminous flux.
UFR	Upward Flux Ratio - The proportion of luminaire luminous flux of the whole lighting scheme that is emitted above the horizontal plane due to direct and reflected light compared to an idealised scenario, expressed as a ratio.

Appendix A

A1 High Dynamic Range Imaging

High dynamic range (HDR) imaging is a technique used to reproduce a greater dynamic range of luminosity that is possible with standard digital imaging or photograph techniques. In simple terms, the technique produces an image where each pixel is correctly exposed and therefore it can be digitised, calibrated and interrogated for luminance information.

Inset A1.1 Photo exposure issues

A single exposure photograph cannot always correctly capture a scene. For example, in **Inset A1.1** above, parts of the first image are overexposed, while the same parts are correctly exposed in the second image.

The **Inset A1.2** below shows the equivalent HDR image, which uses multiple different exposures of the scene. It can be seen that the HDR image has the correct exposure throughout, and below is the digitised version with luminance information.

Inset A1.2 HDR example

This technique is ideal for nocturnal landscape photography, where high levels of contrast are often experienced, and for capturing the nocturnal luminance profile of the scene.

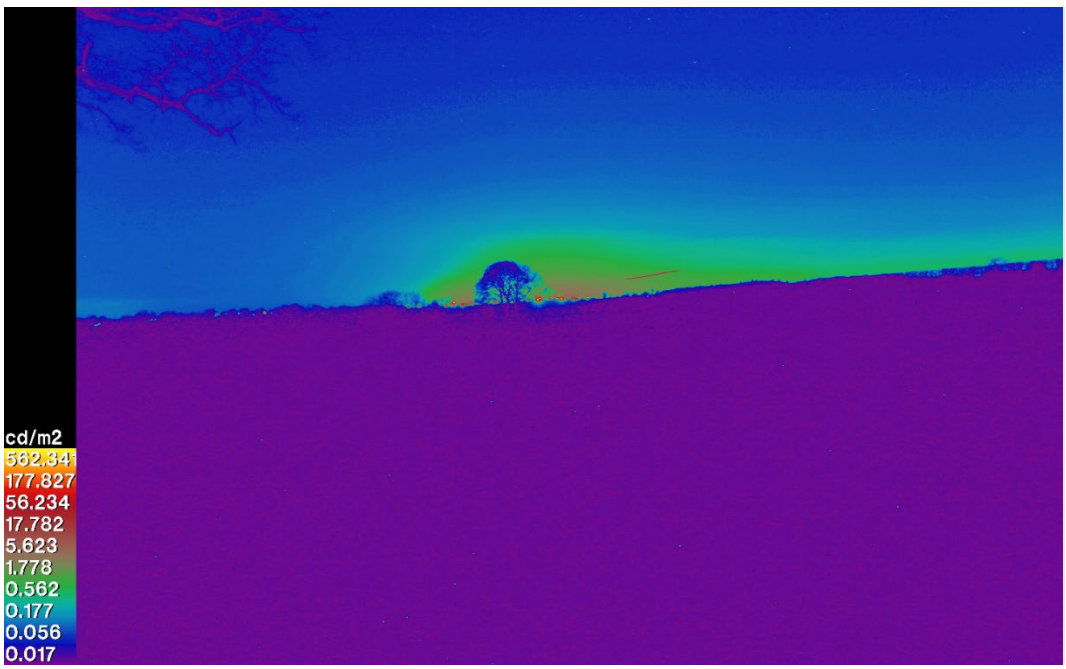
Appendix B

B1 Viewpoint HDR Images

Viewpoint 02

Inset B1.1 HDR image Viewpoint 02

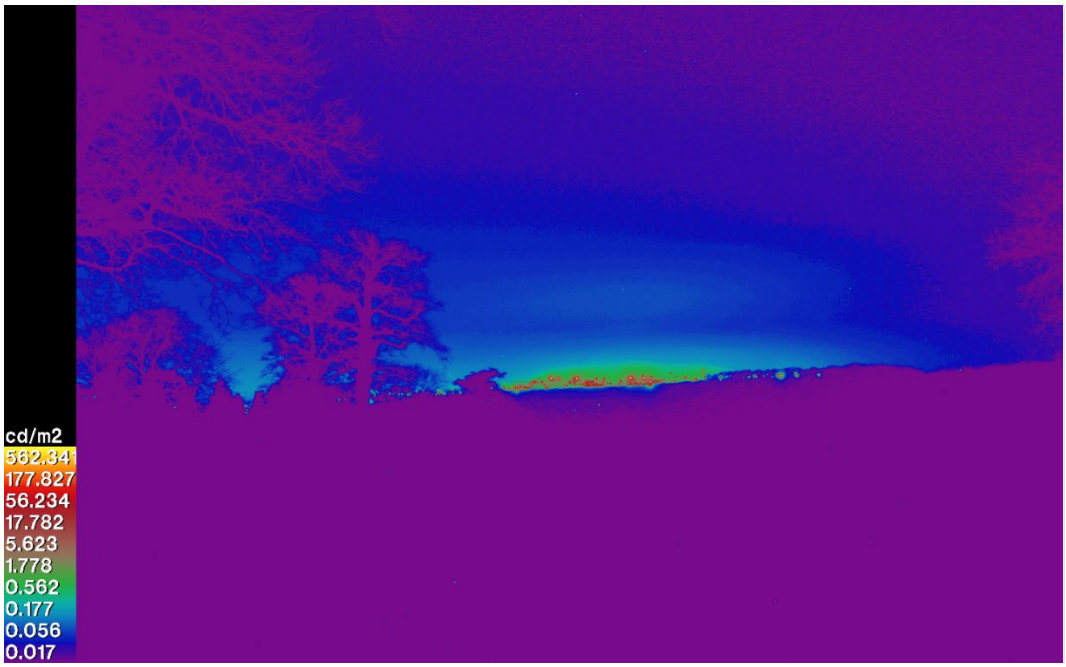
Inset B1.2 Quantitative Luminance Image Viewpoint 02



Viewpoint 05

Inset B2.3 HDR image Viewpoint 05

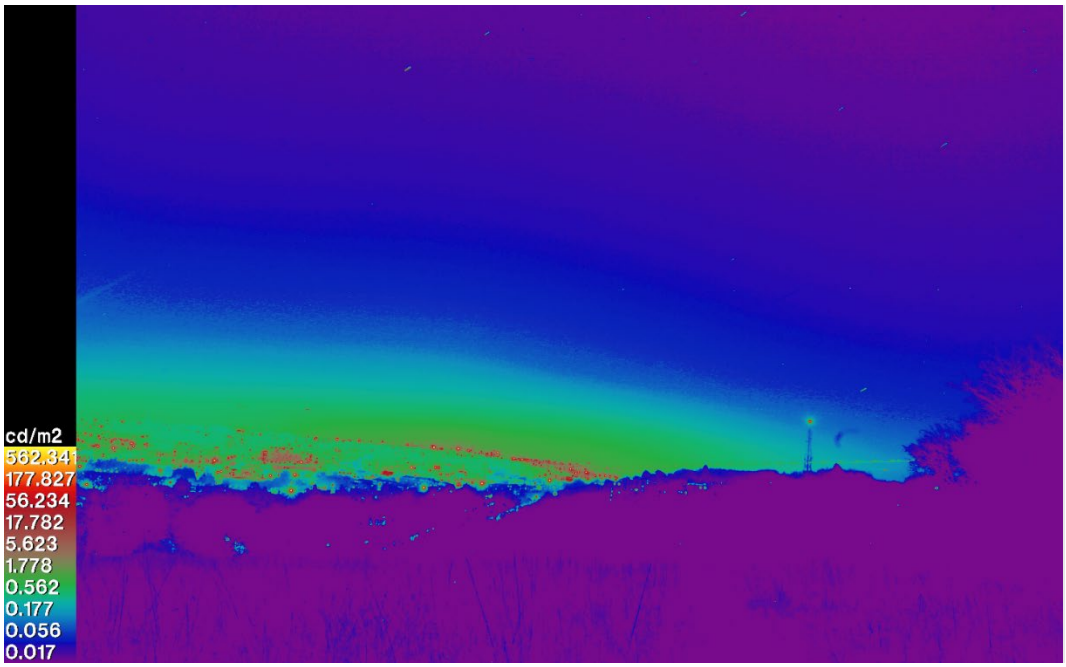
Inset B2.4 Quantitative Luminance Image Viewpoint 05



Viewpoint 06

Inset B3.5 HDR image Viewpoint 06

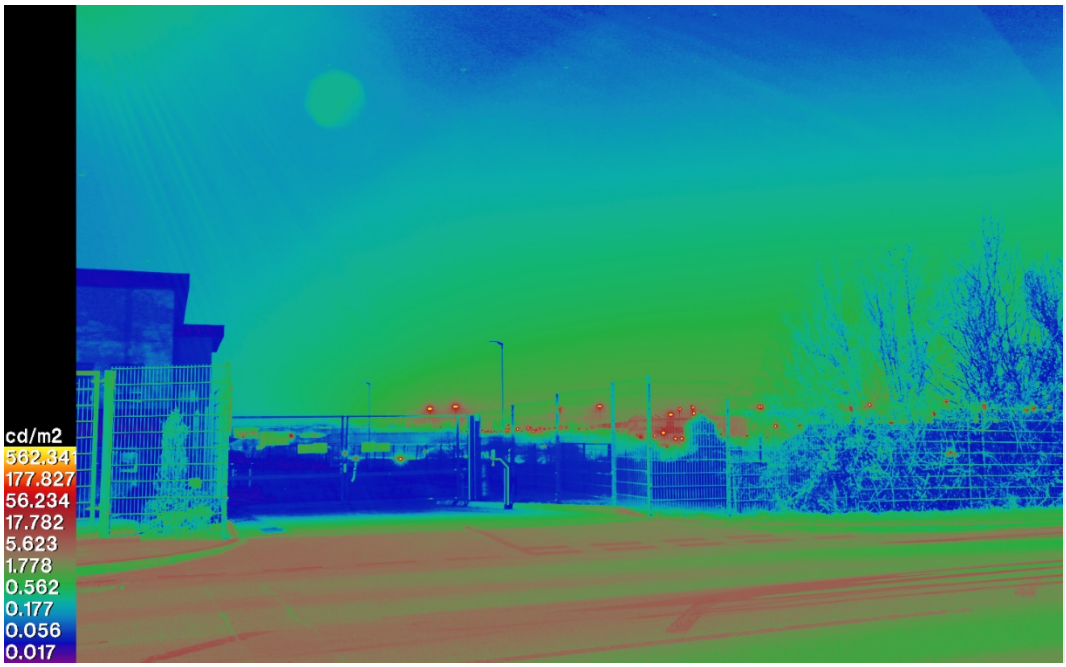
Inset B3.6 Quantitative Luminance Image Viewpoint 06



Viewpoint 08

Inset B4.7 HDR image Viewpoint 08

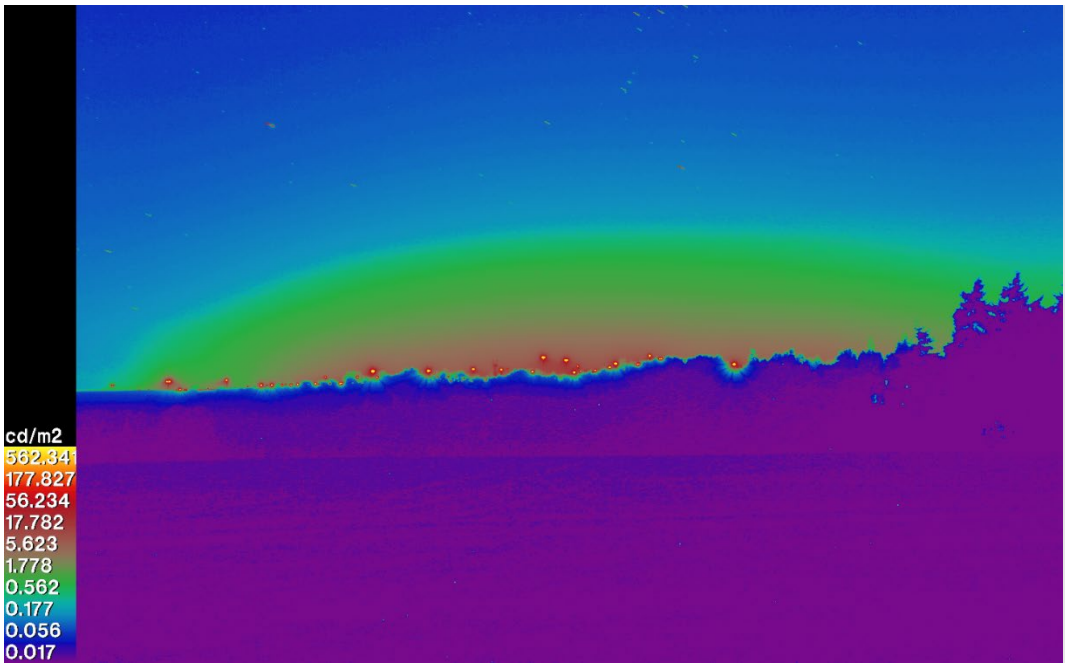
Inset B4.8 Quantitative Luminance Image Viewpoint 08



Viewpoint 10a

Inset B5.9 HDR image Viewpoint 10a

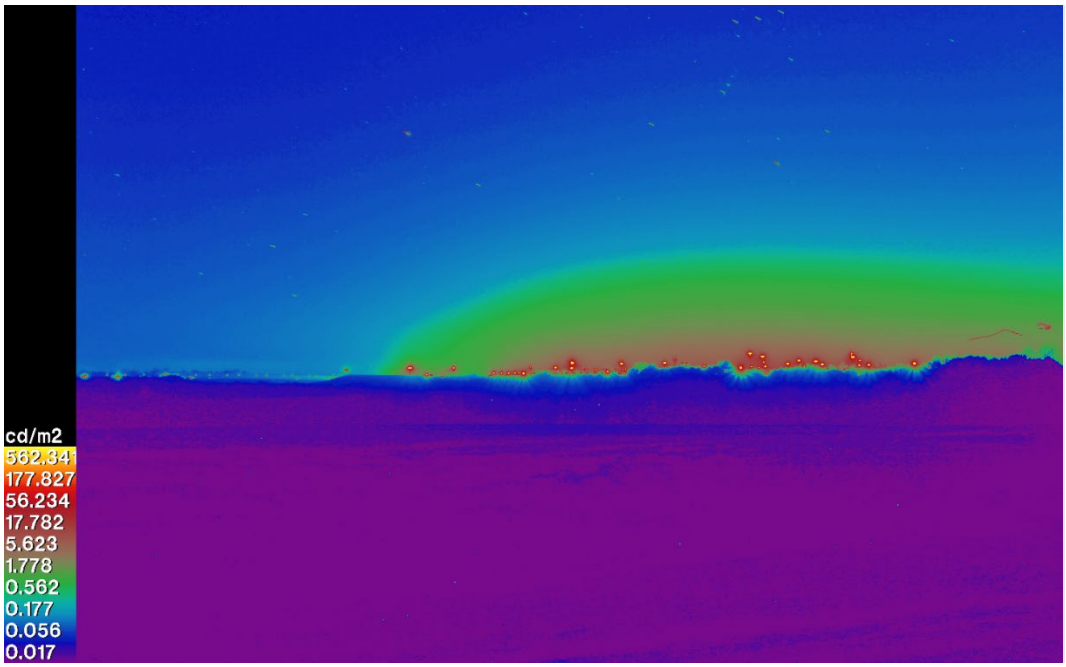
Inset B5.10 Quantitative Luminance Image Viewpoint 10a



Viewpoint 10b

Inset B6.11 HDR image Viewpoint 10b

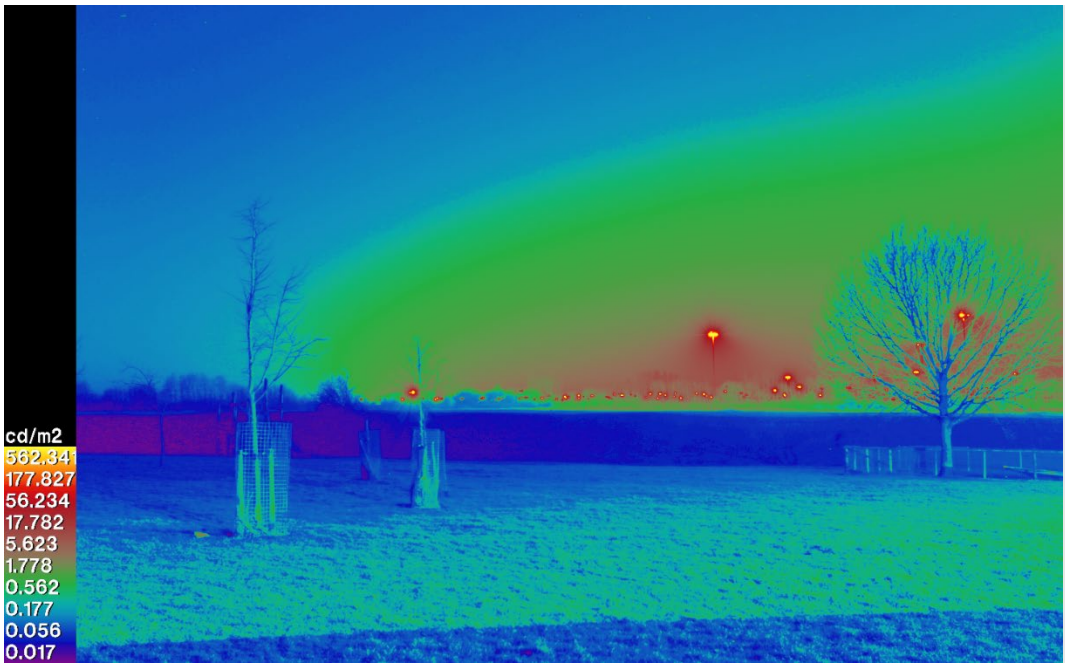
Inset B6.12 Quantitative Luminance Image Viewpoint 10b



Viewpoint 13

Inset B7.13 HDR image Viewpoint 13

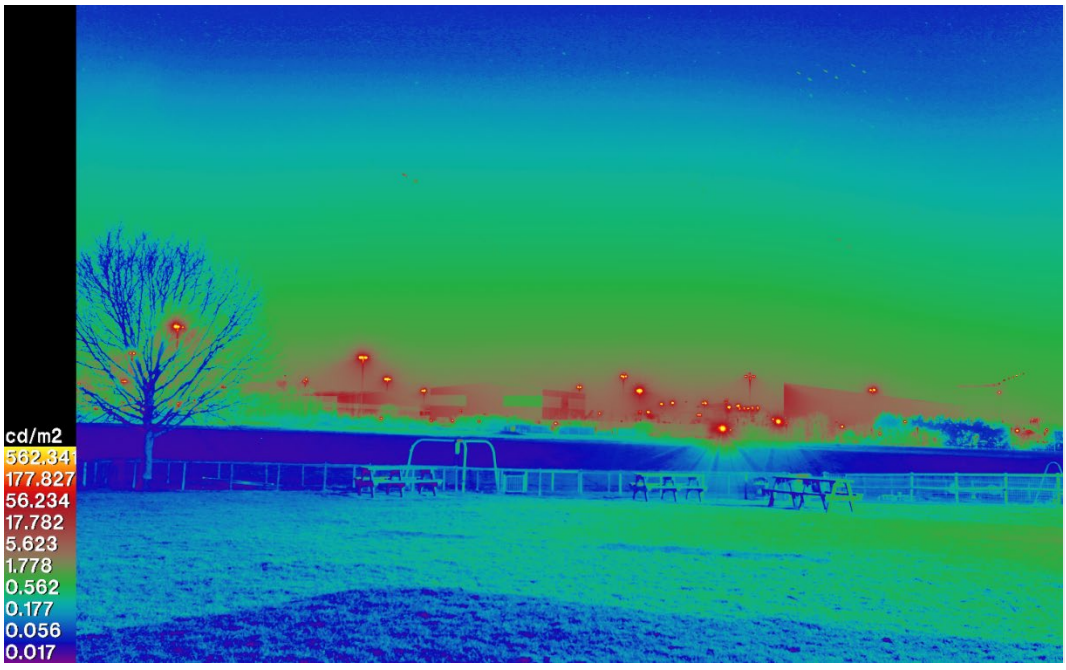
Inset B7.14 Quantitative Luminance Image Viewpoint 13



Viewpoint 13 (continued)

Inset B8.15 HDR image Viewpoint 13 (continued)

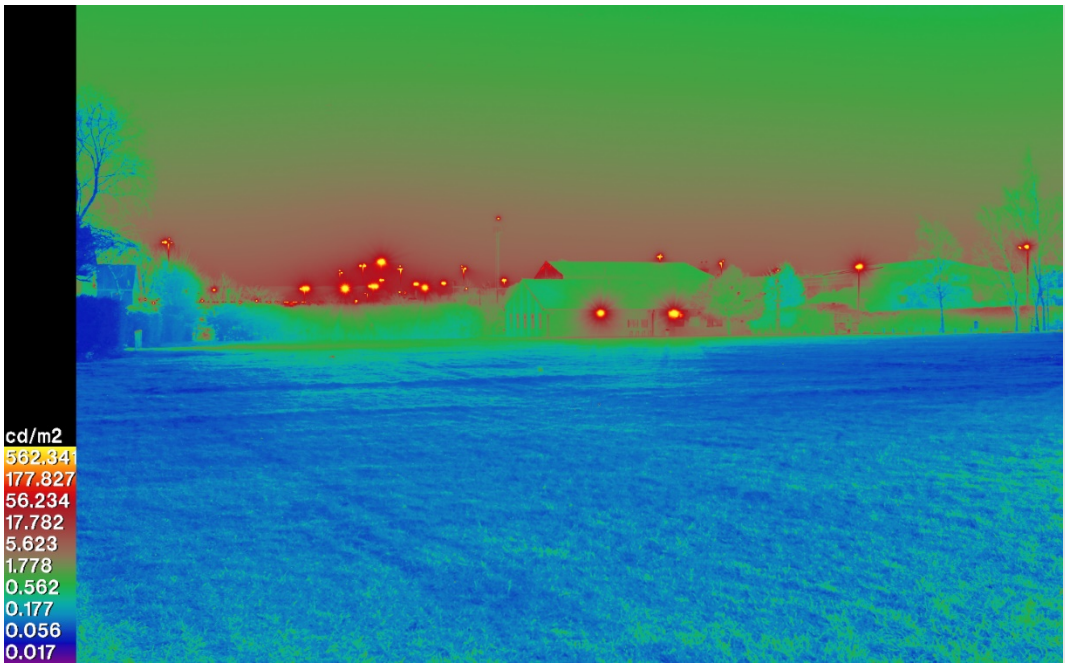
Inset B8.16 Quantitative Luminance Image Viewpoint 13 (continued)



Viewpoint 14

Inset B9.17 HDR image Viewpoint 14

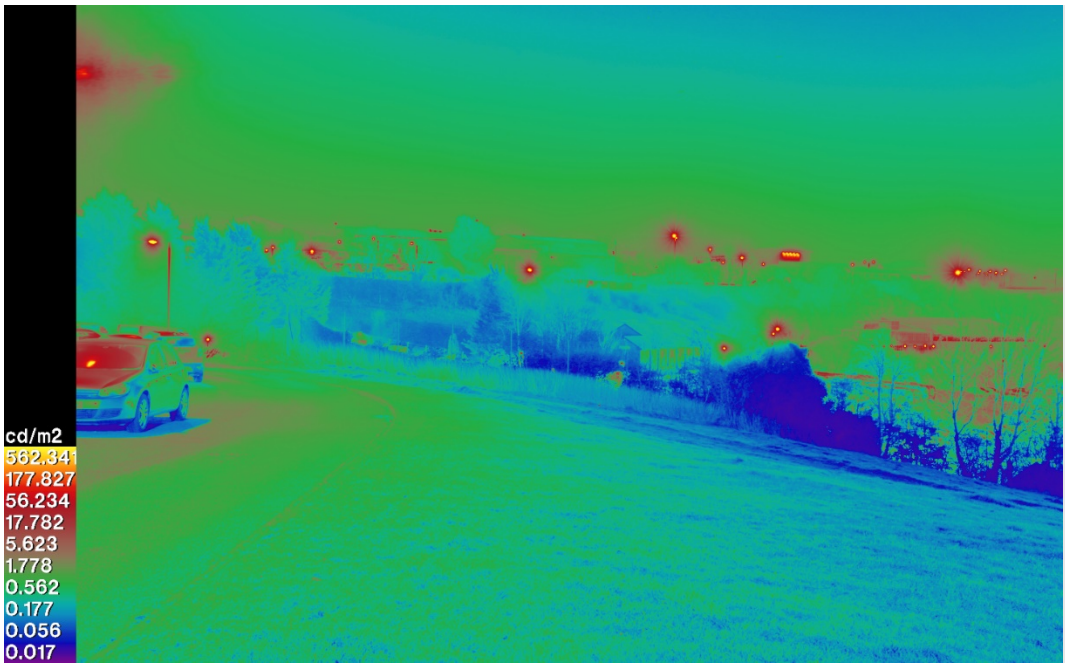
Inset B9.18 Quantitative Luminance Image Viewpoint 14



Viewpoint 15

Inset B10.19 HDR image Viewpoint 15

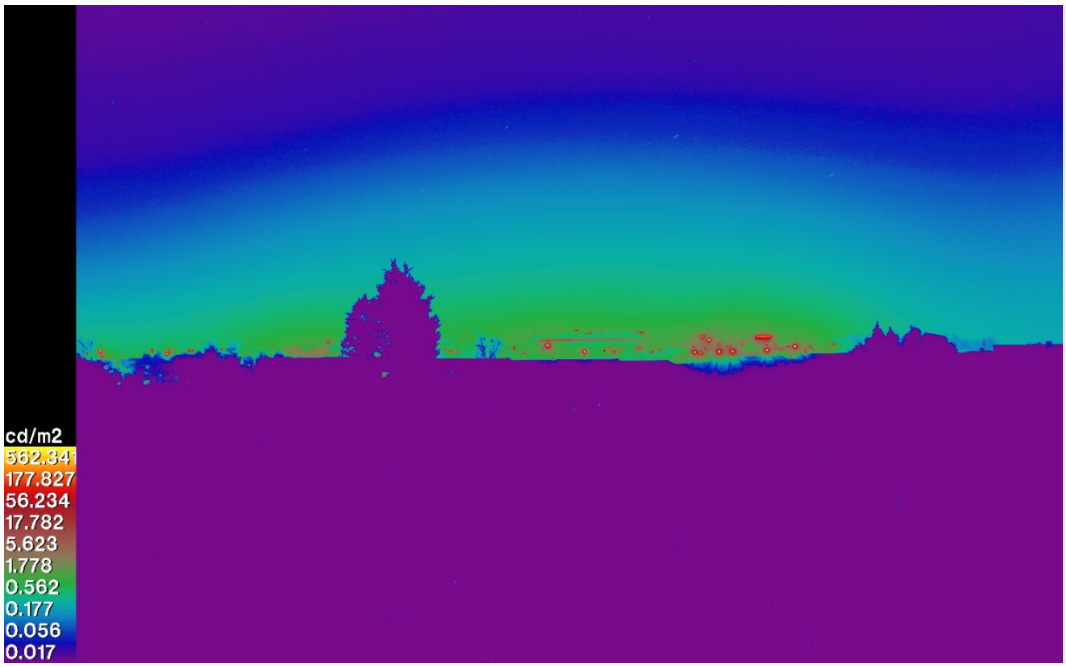
Inset B10.20 Quantitative Luminance Image Viewpoint 15



Viewpoint 16

Inset B11.21 HDR image Viewpoint 16

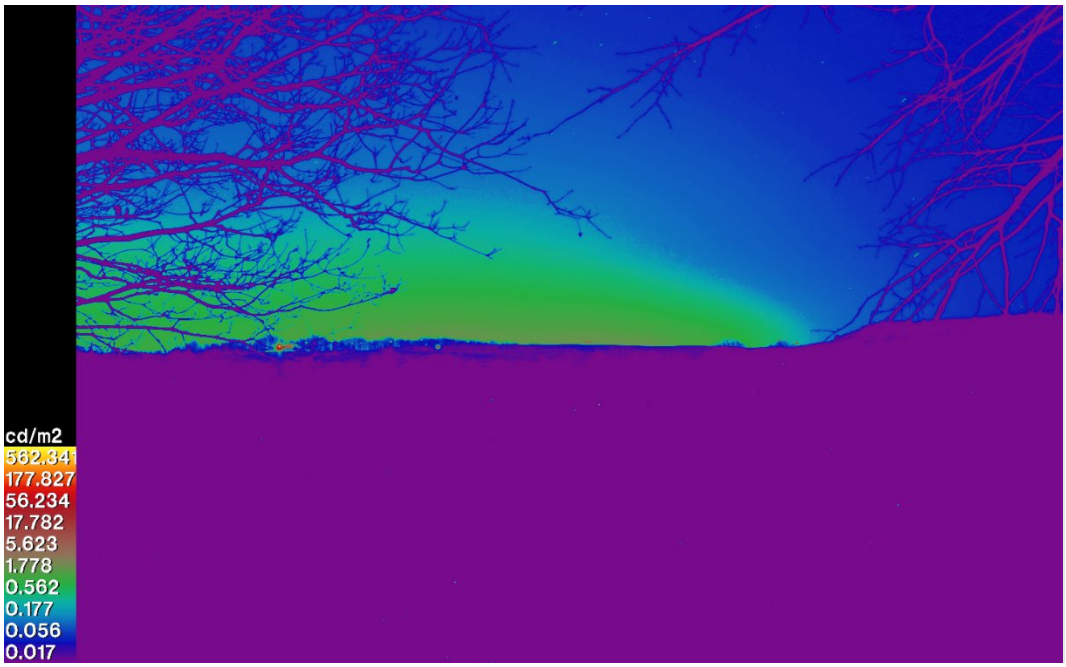
Inset B11.22 Quantitative Luminance Image Viewpoint 16



Viewpoint 18

Inset B12.23 HDR image Viewpoint 18

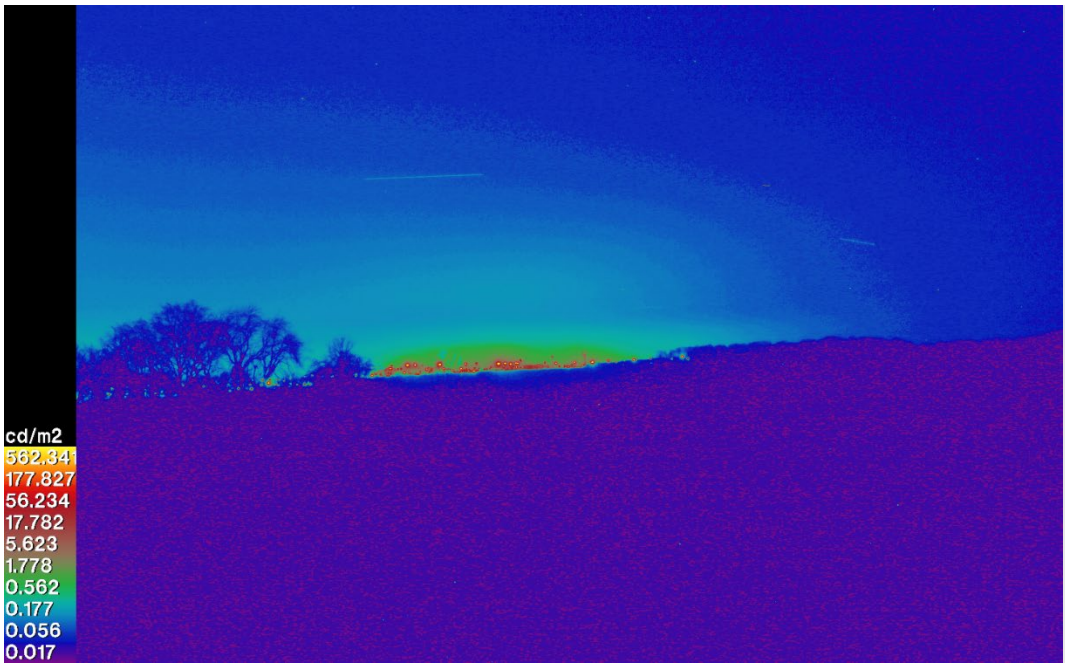
Inset B12.24 Quantitative Luminance Image Viewpoint 18



Viewpoint 19

Inset B13.25 HDR image Viewpoint 19

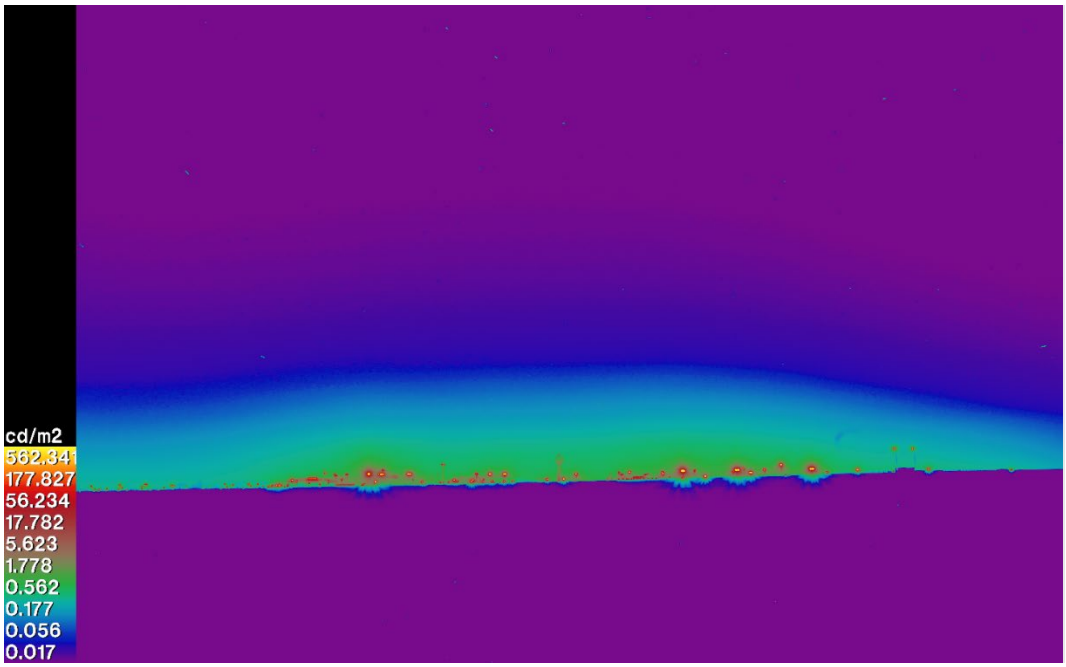
Inset B13.26 Quantitative Luminance Image Viewpoint 19



Viewpoint 20

Inset B14.27 HDR image Viewpoint 20

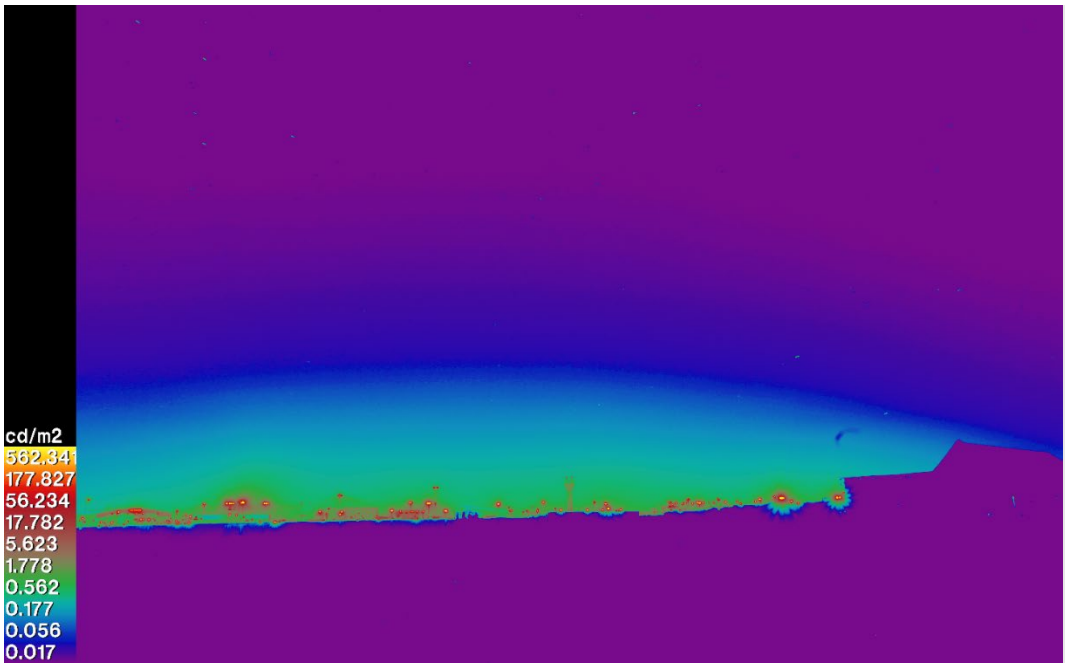
Inset B14.28 HDR image Viewpoint 20



Viewpoint 21

Inset B15.29 HDR image Viewpoint 21

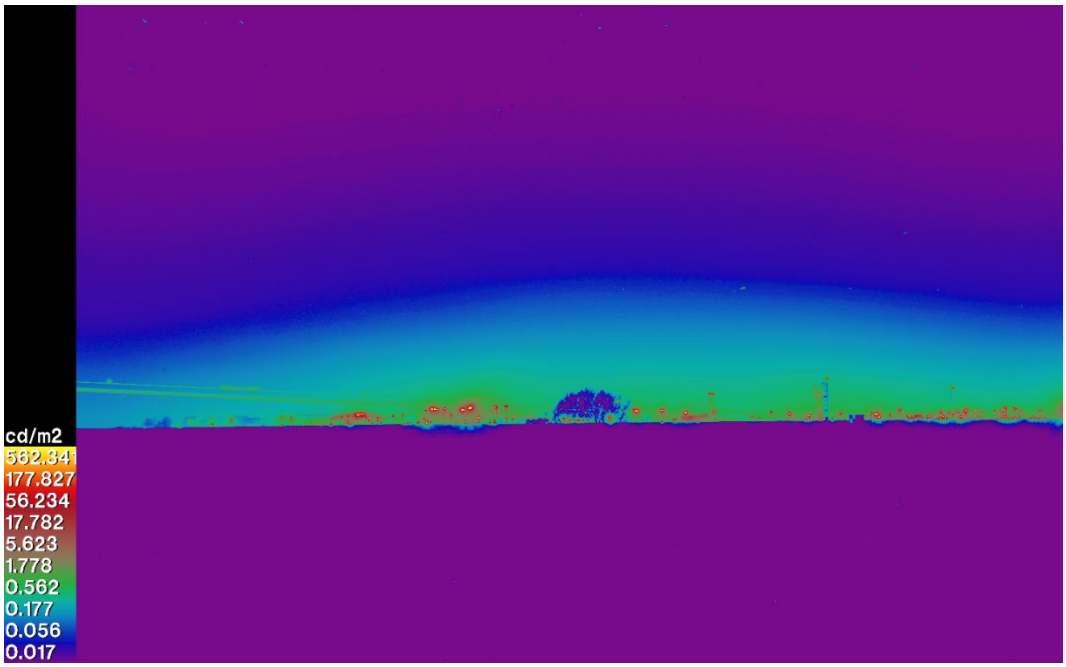
Inset B15.30 Quantitative Luminance Image Viewpoint 21



Viewpoint 22

Inset B16.31 HDR image Viewpoint 22

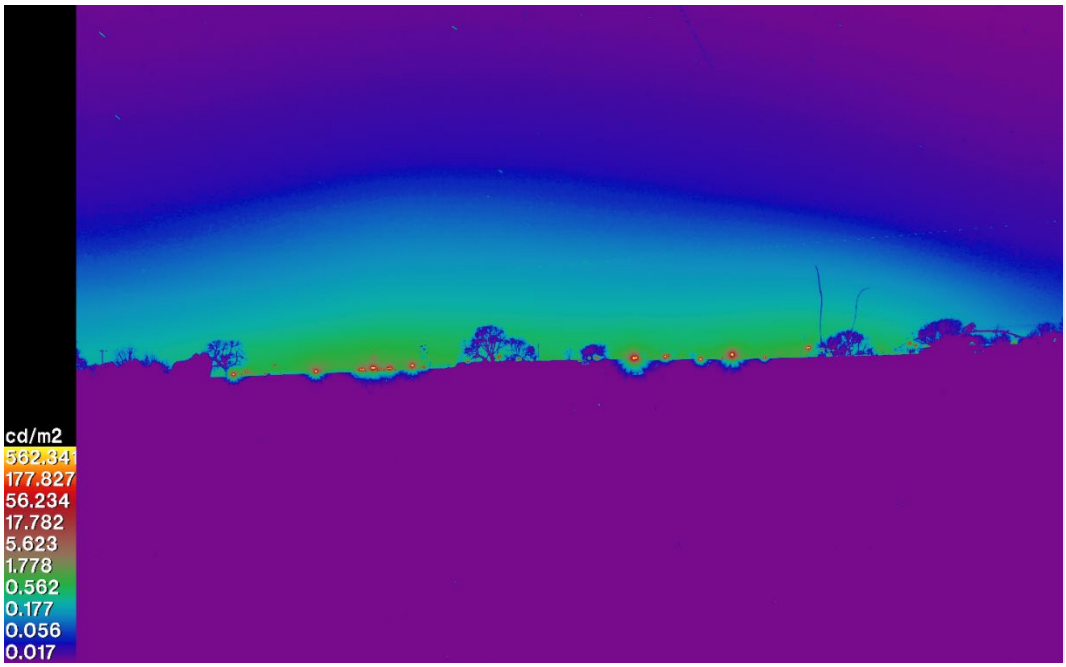
Inset B16.32 Quantitative Luminance Image Viewpoint 22



Viewpoint 27

Inset B17.33 HDR image Viewpoint 27

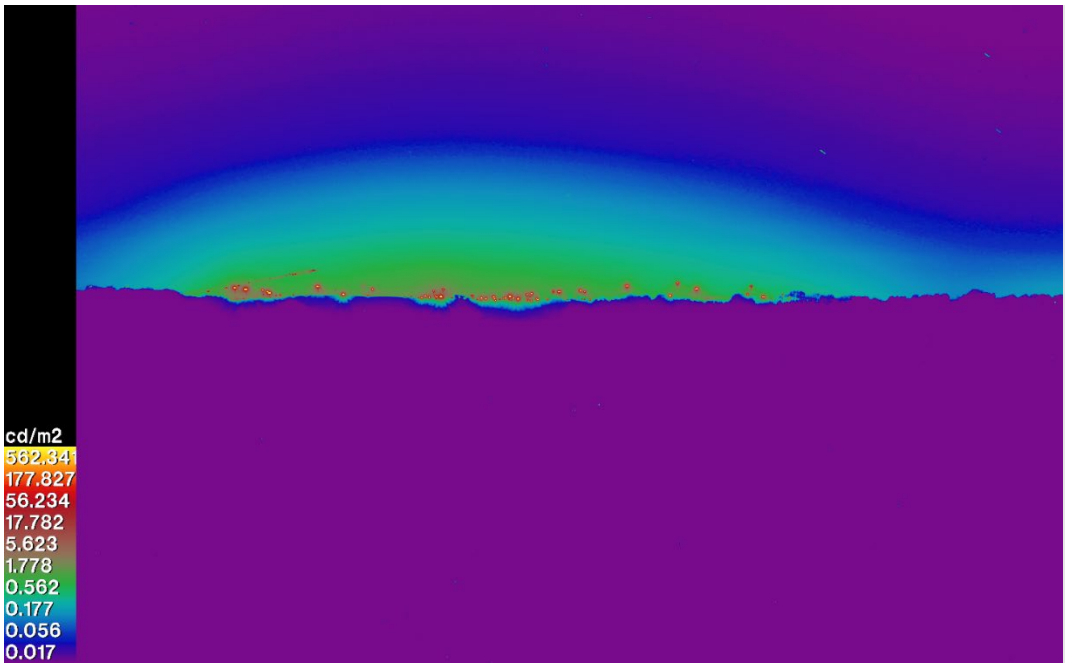
Inset B17.34 Quantitative Luminance Image Viewpoint 27



Viewpoint 28

Inset B18.35 HDR image Viewpoint 28

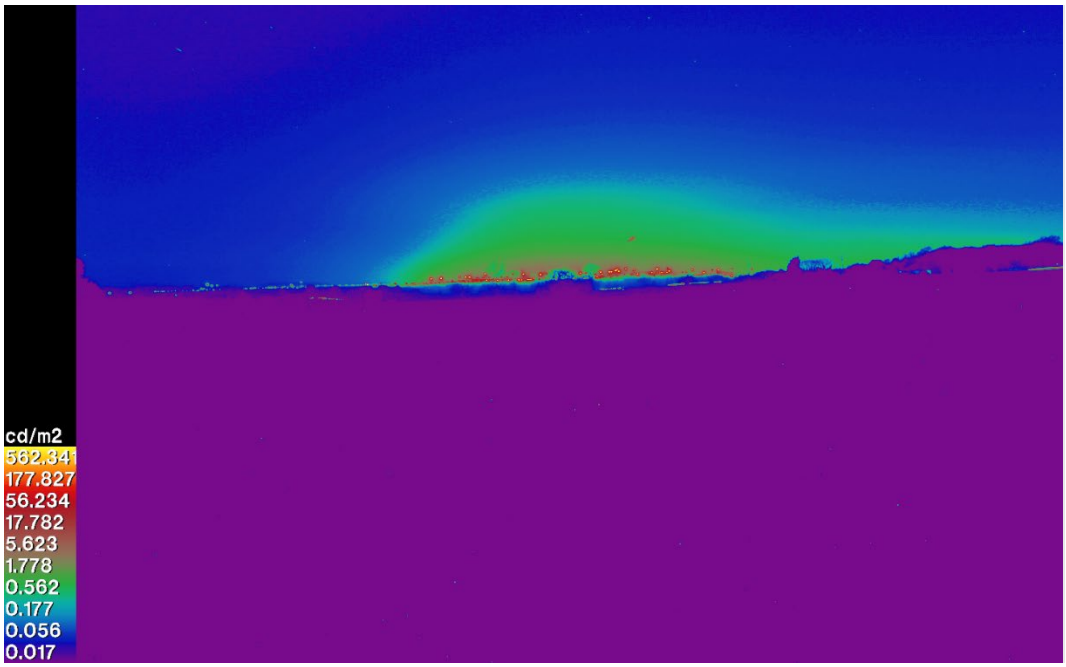
Inset B18.36 Quantitative Luminance Image Viewpoint 28



Viewpoint 31

Inset B19.37 HDR image Viewpoint 31

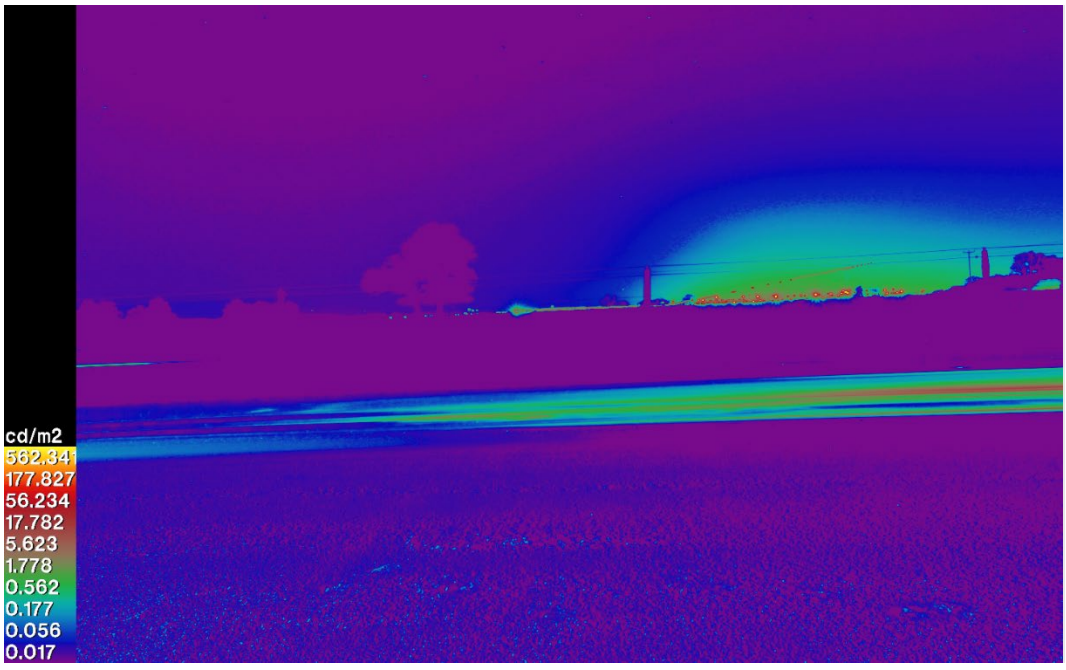
Inset B19.38 Quantitative Luminance Image Viewpoint 31



Viewpoint 32

Inset B20.39 Quantitative Luminance Image Viewpoint 32

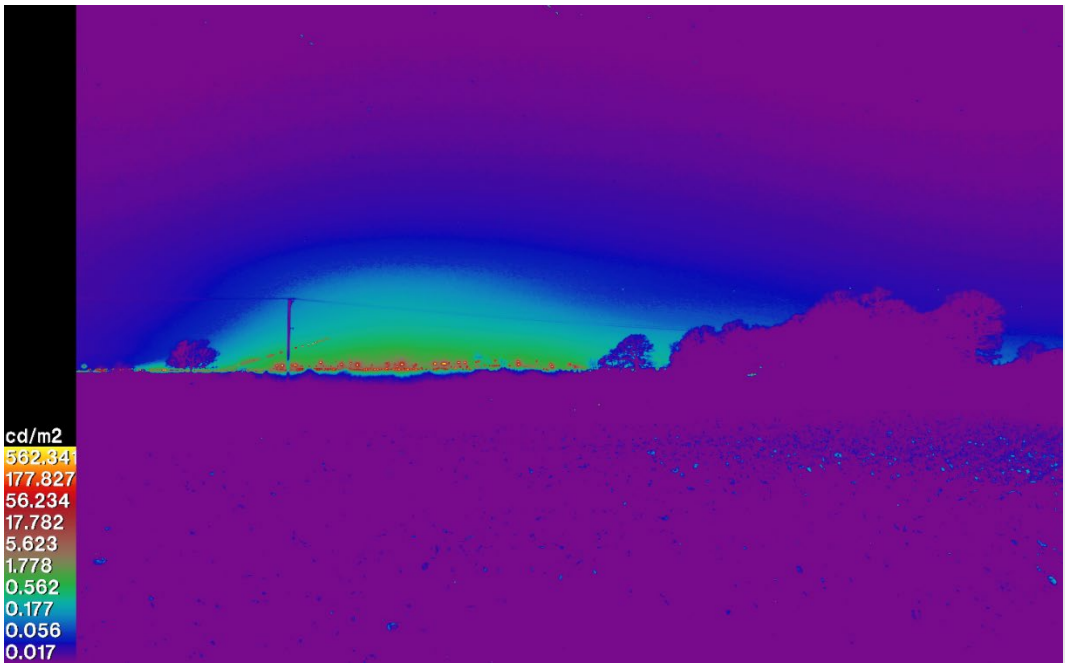
Inset B20.40 Quantitative Luminance Image Viewpoint 32



Viewpoint 33

Inset B21.41 HDR image Viewpoint 33

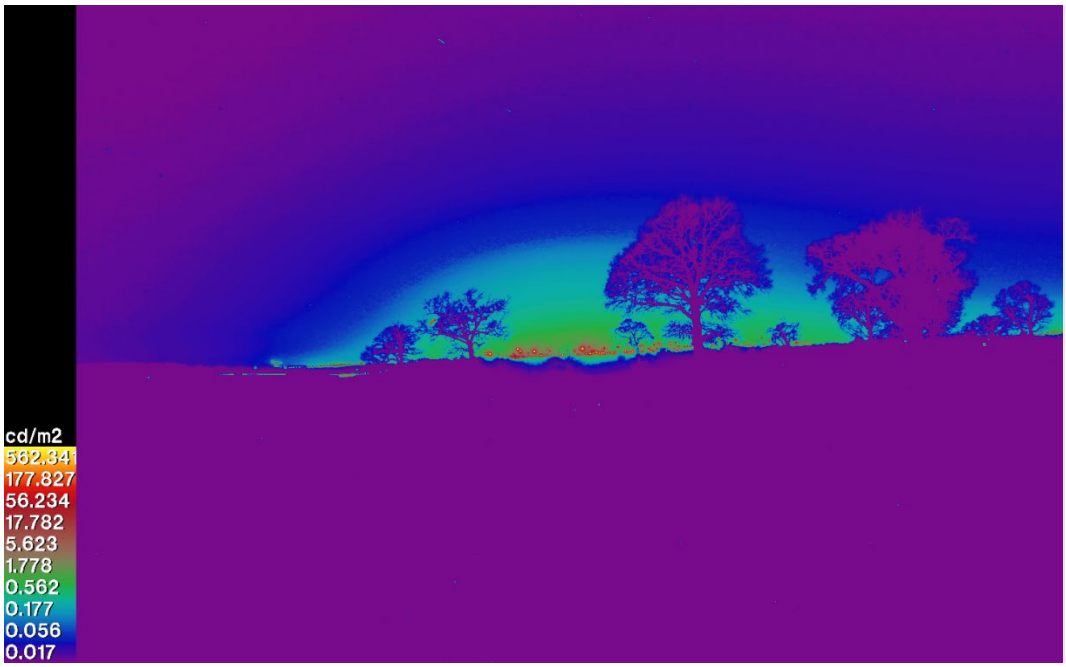
Inset B21.42 Quantitative Luminance Image Viewpoint 33



Viewpoint 34

Inset B22.43 HDR image Viewpoint 34

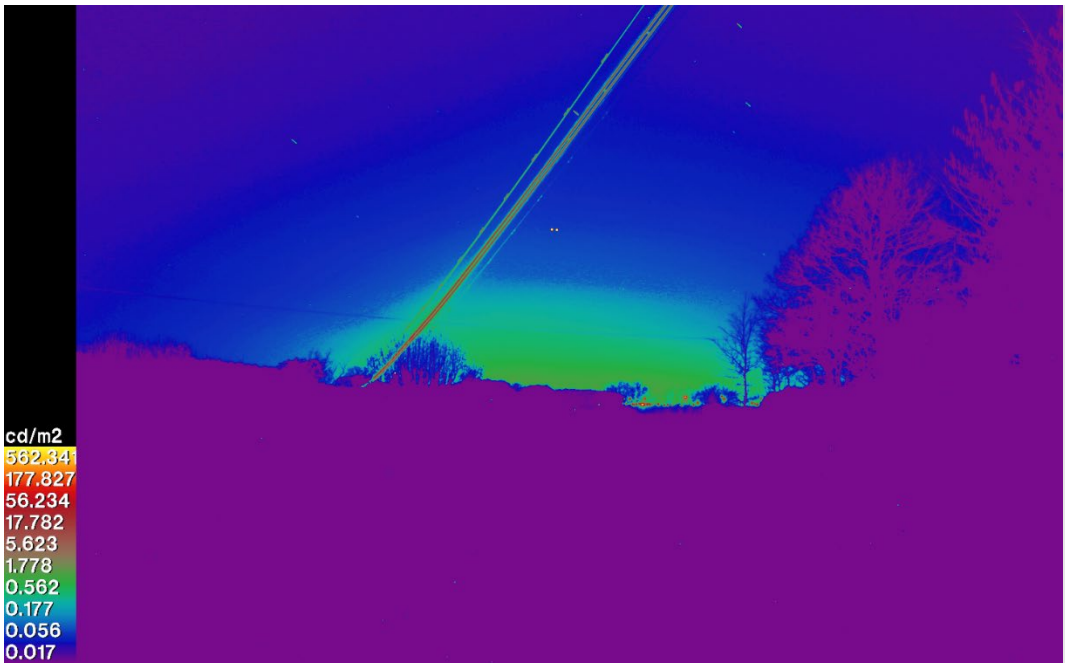
Inset B22.44 Quantitative Luminance Image Viewpoint 34



Viewpoint 35

Inset B23.45 HDR image Viewpoint 35

Inset B23.46 Quantitative Luminance Image Viewpoint 35



Viewpoint 36

Inset B24.47 HDR image Viewpoint 36

Inset B24.48 Quantitative Luminance Image Viewpoint 36

Viewpoint 37

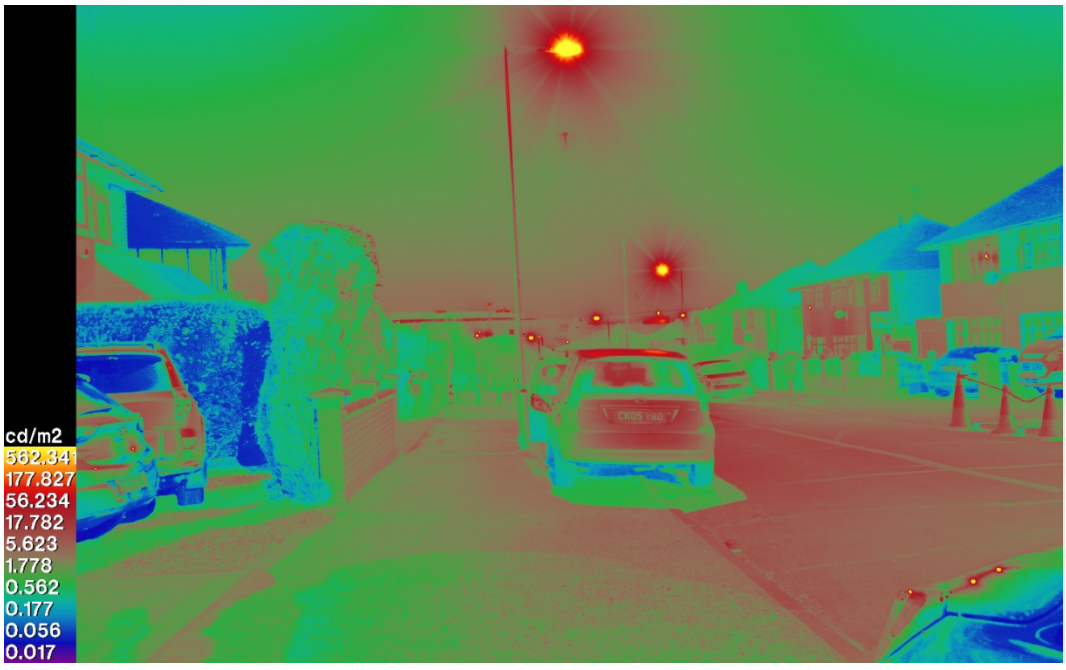
Inset B25.49 DR image Viewpoint 37

Inset B25.50 Quantitative Luminance Image Viewpoint 37

Viewpoint 38

Inset B26.51 HDR image Viewpoint 38

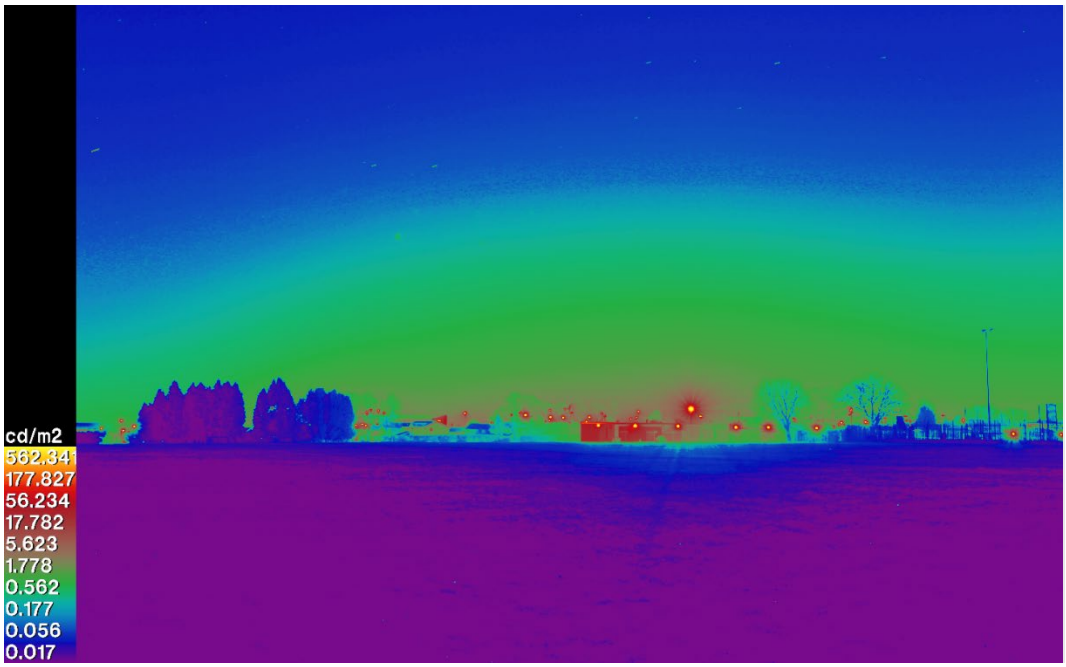
Inset B26.52 Quantitative Luminance Image Viewpoint 38



Viewpoint 40

Inset B27.53 HDR image Viewpoint 40

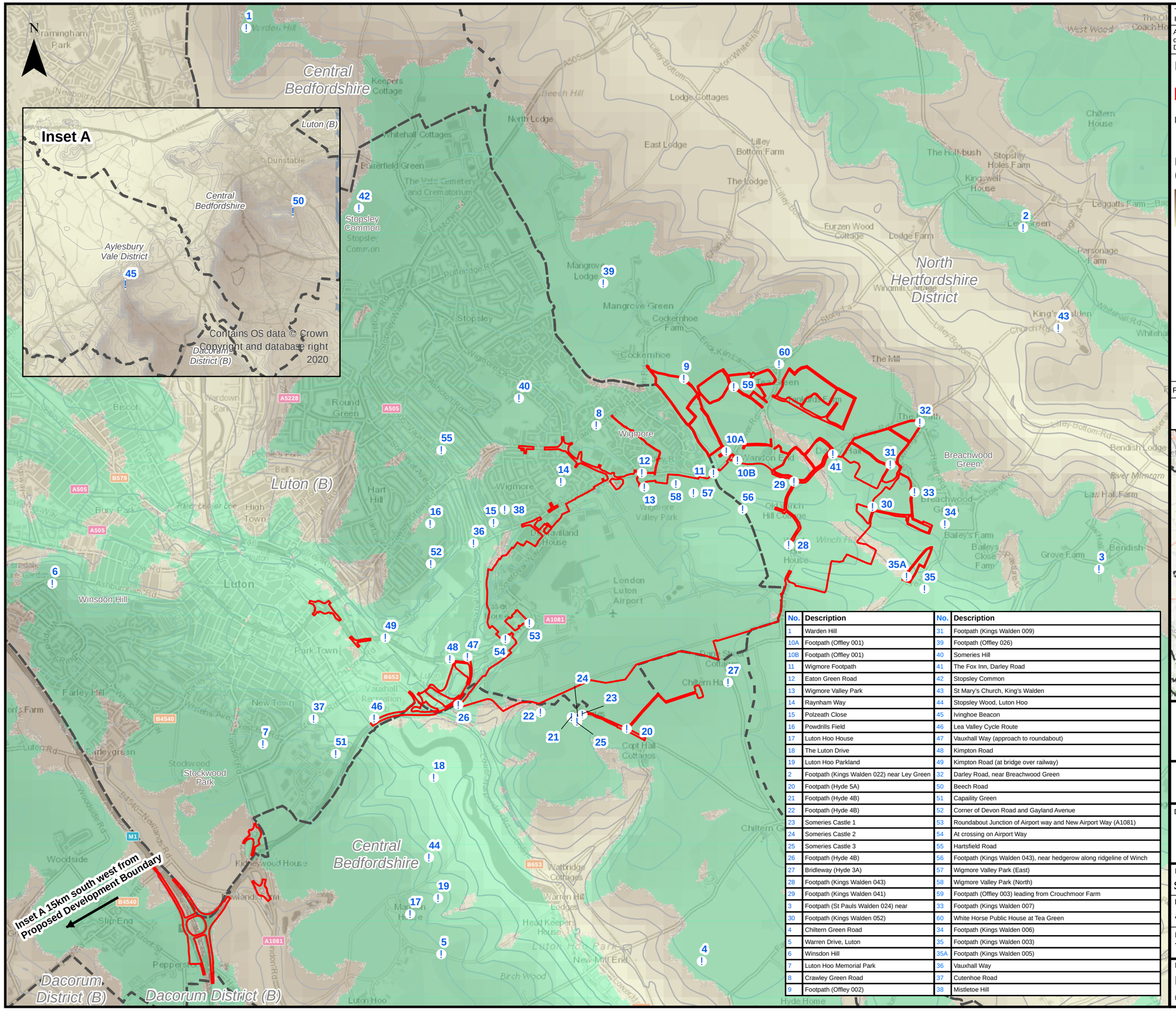
Inset B27.54 Quantitative Luminance Image Viewpoint 40



Appendix C

C1 Proposed Assessment Viewpoints

The drawing below describes the viewpoints of the lighting assessment.



No.	Description	No.	Description
1	Warden Hill	31	Footpath (Kings Walden 009)
10A	Footpath (Offley 001)	39	Footpath (Offley 026)
10B	Footpath (Offley 001)	40	Someries Hill
11	Wigmore Footpath	41	The Fox Inn, Darley Road
12	Eaton Green Road	42	Stopsley Common
13	Wigmore Valley Park	43	St Mary's Church, King's Walden
14	Raynham Way	44	Stopsley Wood, Luton Hoo
15	Polzeath Close	45	Ivinghoe Beacon
16	Powdrills Field	46	Lea Valley Cycle Route
17	Luton Hoo House	47	Vauxhall Way (approach to roundabout)
18	The Luton Drive	48	Kimpton Road
19	Luton Hoo Parkland	49	Kimpton Road (at bridge over railway)
2	Footpath (Kings Walden 022) near Ley Green	32	Darley Road, near Breachwood Green
20	Footpath (Hyde 5A)	50	Beech Road
21	Footpath (Hyde 4B)	51	Capaility Green
22	Footpath (Hyde 4B)	52	Corner of Devon Road and Gayland Avenue
23	Someries Castle 1	53	Roundabout Junction of Airport way and New Airport Way (A1081)
24	Someries Castle 2	54	At crossing on Airport Way
25	Someries Castle 3	55	Hartsfield Road
26	Footpath (Hyde 4B)	56	Footpath (Kings Walden 043), near hedgerow along ridgeline of Winch
27	Bridleway (Hyde 3A)	57	Wigmore Valley Park (East)
28	Footpath (Kings Walden 043)	58	Wigmore Valley Park (North)
29	Footpath (Kings Walden 041)	59	Footpath (Offley 003) leading from Crouchmoor Farm
3	Footpath (St Pauls Walden 024) near	33	Footpath (Kings Walden 007)
30	Footpath (Kings Walden 052)	60	White Horse Public House at Tea Green
4	Chiltern Green Road	34	Footpath (Kings Walden 006)
5	Warren Drive, Luton	35	Footpath (Offley 003)
6	Winsdon Hill	35A	Footpath (Kings Walden 005)
7	Luton Hoo Memorial Park	36	Vauxhall Way
8	Crawley Green Road	37	Cutenhoe Road
9	Footpath (Offley 002)	38	Mistletoe Hill

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

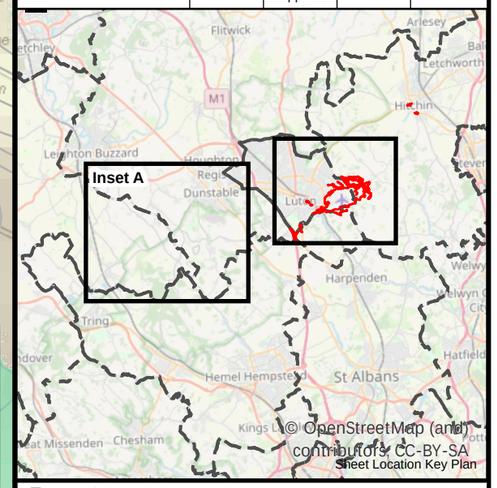
Legend

- Proposed Development Boundary
- Local Authorities Boundaries
- ! Assessment Viewpoint Locations

Elevation (metres above ordnance datum (AOD))

- High : 260
- Low : 50
- Zone of Theoretical Visibility of the Proposed Development

First Issue	AB	PD CS	13/12/21	P01
Revision History	Drawn	Checked Approved	Date	Rev.



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www.lutonrising.org.uk

London Luton Airport
Development Consent Order

Drawing Title

Figure 14.8 Assessment Viewpoint Locations

Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
AB	PD	CS	13/12/21	1:30,000	A3

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0062	P01

Project - Phase - Originator - Asset/Zone - Sub Asset - Type- Discp. - Number

Appendix D

D1 Illuminance Levels (Horizontal)

The drawing below describes the results of horizontal illuminance levels across the Main Application Site.

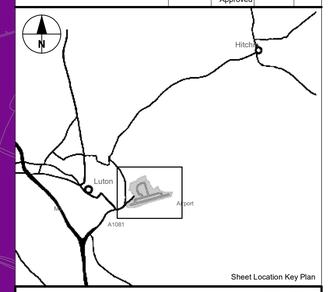
All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Key

Illuminance (lux)

>10
9
8
7
6
5
4
3
2
1
0

Revision History	Drawn	Checked / Approved	Date	Rev.
Approved for Use	JB	RM / RM	29/09/21	P01



Sheet Location Key Plan

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Drawing Title

Airside and Landside horizontal illuminance levels to inform LVIA and EIA

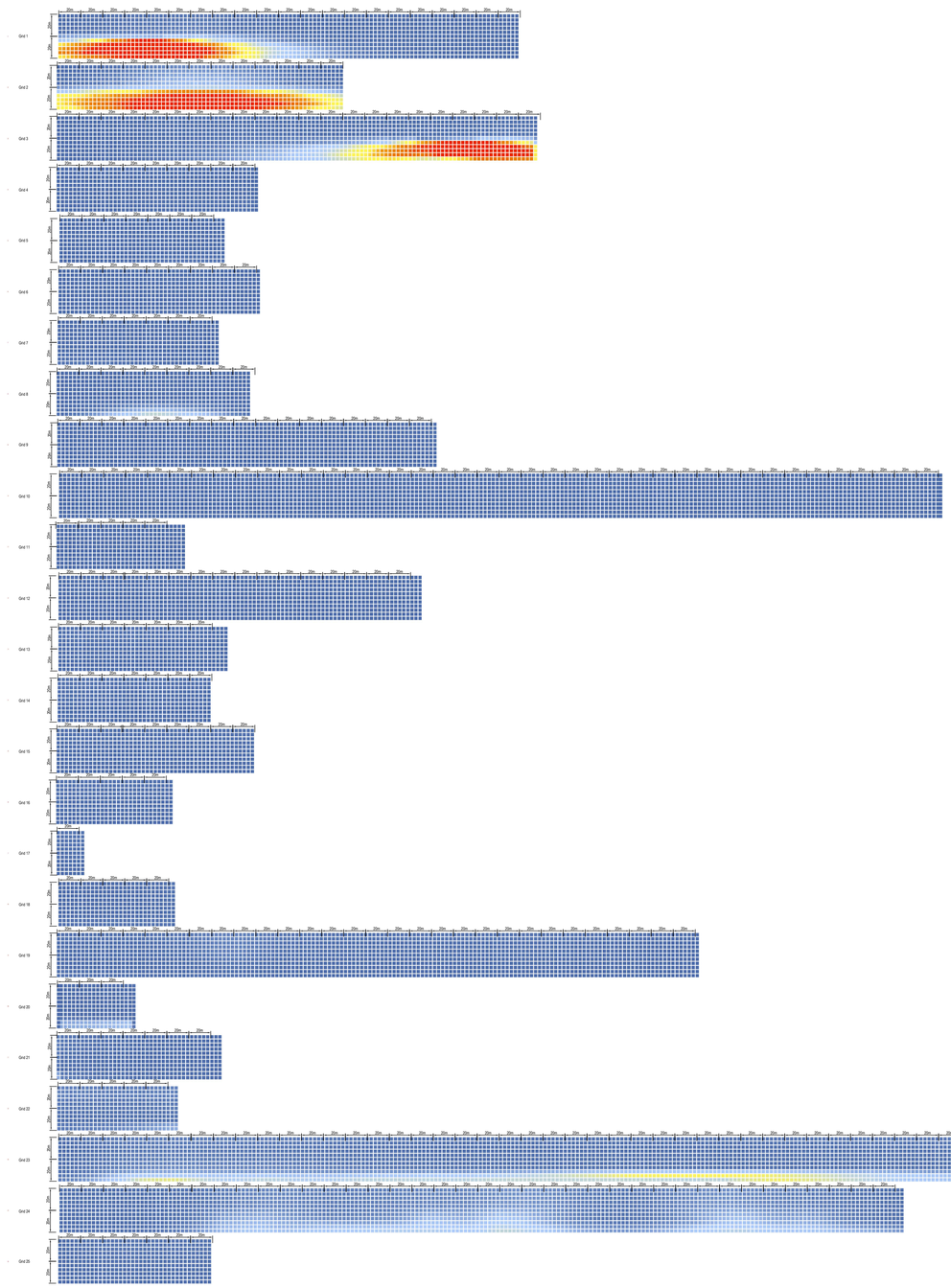
Purpose of issue				Suitability	
SUITABLE FOR COORDINATION				S2	
Drawn	Checked	Approved	Date	Scale	Size
J.Boyd	R.Morris	G.Antonutto	29/09/2021	1:5000	A1
DCO Application Ref.	APFP Regulation	DCO Document Ref.			
TR020001					

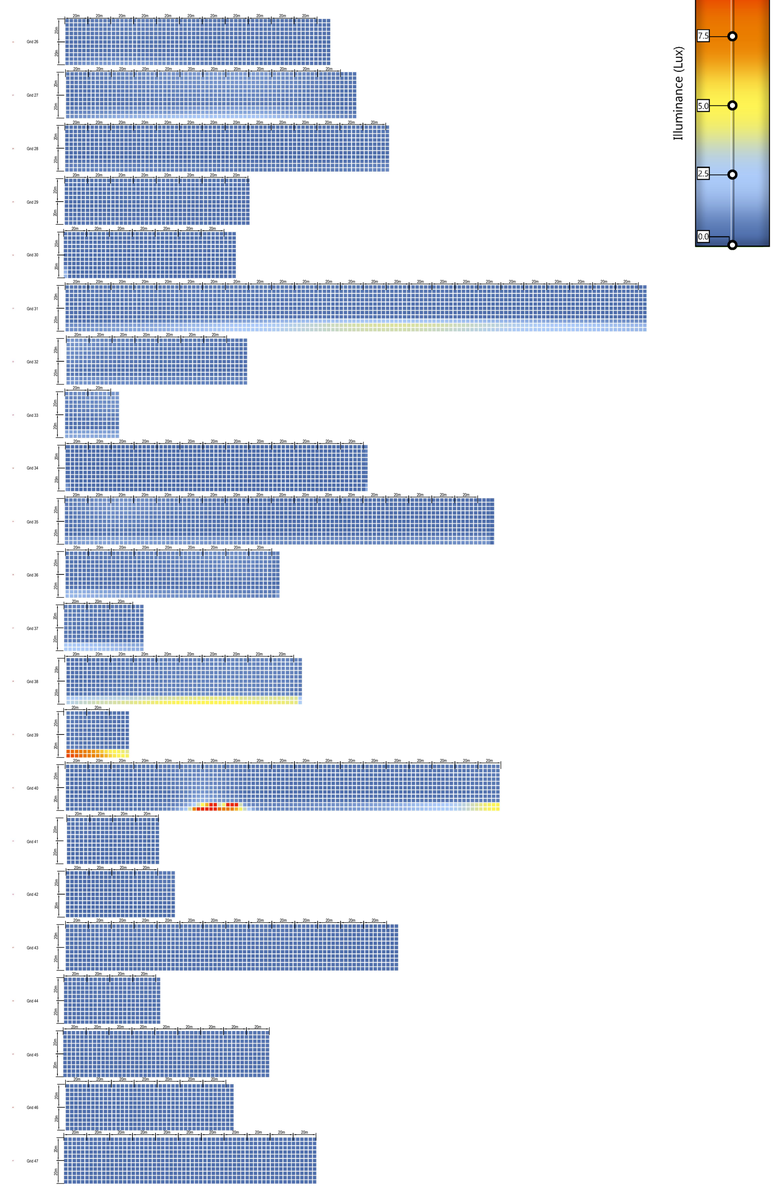
Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YX-0001	P01

Appendix E

E1 Illuminance Levels (Vertical)

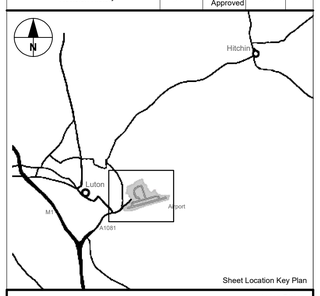
The drawing below describes the results of vertical illuminance levels at the selected grids around the perimeter of the Main Application Site.





All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Revision History	Drawn	Checked / Approved	Date	Rev.
Approved for Use	JB	RM / RM	29/09/21	P01



Sheet Location Key Plan

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Drawing Title

Airside and Landside vertical illuminance levels to inform LVIA and EIA

Purpose of issue	Suitability
SUITABLE FOR COORDINATION	S2

Drawn	Checked	Approved	Date	Scale	Size
J.Boyd	R.Morris	G.Antonutto	29/09/2021	1:5000	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YX-0002	P01

Appendix F

F1 Lighting Design Strategy and Landside Lighting Design

Performance Criteria

This section below describes the lighting design strategy for the Main Application Site and the Landside Lighting Design used for this assessment.

ARUP

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London Luton Airport Expansion Development

Exterior Lighting Strategy Stage 3C Report

29th September 2021

Report ref | LLADCO-3C-ARP-00-00-RP-YX-0001

Document Control			
Document Properties			
Organisation	ARUP		
Author	Anna Forrester / Justin Boyd / Elizabeth Cooper		
Checked by	Richard Morris		
Approved by	Jeff Shaw		
Title	Exterior Lighting Strategy Stage 3C Report		
Document Reference	LLADCO-3C-ARP-00-00-RP-YX-0001		
Version History			
Date	Version	Status	Description/Changes
29.09.2021	P01	For Information	PIER Draft V2

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INTRODUCTION

PURPOSE

Summary

The Lighting Strategy provides both a creative and technical framework by which the true potential of Luton Airport Expansion Project Development can be realised, creating a welcoming and safe environment after dark.

The recommendations for limiting obtrusive light have been considered to minimise potential adverse impacts on local biodiversity, local area residents and users of the space. Equally, optimising value with respect to both capital and running costs is a key element, in relation to project life, energy costs, hours of use, labour rates and light source and control gear replacement periods.

Finally, consideration has been given to the types of lighting equipment selected as well as their mounting locations, materials, the longevity of the finishes and the types of light sources utilised, to ensure minimal disruption to day and night-time activities when the installation needs maintenance or replacement.

The following strategy provides guidance not only on providing a sense of safety and security, but also to ensure that this is done in a sustainable manner. The Lighting Strategy considers the visual requirements for each type of space. The Technical Addendum at the end of this report covers many aspects of the standards and guidance to consider when developing design solutions.

Purpose of report

The purpose of this report is to present the Stage 3c Exterior Lighting Strategy (landside and airside) for the Luton Airport Expansion Project. As well as communication of the current design progress, the main goal of this report is to provide an indication of the character of light proposed for each space.

This report is intended to create a comprehensive Lighting Strategy for the Luton Airport Expansion Project, present the concepts and assist the appointed lighting designers in developing the concepts and the schematic design for the exterior areas at the next stage of the design. This is a concept stage report of the masterplan; the proposed strategy and schematic design shall be validated by the means of lighting calculations at the next stage of the design.

CONTEXT

THE SITE

Location

Luton Airport is located 2.8km to the south-east of Luton town centre. The site covers an area of 43.35km^2 and includes all the amenities associated with an airport on an operational and commercial basis.

The area to the east of the existing terminal, where the long-stay car park is currently located, is approximately the preferred location of the proposed second terminal.

Topography

- Runway on a raised platform and at a higher level than the rest of the site.
- Landfill to the north of the site.
- Expansion to the east of the site.

Land use

- The land to the north of the site is mainly residential; to the west is a mixture of industrial and residential and to the east and south is predominantly rural.
- The airport runway is located directly to the south, with the existing airport terminal building to the east.

- The proposed expansion will replace the current long-term parking, part of Wigmore Park and agricultural land.

Landscape and Heritage

- The surrounding landscape includes several areas designated for their value at local and national levels.
- The existing airport is a visually prominent feature within views from the surrounding areas including Chiltern Way and Chiltern Way Cycle Route, and in distant views from the Chilterns AONB, near Warden.
- Someries Castle, located to the south is the only scheduled monument in the vicinity of the site

Surface Access

- Junction 10 of the M1 motorway is located 5 km west of the site, serving as a primary transport link.
- Airport Way (A1081) connects the M1 to the airport (via Percival Way) and Vauxhall Way.
- LLAL is currently in discussion with the DfT for the introduction of four fast trains per hour.
- These additional services, compared to one train per hour at present, would reduce the journey to 30 minutes.
- Thameslink services provide connections to other stations along the route as well as stations toward the Brighton mainline.
- Several bus services also operate in the proximity of the airport including local services which serve the airport.
- Traffic-free cycle paths, signposted cycle routes and advisory cycle routes away from main roads and dual carriageways have been identified by Sustrans in the Luton area.
- Footways are provided adjacent to all roads surrounding the site.

LIGHTING STRATEGY

THE MASTERPLAN

Introduction

Two development layouts have been proposed for Luton Airport Expansion Project, that will be developed in two phases:

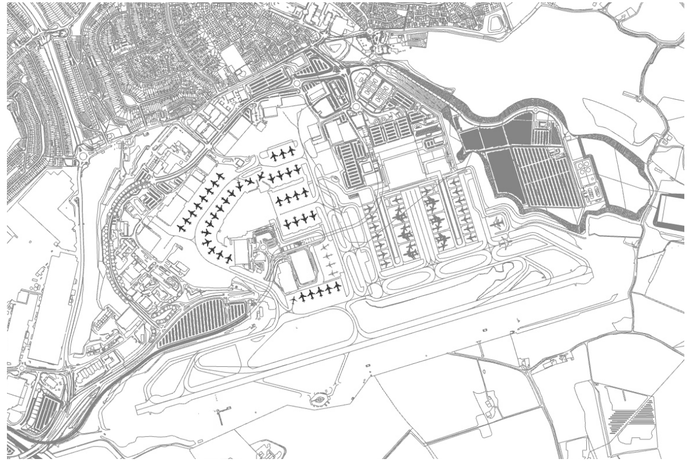
- Phase 1 - Layout to achieve a target capacity of 21.5mppa
- Phase 2 - Layout to achieve a target capacity of 27mppa
- Phase 3 - Layout to achieve a target capacity of 32mppa

21.5mppa site plan

The masterplan to the right shows the 21.5mppa site plan proposal. When compared to the 32mppa site plan, the main differences between the phased proposals are:

- Less expansion to the north-east of the site with a smaller size of surface car park.
- Less expansion to the apron accommodating a reduced number of aircraft stands and taxiways.
- A slight decrease of the new Terminal building size towards west.
- A surface car park replacing the office/retail park to the north.

21.5mppa proposed development layout



32mppa proposed development layout

32mppa site plan

The masterplan to the left shows the 32mppa site plan proposal. When compared to the 21.5mppa site plan, the main differences between the phased proposals are:

- Further expansion to the north-east of the site with additional spaces of surface car parks.
- Further expansion to the apron to accommodate more aircraft stands and taxiways.
- A slight increase of the new Terminal building size towards east.
- An office/retail park to the north replacing the previous surface car park.

The exterior Lighting Strategy described in this report can be applied to both proposed development layouts of the masterplan regardless of the phasing and preferred target capacity achieved.

BASIS OF DESIGN

The exterior lighting vision for Luton Airport will define the experience and environment through which the staff and passengers will move, whether they are at the start or the end of their journey or going to work.

Design Objectives

The underlying strategy for the use of light at Luton Airport has four elements:

- To create a comfortable environment and passenger experience that is positively memorable.
- To aid way-finding and help passengers on their journey to, through and from the airport.
- To create continuity and coherence between spaces.
- Conservation of energy.

Amenity

A primary function of the lighting will be to provide appropriate levels of illumination to enable people to see in the absence of natural light. The extent to which people need to see after dark will vary from area to area, with some requiring high levels of visual acuity whilst others should enable just a basic understanding of scale and the ability to identify a safe passage through a space.

The lighting designers responsible for each project must therefore gain a clear understanding of the manner in which the space that they are designing will be used after dark as well as its relationship to spaces adjoining it.

Legibility and Wayfinding

During daylight hours people use elements of the man-made and natural environments to build a 'mental map' of an area. This helps them to orientate themselves, navigate from place to place and gain an understanding of the scale and nature of a space and its relationship to the wider context.

After dark many of these 'visual signs' disappear and it is largely left to artificial light and natural darkness to inform the interpretation of a space and its relationship to those around it.

The most visible elements in a nocturnal landscape can tend to take on a more dominant role in a person's 'mental map'. The most visually prominent elements are generally those that are perceived as being the brightest, although other factors such as colour, scale, animation and personal association also play important roles.

Without careful planning an environment can easily be rendered 'illegible' after dark, with skewed spatial hierarchies that can hinder people (particularly passengers) from orientating themselves and finding their way in the absence of daylight.

By developing a considered and consistent approach to the lighting of key navigational tools such as roads and pedestrian paths, light will play a crucial role in supporting legibility and accessibility and in reinforcing specific visual and physical connections across the airport.

Accessibility

The design of artificial light must support the various needs of the passengers and staff of the airport after dark. This includes those with special needs and the elderly. Supporting a highly accessible after-dark environment will include avoiding excessive contrasts, avoiding direct and reflected sources of glare, avoiding shiny, mirror-like surfaces at pedestrian level, controlling shadow and limiting potentially confusing upward lighting.

Energy and Costs

Energy is a very important element in the operation and maintenance of any building. An airport building is a 24 hour 365 day a year concern. As a consequence the control of lighting and thus the energy consumption is of vital importance. Lighting shall respond to the presence or absence of staff and passengers, reducing the light output when a space is empty. Lighting schemes must be designed to optimise value with respect to both capital and running costs. Whole life-cycle costs must be considered in relation to project life, energy costs, hours of use, labour rates and light source and control gear replacement periods.

Safety and Security

Artificial light must be designed to assist in maintaining a safe environment at all times. This includes positively defining potential hazards such as steps and ramps and areas where pedestrians encounter moving vehicles – e.g. at pedestrian crossings. Such areas may be defined after dark through passive techniques, such as landscape materials with appropriately contrasting reflectances, as well as through active illumination - e.g. the use of focused light and increased intensity.

Light should be designed to provide an overall sense of security throughout the airport, including supporting both active surveillance (e.g. CCTV) if/when required and passive surveillance. Adequate recognition and modelling of people and surfaces should be provided where required.

It should be noted that perceptions of security are not necessarily dependant on providing high intensities of light and indeed, in some cases, low levels of light can be important in maintaining a sense of security and privacy. Creating an environment that feels secure will largely be dependent on ensuring that spaces are legible, appear well maintained and do not inhibit adaptation.

Maintenance

As part of the development of individual lighting schemes, consideration must be given to the types of lighting equipment selected as well as their mounting locations, materials, the longevity of their finishes and the types of light sources utilised.

This will ensure minimal disruption to day and night-time activities when the installation needs maintenance or replacement. A reduced portfolio of luminaires and light sources will also help to simplify maintenance regimes. Maintenance issues will need to be addressed in terms of cost effectiveness and maintenance programmes. Lighting control systems can also be used to provide remote monitoring of individual luminaires to report lamp-life and lamp failure to further ease maintenance regimes.

Light Source

LED technology is proposed to be the light source of choice for applications across the Project site, with a colour temperature of 3,000K. However, where ecological considerations or human factors take precedence, warmer colour temperatures (<2,700K) will be considered for the advantages of reduced blue spectral content (minimised wavelength <550nm) and promotion of a warmer and more intimate setting. Refer to ILP Guidance Note GN08 (Bats and Artificial Lighting).

Generally all white-light light sources will have a colour rendering index Ra greater than 80 in accordance with the international colour code. This is of particular importance in areas with higher levels of illumination, where improved visual quality and accurate rendition of skin tones and signage, etc. can facilitate tasks and interactions and help to improve a user journey.

LED light sources can be susceptible to high frequency flicker and sensitivity varies between humans and different species of ecological receptors. Visible blinking, flickering or strobing will not be acceptable at full lumen output, nor at any dimming level should dimming be specified. Many drivers available on the market are able to dim down to 1% output while maintaining Flicker Frequency above 500Hz. The requirements of IEEE 1789–2015 will apply to all LED drivers, where unless specified otherwise drivers will aim to limit the other biological effects of flicker.

Consultation with an Ecologist is an essential activity when selecting appropriate light sources as part of the Lighting Design development.

Lighting Controls

Lighting controls form an essential part of the Initial Lighting Strategy and can provide benefits ranging from the reduction of lighting energy consumptions to self reporting and testing of lighting equipment to streamline maintenance activities.

The degree of electric lighting control provided can vary from a simple switched system to a networked solution across buildings, and shall be assessed on a project by project basis to ensure that a proportionate system is put into place.

The following considerations shall guide the selection of a suitable lighting controls system:

- Requirements for interfacing or integration with an existing or desired Central Management System (CMS) or Building Management System (BMS).
- Monitoring dashboard to display and time-log operational performance data, for example (but not limited to); operational hours (for maintenance planning), power load, temperature, voltage, switching cycles, luminaire status, device addressing, grouping, dimming level, communication faults and energy use on a zonal basis
- Automatic reporting of luminaire failure, including but not limited to failure to respond to instructions or driver failure.
- Control protocol (it is recommended that a standard open protocol is utilised for greater commercial selection and compatibility of control equipment, sensors, etc).
- Addressability and dimmability (e.g., individual control of luminaires, or grouping / zonal control).
- Schedule control, programmable with predefined events per day, per zone.
- Degree of feedback to the lighting system (eg. photocells for daylight-linked dimming, PIR sensors for occupancy based control and astronomical timeclock for time of day linked control).
- Integral ability for luminaires to have constant light output (CLO) control, allowing energy use to be minimised while achieving lighting targets and extending the life of the LED sources.
- Design Accreditations (eg. BREEAM) or energy targets.
- Astronomical timeclock programmable schedule with a minimum of six events per day per zone, and with a 365-day calendar function.

THE JOURNEY

Introduction

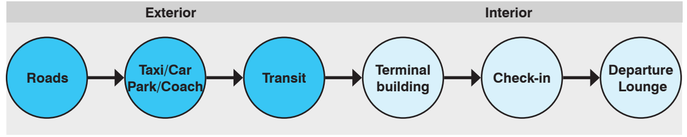
In this section, we identify the variation in the lighting environments experienced on the journeys to and from the airport. The exterior lighting is the first and last impression of each journey and it should be a memorable one.

Each project commissioned (Exterior or Interior) whilst being a stand alone project is also part of the airport's overall development. As such each project shall be integrated with its surroundings and adjacent spaces.

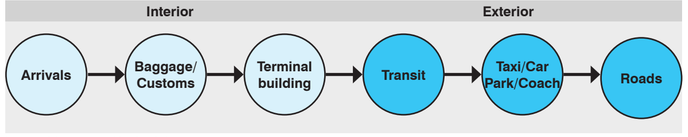
Any new or refurbished space forms part of the wider context and it shall be designed to compliment the surrounding spaces so passengers can move seamlessly through the visual environment, without the journey appearing to be a series of diverse experiences lacking in cohesion.

There are two main journeys through the site:

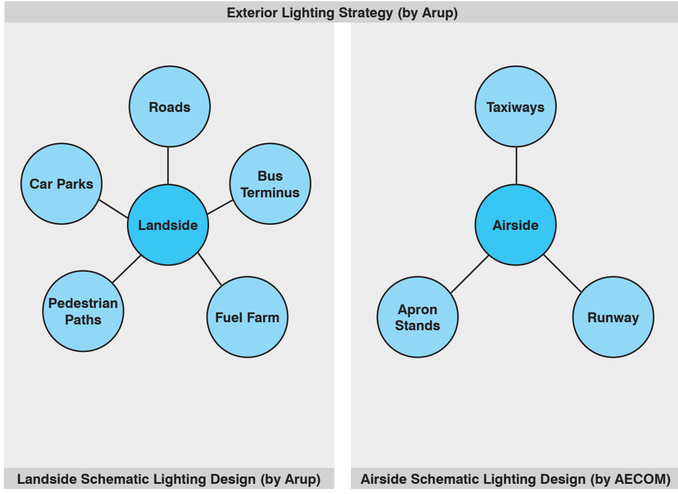
- Outward journey or departures, starting at the set down point, the roads, the car park or the bus terminus or the taxi, through the check-in hall, and finally the departures lounge.
- Inward journey or arrivals, starting at air bridges, baggage reclaim and customs and finally to the car park, bus terminus, taxi, pick-up points, roads, etc.



Outward journey (Departures)



Inward journey (Arrivals)



Exterior Lighting Strategy and Schematic Lighting Design Scope of Works

The scope of this report is the overall exterior Lighting Strategy; Landside and Airside (as shown at the diagram to the left).

Landside includes the outward/inward journey from the car park or bus terminus to the Terminal building and vice-versa.

Airside includes the apron stands, taxiways and runways lighting (by AECOM).

The overall lighting design strategy is developed by Arup (Landside and Airside). The schematic lighting design for Landside is developed by Arup and the schematic lighting design for Airside is developed by AECOM.

HIERARCHY

Light Levels

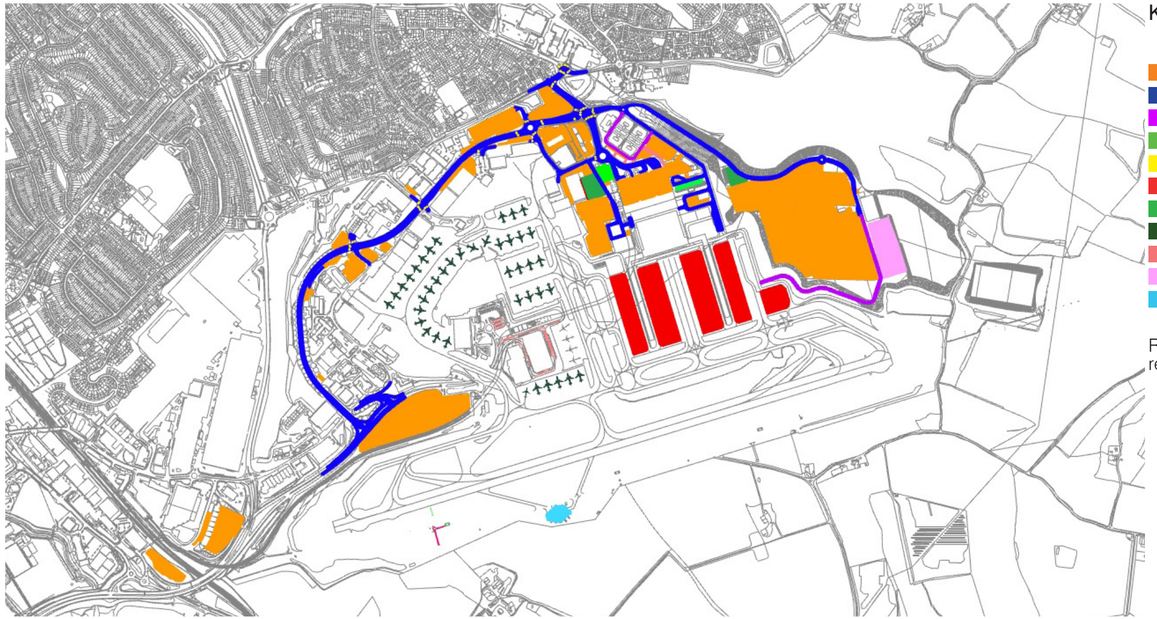
The opposite diagram describes the hierarchy and approach of the lighting for the proposed masterplan.

As a first step towards determining appropriate lighting performance for Luton Airport, an 'Environmental Zone' (as defined by the Institute of Lighting Professionals', publication, "Guidance Notes for the Reduction of Light Pollution") has been selected.

This categorisation system represents current best practice and aims to ensure that the relative brightness of the site with respect to its environmental context is appropriate.

Environmental Zones are categorised in the ILP document as follows:

- E1: Intrinsically dark landscapes (national parks, areas of outstanding natural beauty, etc.)
- E2: Low district brightness areas (rural, small village, or relatively dark urban locations)



Key

- Car Park
- Roads Primary
- Roads Secondary
- Coach Parking
- Pedestrian Crossing
- Apron Stand
- Emergency Muster
- Loading Bay
- Pedestrian Route
- Fuel Farm
- Fire Training

Refer to the technical addendum of this report for the lighting levels.

- E3: Medium district brightness areas (small town centres or urban locations)
- E4: High district brightness areas (town/city centres with high levels of night-time activity

It has been assumed that the Luton Airport falls under the category E3.

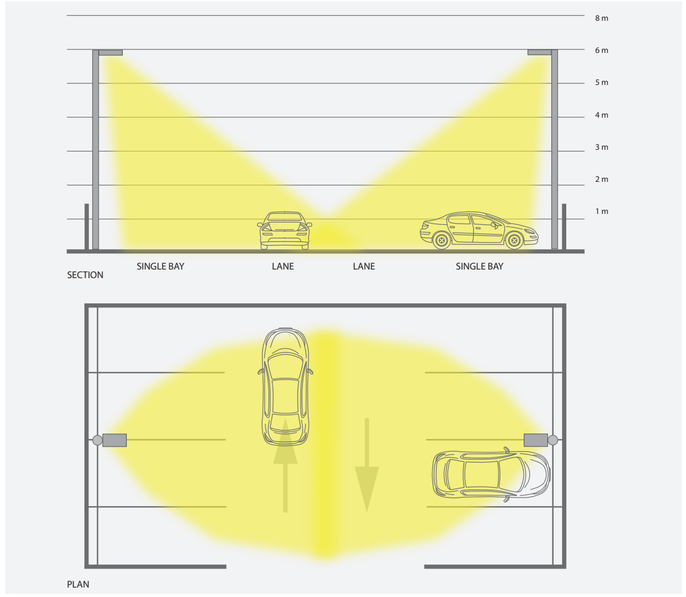
SURFACE CAR PARKS

Car Parks Surface Level (single bay)

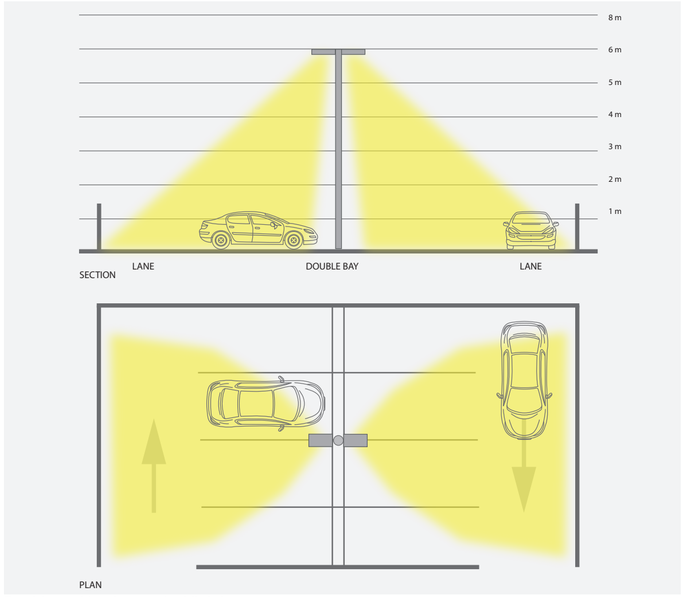
The figure to the right shows a typical arrangement for a car park, single parking bay and access.

In principle:

- Car park lighting shall use white light sources which shall be dimmable.
- A good uniformity over the space shall be achieved by utilising lanterns mounted on columns at the perimeter of the car park.
- Columns shall be aligned with the parking space lines to avoid collision.
- The preferred height of the column mounted lanterns shall not exceed 6m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.



Single parking bay typical lighting arrangement



Double parking bay typical lighting arrangement

Car Parks Surface Level Car (double bay)

The figure to the left shows a typical arrangement for a car park, double parking bay and access.

In principle:

- Car park lighting shall use white light sources which shall be dimmable.
- A good uniformity over the space shall be achieved by utilising lanterns mounted on columns located in between the parking spaces.
- Columns shall be aligned with the parking space lines to avoid collision.
- The preferred height of the column mounted lanterns shall not exceed 6m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.

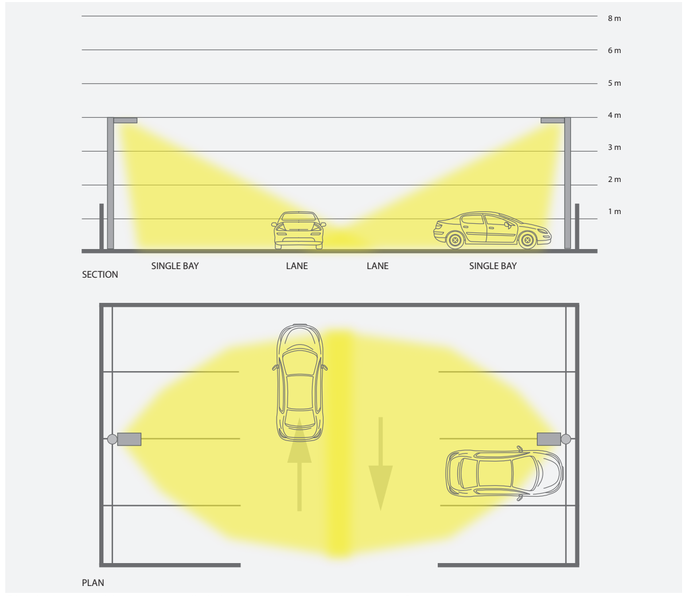
DECKED CAR PARKS

Car Parks Decked (open roof) single parking bay

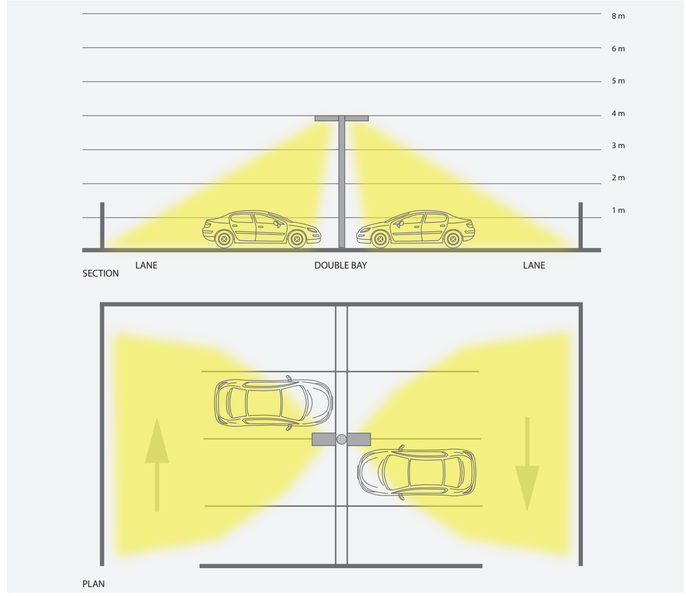
The figure to the right shows a typical arrangement for an open roof car park, single parking bay and access.

In principle:

- Car park lighting shall use white light sources which shall be dimmable.
- A good uniformity over the space shall be achieved by utilising lanterns mounted on columns at the perimeter of the car park.
- Columns shall be aligned with the parking space lines to avoid collision.
- The preferred height of the column mounted lanterns shall not exceed 4m above finished deck level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.
- Barrier design shall limit vehicle head light spill externally.



Single bay parking spaces lighting arrangement (open roof)



Double bay parking spaces lighting arrangement (open roof)

Car Parks Decked (open roof) double parking bay

The figure to the left shows a typical arrangement for an open roof car park, double parking bay and access.

In principle:

- Car park lighting shall use white light sources which shall be dimmable.
- A good uniformity over the space shall be achieved by utilising lanterns mounted on columns located in between the parking spaces.
- Columns shall be aligned with the parking space lines to avoid collision.
- The preferred height of the column mounted lanterns shall not exceed 4m above finished deck level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.
- Barrier design shall limit vehicle head light spill externally.

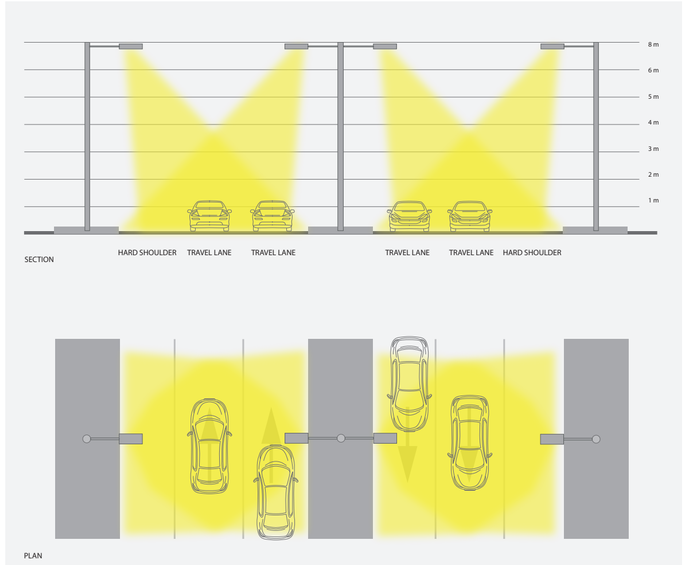
ROADS

Primary Vehicular

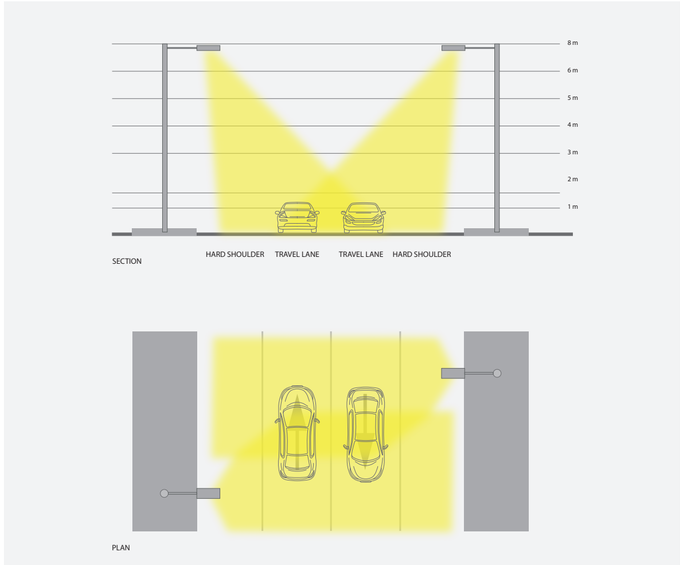
The figure to the right shows a typical arrangement for a primary vehicular road (dual carriageway).

In principle:

- Road lighting shall use white light sources.
- A good uniformity over the road shall be achieved by utilising road lighting lanterns mounted on columns with an opposite arrangement.
- Dual carriageways can be satisfactorily lit by means of opposite arrangements mounted on the outside edges of the road, or by twin lanterns on the central reserve only. The appropriate arrangement will be defined at the next stage of the design and will be depended on the column height and the width of the road.
- The preferred height of the road lighting lanterns shall be 8m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.



Primary vehicular lighting arrangement



Secondary vehicular lighting arrangement

Secondary Vehicular

The figure to the left shows a typical arrangement for a secondary vehicular road (single carriageway).

In principle:

- Road lighting shall use white light sources.
- A good uniformity over the road shall be achieved by utilising road lighting lanterns mounted on columns with a staggered arrangement.
- Single carriageways can be satisfactorily lit by means of staggered arrangement mounted on the outside edges of the road.
- The preferred height of the road lighting lanterns shall be 8m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.

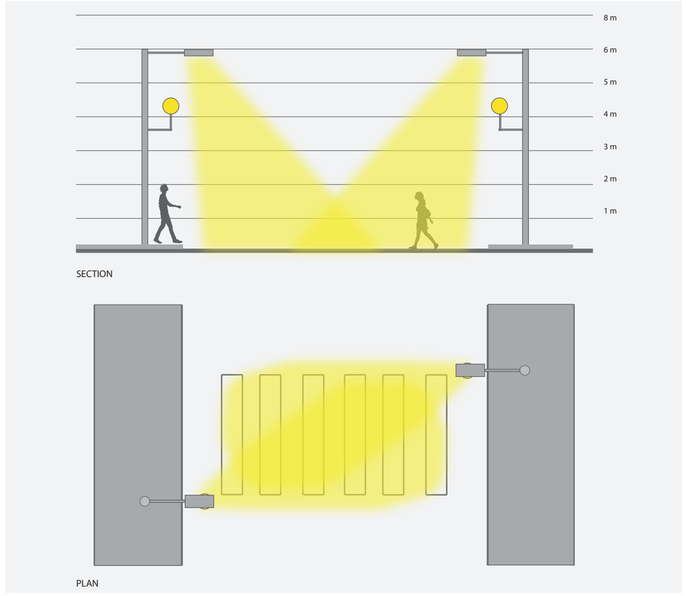
PEDESTRIAN CROSSING

Pedestrian Crossing

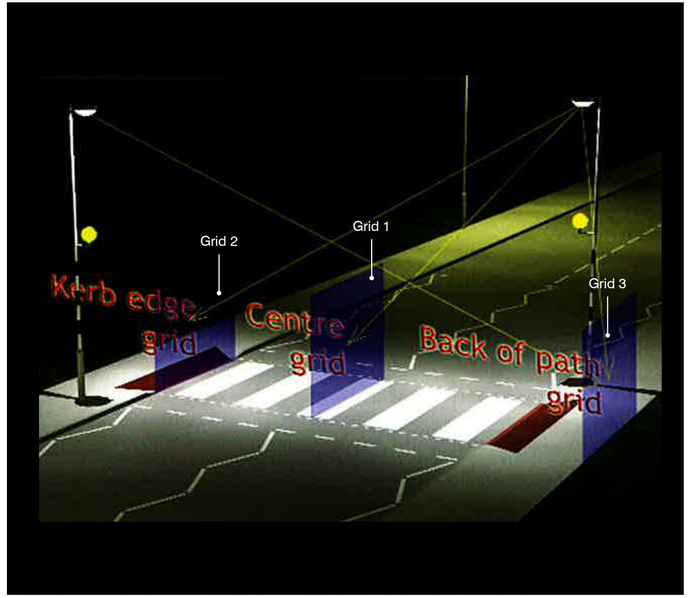
The figure to the right shows a typical arrangement for a pedestrian crossing.

In principle:

- Pedestrian crossing lighting shall illuminate any pedestrian who is approaching, at and on the crossing in such manner as to make them clearly visible to the approaching driver.
- A good uniformity over the road shall be achieved by utilising road lighting lanterns mounted on the outside edges of the road with a staggered arrangement. The road lighting lanterns shall be of side asymmetric distribution specifically designed for this application to provide adequate illumination at horizontal and vertical level.
- At pedestrian crossings it is best practice to have supplementary luminaires mounted on an extended beacon pole either located on an offset bracket or designed to wrap around the pole. This aids the lighting of the crossings, reduces street clutter and improves all-round visibility.



Pedestrian Crossing typical lighting arrangement



Pedestrian crossing (extract from ILP TR12 Lighting of Pedestrian Crossings)

Pedestrian Crossing (continued)

As pedestrian crossings are considered to be conflict areas for the purpose of lighting it is recommended that the carpet and adjacent footway “waiting area” are illuminated to a higher level than of the road to draw the attention of the approaching driver to the proximity of a pedestrian crossing and to illuminate the pedestrian on the crossing and adjacent footways.

The figure to the left is an extract from ILP TR12 Lighting of Pedestrian Crossings. It shows the three recommended vertical grids that should be calculated, each 1.5 meters high and the width of the crossing mat, located as follows:

- Grid 1: At the centre of the crossing running along the centre line of the road
- Grid 2: Along the kerb edge with the measurement field facing across the road
- Grid:3 At the rear of the waiting area or 1.8 meters back from the kerb, whichever is less, and again with its axis along the road line.

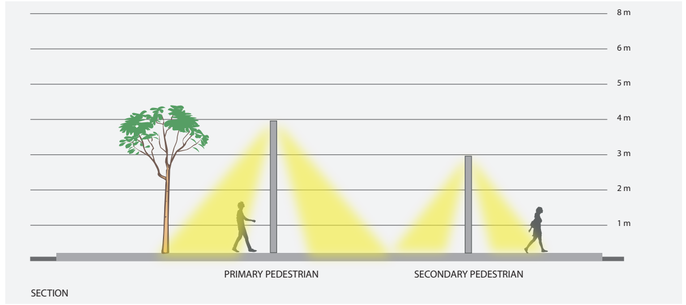
PEDESTRIAN PATHS

Primary & Secondary Pedestrian

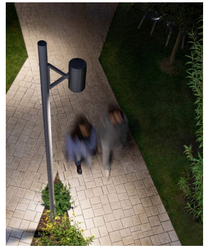
The figure to the right shows a typical arrangement for a primary and secondary path exclusive to pedestrians.

In principle:

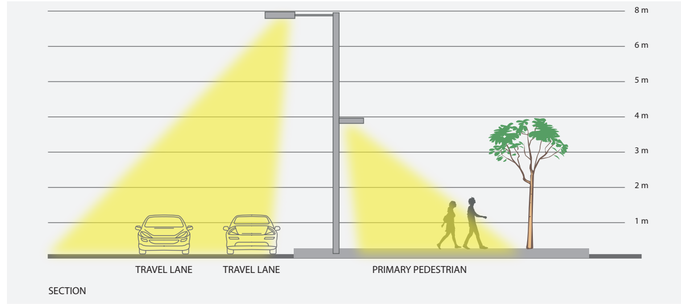
- Pedestrian paths lighting shall use white light sources.
- A good uniformity over the ground shall be achieved by utilising lanterns with a side throw that direct the light towards the ground and not upwards. The lantern chosen shall be of 0° uplight to minimise light obtrusion and environmental impact.
- A single side through or a dual side through can be used depending on the width of the path. The paths can be satisfactory lit by means of opposite or staggered arrangement mounted on the outside edges of the road, or by twin lanterns on the central path only.
- The preferred height of the pedestrian paths lighting lanterns shall be 4m and 3m above finished ground level for primary and secondary pedestrian respectively, which is closer to the human scale.



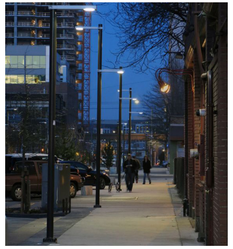
Typical lighting arrangement of Primary and Secondary pedestrian paths



Precedents of pedestrian paths



Typical lighting arrangement of Pedestrian paths combined with vehicular



Precedents of pedestrian paths

Pedestrian paths adjacent Vehicular routes

In instances where pedestrian pathways, either primary or secondary, are adjacent to any vehicular routes, the pedestrian path lighting shall be provided by using the road lighting lantern. This will aim to de-clutter the roads and paths by combining the same column.

The height of the lighting lanterns for pedestrian paths shall follow the same strategy of either 4m (primary paths) or 3m (secondary paths) that is closer to the human scale, whereas the road lighting lanterns shall follow the strategy of 8m.

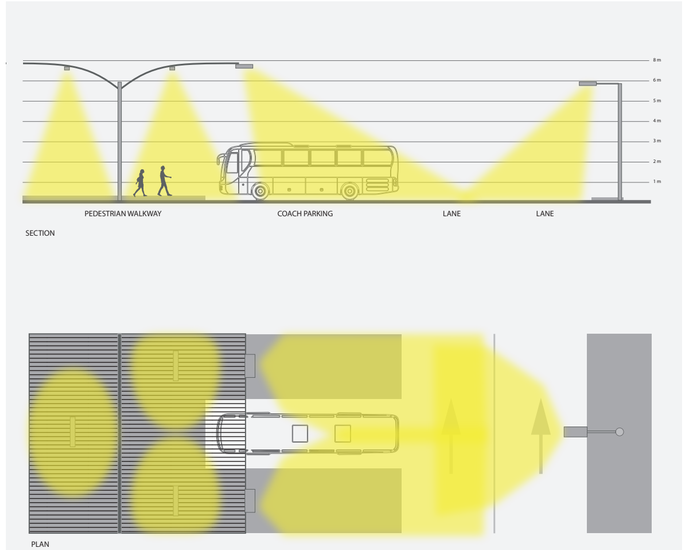
COACH STATION

Coach station

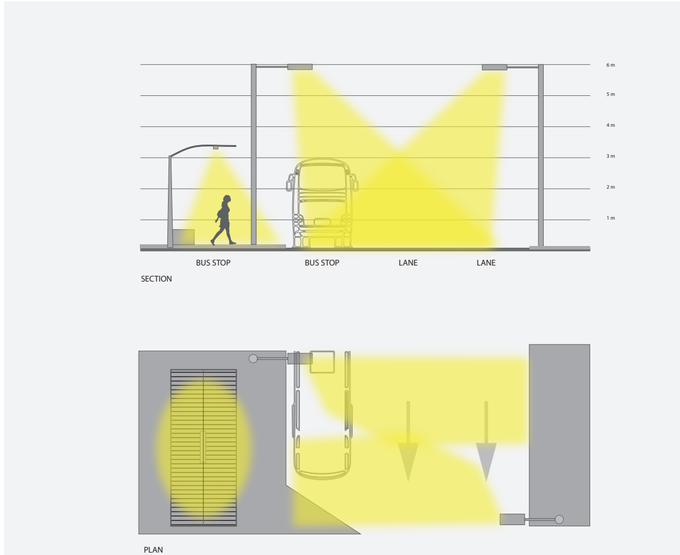
The figure to the right shows a typical lighting arrangement for a coach station.

In principle:

- The area under the canopy shall be illuminated by the use of luminaires at canopy level. Lighting shall use white light sources which shall be dimmable. A good uniformity over the space shall be achieved.
- The lighting shall have reduced output during off peak periods, dimming the lighting uniformly down to an appropriate level. Lighting under the canopy shall be switched off where daylighting levels permit.
- Luminaires shall be installed in between the coach parking spaces to provide lighting from both sides when the coach is parked.
- The drive lanes shall be illuminated by a combination of road lighting lanterns on the outside edges of the road and by road lighting projectors mounted at canopy level to avoid vehicle movement disruption by columns next to coach parking.



Coach station typical lighting arrangement



Bus stop typical lighting arrangement

Bus stop

The figure to the left shows a typical lighting arrangement for a bus stop.

In principle:

- The area under the canopy shall be illuminated by the use of luminaires at canopy level. Lighting shall use white light sources which shall be dimmable.
- The lighting under the canopy shall have reduced output during off peak periods, dimming the lighting uniformly down to an appropriate level. Lighting shall be switched off where daylighting levels permit.
- A good uniformity over the road and bus stop shall be achieved by utilising road lighting lanterns mounted on columns with a staggered arrangement.
- The preferred height of the road lighting lanterns shall be 6m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.

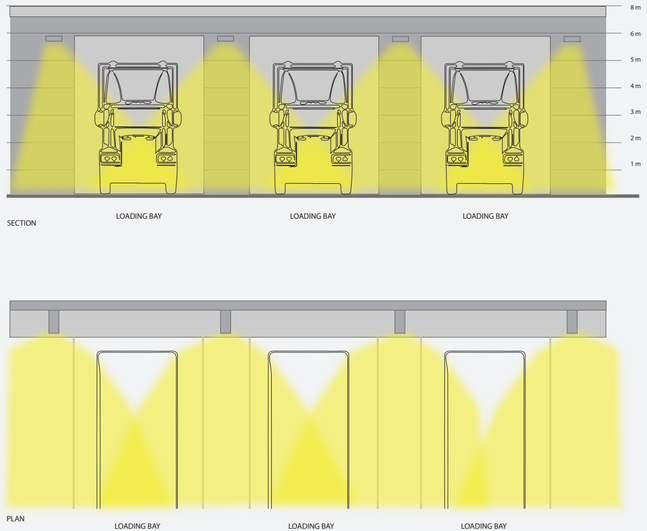
LOADING BAYS

Loading Bays

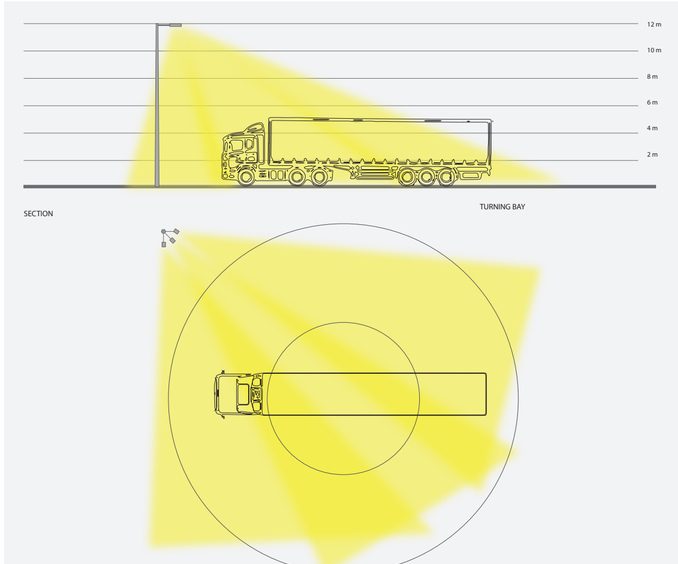
The figure to the right shows a typical lighting arrangement for a Loading Bay, and a similar approach shall be used at the PV store.

In principle:

- The area under the canopy shall be illuminated by the use of luminaires at canopy level. Lighting shall use white light sources which shall be dimmable. A good uniformity over the space shall be achieved.
- The lighting shall have reduced output during off peak periods, dimming the lighting uniformly down to an appropriate level. Lighting under the canopy shall be switched off where daylighting levels permit.
- Luminaires shall be installed in between the bay spaces to provide lighting from both sides when the truck is unloading.
- The drive lanes shall be illuminated by a combination of road lighting lanterns on the outside edges of the road and by road lighting projectors mounted at canopy level to avoid vehicle movement disruption by columns next to loading areas.



Loading bays typical lighting arrangement



Vehicle turning circle typical lighting arrangement

Vehicle turning circle

The figure to the left shows a typical lighting arrangement for turning circle.

In principle:

- Lighting shall use white light sources which shall be dimmable.
- A good uniformity over the turning area shall be achieved by utilising road lighting lanterns mounted on columns.
- The preferred height of the road lighting lanterns shall be 12m above finished ground level to minimise light obtrusion and environmental impact. Equally the lantern chosen shall be of flat glass with 0° uplight and no tilt above horizontal level.

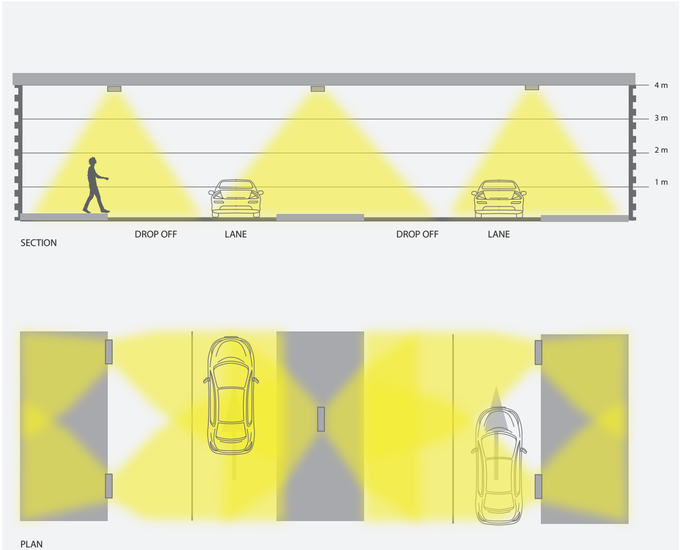
MSCP

Drop-off/Pick-Up (Forecourt)

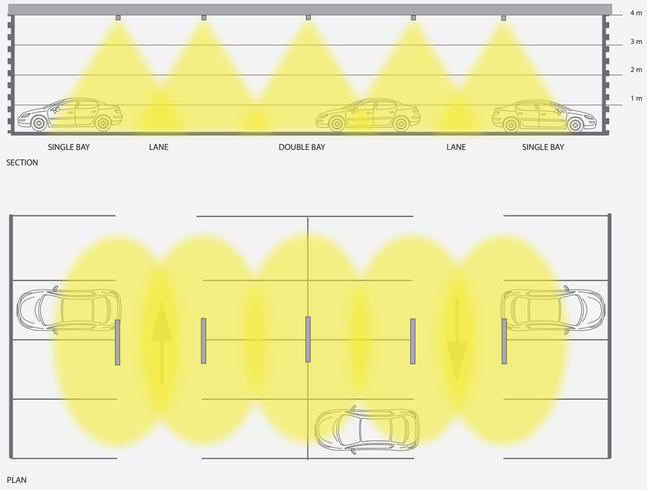
The figure to the right shows a typical lighting arrangement for a drop-off/pick-up area and access.

In principle:

- Drop-off/pick-up area lighting shall use white light sources which shall be dimmable. A good uniformity over the space shall be achieved, with higher illuminances over the drive lane and walkways.
- The lighting shall have reduced output during off peak periods, dimming the lighting uniformly down to an appropriate level.
- Perimeter lighting shall be switched off where daylighting levels permit.
- Luminaires shall be installed to the side of the road and along the travel lanes and drop-off to ease maintenance and minimise vehicle movement disruption.



Drop-off/Pick-up typical lighting arrangement



Interior car park typical lighting arrangement

Car-park (interior)

The figure to the left shows a typical lighting arrangement for an interior car park, parking bays and access.

In principle:

- Car park lighting shall use white light sources which shall be dimmable. A good uniformity over the space shall be achieved, with higher illuminances over the drive lane and walkways.
- The lighting shall have reduced output during off peak periods, dimming the lighting uniformly down to an appropriate level. When a passenger walks onto a floor through any access point the illumination for that floor shall ramp up to full output, reducing again after a reasonable length of time.
- Perimeter lighting shall be switched off where daylighting levels permit.
- Luminaires shall be installed to the side of the drive lanes to ease maintenance and minimise vehicle movement disruption.

AIRCRAFT STANDS

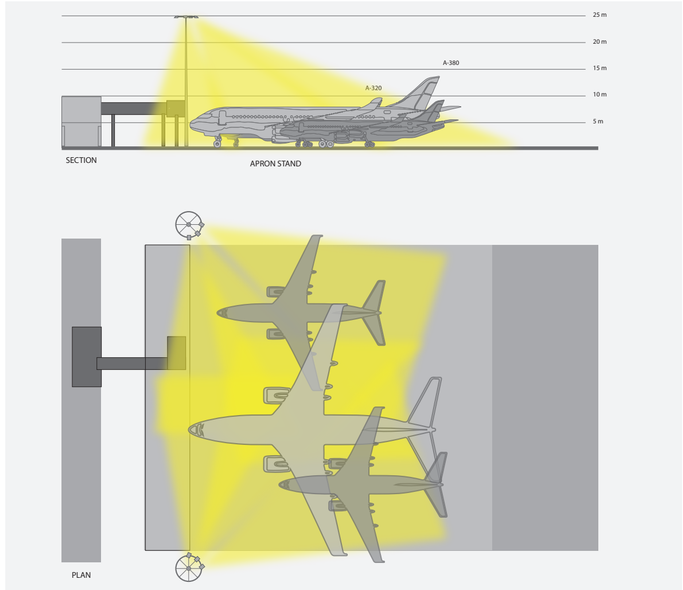
Aircraft stands

The lighting installation for the aircraft stand shall consist of high-mast floodlighting from 25m in height located in specific areas in the airfield apron.

Design constraints of the airfield planning and the services infrastructure will affect both the height and position of the floodlight masts. The masts shall also be sited so that floodlights do not create glare, which could adversely affect visibility of ground staff, pilots or Air Traffic Control (ATC) tower operatives.

The ATC tower must be able to view all aircraft movements both in the air and on the ground at all times. Direct view of apron lighting from the ATC tower shall be avoided. Floodlight masts maybe used to light more than one stand but consideration shall be given to electrical circuitry and lighting control design on a stand by stand basis to allow shut-down without affecting adjacent stands.

The type of stand for Luton Airport is a pier-served stand. The preferred lighting arrangement illustrated at the figure to the right is a typical high-mast floodlighting column configuration.



Aircraft stands lighting arrangement

Precedents of apron stands lighting

The appropriate light source for the aircraft stand lighting should have a long lifetime expectancy and good quality of colour rendering.

Lighting to the back of stand roads service area, and inter-stand roads shall be provided by the high-mast floodlighting columns. Attention shall be taken to positions of shadows (e.g. under air-bridges), where additional lighting shall be provided if required.

TECHNICAL ADDENDUM

LIGHTING CRITERIA

Standards and Guidance

The standards and guidance documents used for the external Lighting Strategy are described in Table 1 to the right.

Document No.	Title
BS 5489-1:2020	Code of practice for the design of road lighting Part 1: Lighting of roads and public amenity areas.
BS EN 12464-2:2014	Light and lighting - Lighting of work places Part 2: Outdoor work places.
BS EN 12464-1:2011	Light and lighting - Lighting of work places Part 1: Indoor work places.
BS EN 13201-1:2014	Road Lighting - Part 1: Guidelines on selection of lighting classes.
BS EN 13201-2:2015	Road Lighting - Part 2: Performance requirements.
BS 8300:2018	Design of buildings and their approaches to meet the needs of disabled people - Code of practice.
ILP GN01 (2021)	Guidance Notes for the Reduction of Obtrusive Light.
ILP GN08/18 (2018)	Bats and artificial lighting in the UK; Bats and the Built Environment series.
ILP PLG 03	Lighting for Subsidiary Roads: Using white light sources to balance energy efficiency and visual amenity.
ILP PLG 02	The Application of Conflict Areas on the Highway.
ILP TR 12	Lighting of Pedestrian Crossing.
ILP TR 24	Guidance on the Development of Public Lighting Policy.
CIBSE SLL LG6 (2016)	Lighting Guide LG6: The exterior environment.
CIBSE SLL LG15 (2017)	Lighting Guide LG15: Transport buildings.
CAP 168 (2019)	Licensing of Aerodromes Edition 11
ICAO Annex 14 (2018)	International Civil Aviation Organisation: Aerodromes Volume I Aerodrome Design and Operation

Table 1: Standards and Guidance documents

Type of area, task or activity	Illuminance E_m (lux)	Uniformity U_o	Glare UGR_L	Colour Rendering R_a	Notes/Specific Requirements
Airport Landside - External Car Parks					
Long stay Car Park (Light Traffic)	5	0,25	55	20	• Illuminance at ground level or deck level for open roof car parks.
Mid stay Car Park (Light Traffic)	5	0,25	55	20	• Illuminance at ground level or deck level for open roof car parks.
Short stay Car Park (Light Traffic)	10	0,25	50	20	• Illuminance at ground level or deck level for open roof car parks.
Staff Parking (Light Traffic)	5	0,25	55	20	• Illuminance at ground level or deck level for open roof car parks.
Airport - Airside					
Aircraft stand Horizontal	20	0.25	-	-	
Aircraft stand Vertical	20	-	-	-	• Illuminance at 2m above the apron in relevant directions.
Other apron areas	10	0.25	-	-	• 50% of average illuminance on aircraft stands.
Airport - Other areas					
Hangar Apron	20	0,10	55	20	
Terminal Apron	20	0,25	50	20	
Loading Areas	20	0,25	50	40	• For reading labels E_m = 50 lux
Fuel Depot	50	0,25	50	40	

Table 2: General lighting requirements - Airport exterior areas

Illuminance Recommendations

The following tables have been compiled from the standards and guidance documents described in Table 1, to present the minimum maintained recommended general lighting requirement for the airport.

Table 2 to the left presents the exterior airside and landside illuminance recommendations for the various external areas of the airport.

Illuminance Recommendations (continued)

Table 2 to the right presents the minimum maintained landside illuminance recommendations for the internal car parks areas.

Type of area, task or activity	Illuminance E_m (lux)	Uniformity U_o	Glare UGR_L	Colour Rendering R_a	Notes/Specific Requirements
Airport Landside - Internal Car Parks					
In/Out Ramps (daytime)	300	0,4	25	40	• Illuminance at floor level. • Safety colours shall be recognisable.
In/Out Ramps (night time)	75	0,4	25	40	• Illuminance at floor level. • Safety colours shall be recognisable.
Traffic Lanes	75	0,4	25	40	• Illuminance at floor level. • Safety colours shall be recognisable.
Parking Areas	75	0,4	-	40	• Illuminance at floor level. • Safety colours shall be recognisable. • A high vertical illuminance increases recognition of people's faces and therefore the feeling of safety.
Ticket Office / Machine	300	0,6	19	80	• Reflections in the window should be avoided. • Glare from the outside shall be prevented.

Table 2: General lighting requirements - Airport exterior areas (continued)

Class	Luminance of the road surface of the carriageway for dry road surface conditions			Disability glare (dry conditions)	Lighting of surroundings (dry conditions)
	L (minimum maintained) cd m^2	U_o (minimum)	U_l [a] (minimum)	f_{TI} [c] (maximum) %	R_{EI} [d] (minimum)
M1	2.00	0.40	0.70	10	0.35
M2	1.5	0.4	0.7	10	0.35
M3	1.0	0.4	0.6	15	0.3
M4	0.75	0.4	0.6	15	0.3
M5	0.50	0.35	0.4	15	0.3
M6	0.30	0.35	0.4	20	0.3

[a] to provide for uniformity, the actual value of the maintained average illuminance shall not exceed 1.5 times the minimum E value indicated for the class.
[c] The values stated in the column f_{TI} are the maximum recommended for the specific lighting class, however, they may be amended where specific national requirements appertain.
[d] This criterion shall be applied only where there are no traffic areas with their own lighting requirements adjacent to the carriageway. The values shown are tentative and may be amended where specific national or individual scheme requirements are specified. Such values may be higher or lower than the values shown, however care should be taken to ensure adequate illumination of the areas is provided.

Table 3: Extract from BS EN 13201-2:2015 (Table 1 - M lighting classes)

Road Lighting Classes

As part of the strategy, lighting classes have been determined.

These classes will predominantly be applied to roadways and pedestrian paths.

Table 3 to the left is an extract from BS EN 13201-2:2015 and describes the minimum maintained lighting requirements for the various road classes.

Road Lighting Classes (continued)

Table 4 to the right presents the P classes.

Hemispherical illuminance

On pedestrian paths, hemispherical illuminance 'HS' classes will be recommend as alternatives to horizontal illuminance 'S' and 'P' classes, in accordance with the British Lighting Standards BS EN 13201-2:2015 (Table 4).

Hemispherical illuminance calculations consider the amount of light falling onto (and modelling) objects in space. They provide an indication of the amount of light falling onto 3-dimensional objects and people and so can provide a clearer understanding of the way in which an object can be seen and understood after dark.

As such, hemispherical illuminance criteria are considered an appropriate option for pedestrian areas, where the illumination and uniformity levels applied to objects in space can be more critical

Class	Horizontal Illuminance		Additional requirements if facial recognition is necessary	
	E^a (minimum maintainted) lux	E_{mn} (maintained) lux	$E_{v,mn}$ (maintained) lux	$E_{x/mn}$ (maintainted) lux
P1	15.0	3.0	5.0	5.0
P2	10.0	2.0	3.0	2.0
P3	7.5	1.5	2.5	1.5
P4	5.0	1.0	1.5	1.0
P5	3.0	0.6	1.0	0.6
P6	2.0	0.4	0.6	0.2
P7	Performance not determined	Performance not determined	-	-

[a] to provide for uniformity, the actual value of the maintained average illuminance shall not exceed 1.5 times the minimum E value indicated for the class

Table 4: Extract from BS EN 13201-2:2015 (Table 3 - P classes)

Class	Hemispherical Illuminance	
	E_{hs} (minimum maintained) lux	U_o (minimum)
HS1	5.0	0.15
HS2	2.5	0.15
HS3	1.0	0.15
HS4	Performance not determined	Performance not determined

Table 5: Extract from BS EN 13201-2:2015 (Table 4 - HS lighting classes)

than those on the ground plane alone. Hemispherical illuminance classes are particularly usefully applied in situations where luminaire mounting heights are very low.

Table 5 to the left is an extract from BS EN 13201-2:2015 and describes the lighting requirements of hemispherical Illuminance for each class.

Obtrusive Light and Environmental Impact

As part of the Lighting Strategy, environmental zones have been selected. Table 6 is an extract from the ILP Guidance and describes the lighting environment for each environmental zone. Luton Airport is assumed fall under E3.

Obtrusive light shall consider road users as part of the exterior lighting installation. Table 7 describes the obtrusive light limitations for road lighting.

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks.
E1	Natural	Dark	National Parks, Areas of Outstanding Natural Beauty etc.
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations.
E3	Suburban	Medium district brightness	Small town centres or suburban locations.
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity.

Table 6: Extract from ILP Guidance Note 01 (Table 1 - Environmental Zones)

Road Classification (1)	Threshold Increment (TI)	Veiling Luminance (Lv)
No road lighting	15% based on adaptation luminance of 0.1cd/m²	0.037
ME6 / ME5	15% based on adaptation luminance of 1cd/m²	0.23
ME4 / ME3	15% based on adaptation luminance of 2cd/m²	0.40
ME2 / ME1	15% based on adaptation luminance of 5cd/m²	0.84

TI = Threshold Increment is a measure of the loss of visibility caused by the disability glare from the obtrusive light installation.
Lv = Veiling Luminance is a measure of the adaptation luminance caused by the disability glare from the obtrusive light installation.
(1) = Road Classifications as given in BS EN 13201-2:2003 Road lighting Performances requirements. Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in path of travel. For a more detailed description and methods for determining, calculating and measuring the above parameters see CIE Publication 150:2003.

Table 7: Extract from ILP Guidance Note 01 (Table 3 - Obtrusive Light Limitations for Exterior Light) Installations - Road Users

Lighting Calculations

The section below presents the lighting calculations of the landside scheme used for this assessment.

Luton Airport Expansion

Loading Bays

Date: 27.09.2021
Operator: Justin Boyd

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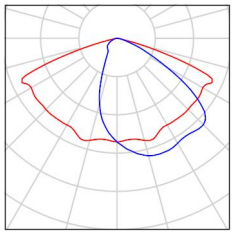
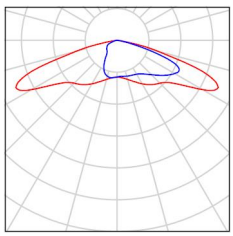
Luton Airport Expansion / Luminaire parts list

11 Pieces	WE-EF;Eulumdat2 108-0907 VFL540 [S60] IP66:LED-36/72W/4K;VFL540, Street and Area Lighting Article No.: 108-0907 Luminous flux (Luminaire): 7973 lm Luminous flux (Lamps): 8854 lm Luminaire Wattage: 81.0 W Luminaire classification according to CIE: 100 CIE flux code: 40 74 97 100 90 Fitting: 36 x LED-36/72W/840 - 4000K (Correction Factor 1.000).	See our luminaire catalog for an image of the luminaire.	
97 Pieces	WE-EF;Eulumdat2 147-0682 FLA740 [R65] IP66:LED-24/72W/4K;FLA740 LED, Area Floodlights Article No.: 147-0682 Luminous flux (Luminaire): 7884 lm Luminous flux (Lamps): 10800 lm Luminaire Wattage: 81.0 W Luminaire classification according to CIE: 100 CIE flux code: 28 61 95 100 73 Fitting: 24 x LED-24/72W/840 - 4000K (Correction Factor 1.000).	See our luminaire catalog for an image of the luminaire.	

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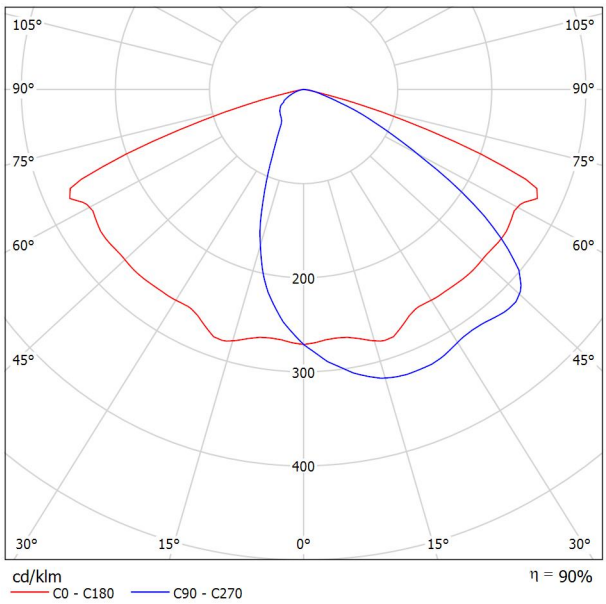
WE-EF;Eulumdat2 108-0907 VFL540 [S60] IP66:LED-36/72W/4K;VFL540, Street and Area Lighting / Luminaire Data Sheet

See our luminaire catalog for an image of the luminaire.

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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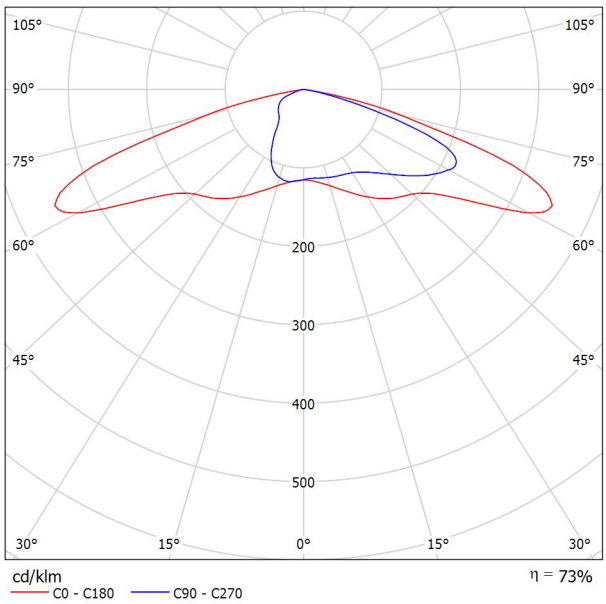
WE-EF;Eulumdat2 147-0682 FLA740 [R65] IP66:LED-24/72W/4K;FLA740 LED, Area Floodlights / Luminaire Data Sheet

See our luminaire catalog for an image of the luminaire.

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 28 61 95 100 73

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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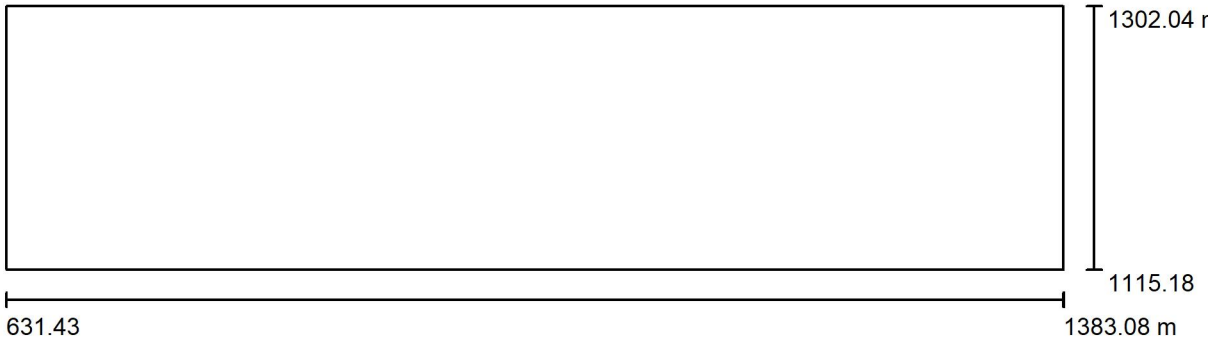
Loading Bay / PV Store / Planning data



Light loss factor: 0.80, ULR (Upward Light Ratio): 0.0% Scale 1:5374

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	11	WE-EF;Eulumdat2 108-0907 VFL540 [S60] IP66:LED-36/72W/4K;VFL540, Street and Area Lighting (1.000)	7973	8854	81.0
2	48	WE-EF;Eulumdat2 147-0682 FLA740 [R65] IP66:LED-24/72W/4K;FLA740 LED, Area Floodlights (1.000)	7884	10800	81.0
		Total:	466142	Total: 615794	4779.0

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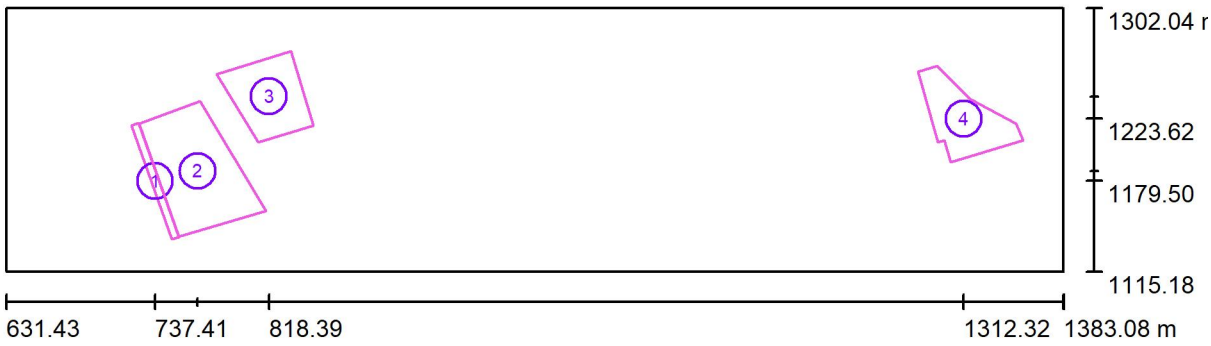
Loading Bay / PV Store / Calculation surfaces (results overview)



Scale 1 : 5374

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Loading Bay 50lux Target	perpendicular	128 x 16	47	16	65	0.346	0.252
2	Loading Bay 20lux Target	perpendicular	128 x 128	21	8.49	53	0.405	0.159
3	Emergency Muster	perpendicular	128 x 128	19	7.76	33	0.400	0.235
4	Loading Bay (PV) 20lux	perpendicular	128 x 128	20	5.09	47	0.249	0.109

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	4	22	5.09	65	0.24	0.08

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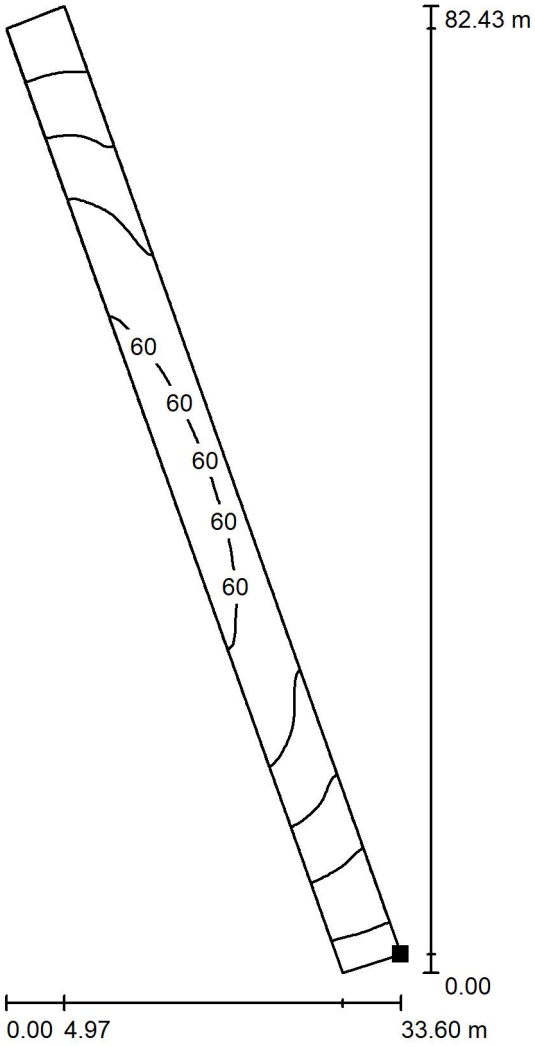
Loading Bay / PV Store / Loading Bay 50lux Target / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 645

Position of surface in external scene:
Marked point:
(754.270 m, 1139.771 m, 0.750 m)

Grid: 128 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
47	16	65	0.346	0.252

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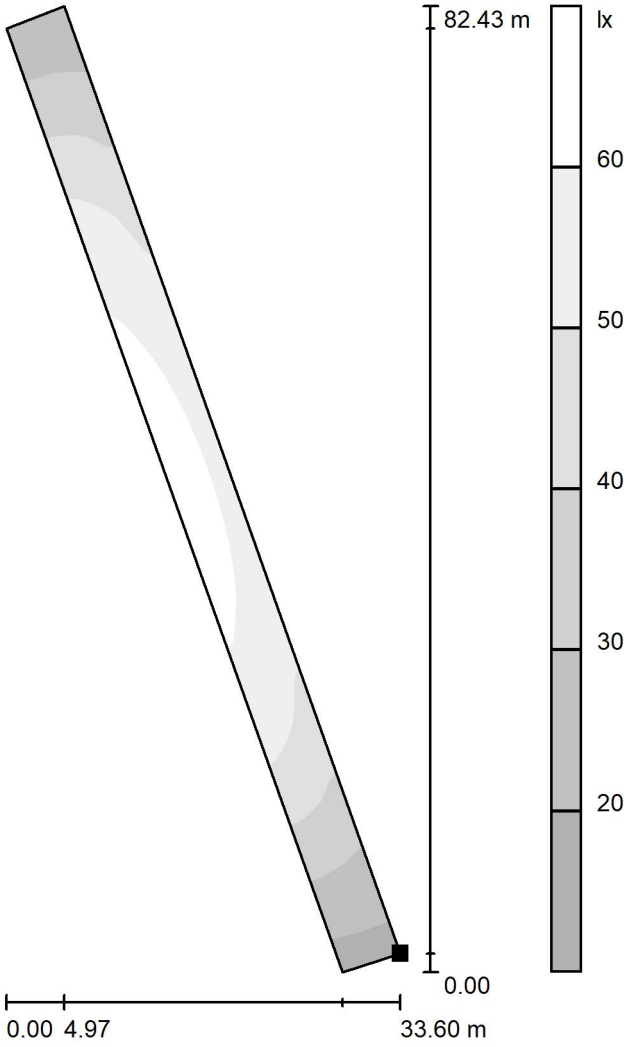
Loading Bay / PV Store / Loading Bay 50lux Target / Greyscale (E, Perpendicular)



Scale 1 : 645

Position of surface in external scene:
Marked point:
(754.270 m, 1139.771 m, 0.750 m)

Grid: 128 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
47	16	65	0.346	0.252

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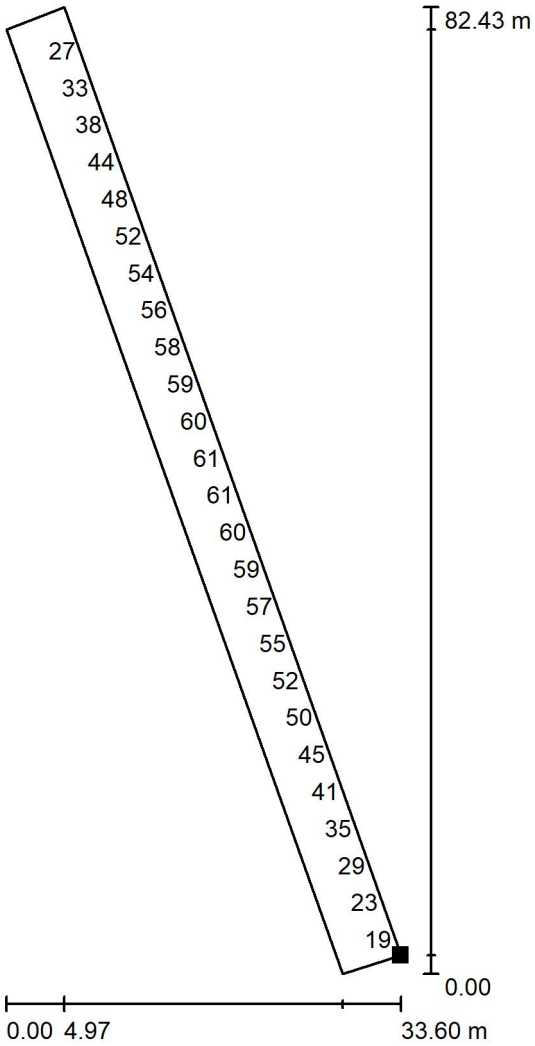
Loading Bay / PV Store / Loading Bay 50lux Target / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 645

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(754.270 m, 1139.771 m, 0.750 m)

Grid: 128 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
47	16	65	0.346	0.252

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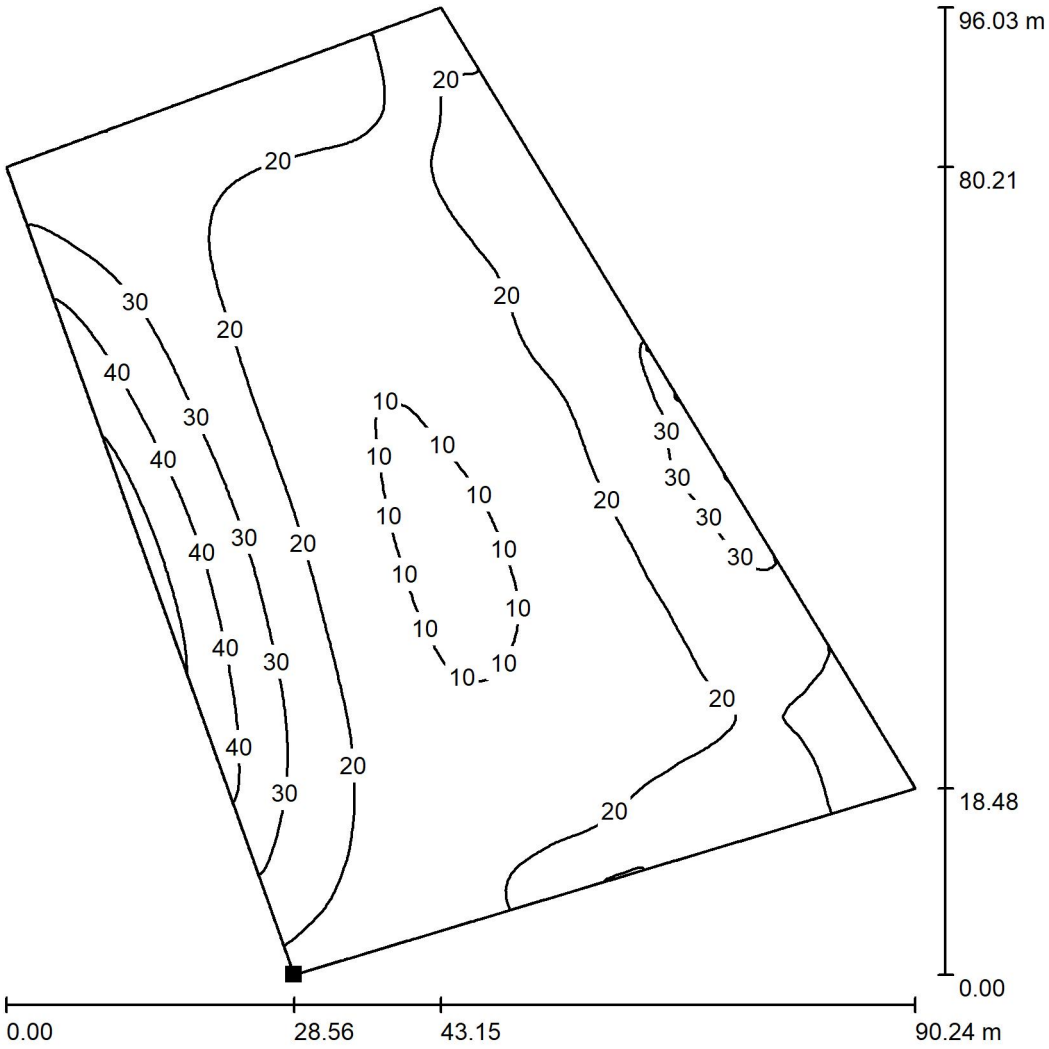
Loading Bay / PV Store / Loading Bay 20lux Target / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 751

Position of surface in external scene:
Marked point:
(754.408 m, 1139.935 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	8.49	53	0.405	0.159

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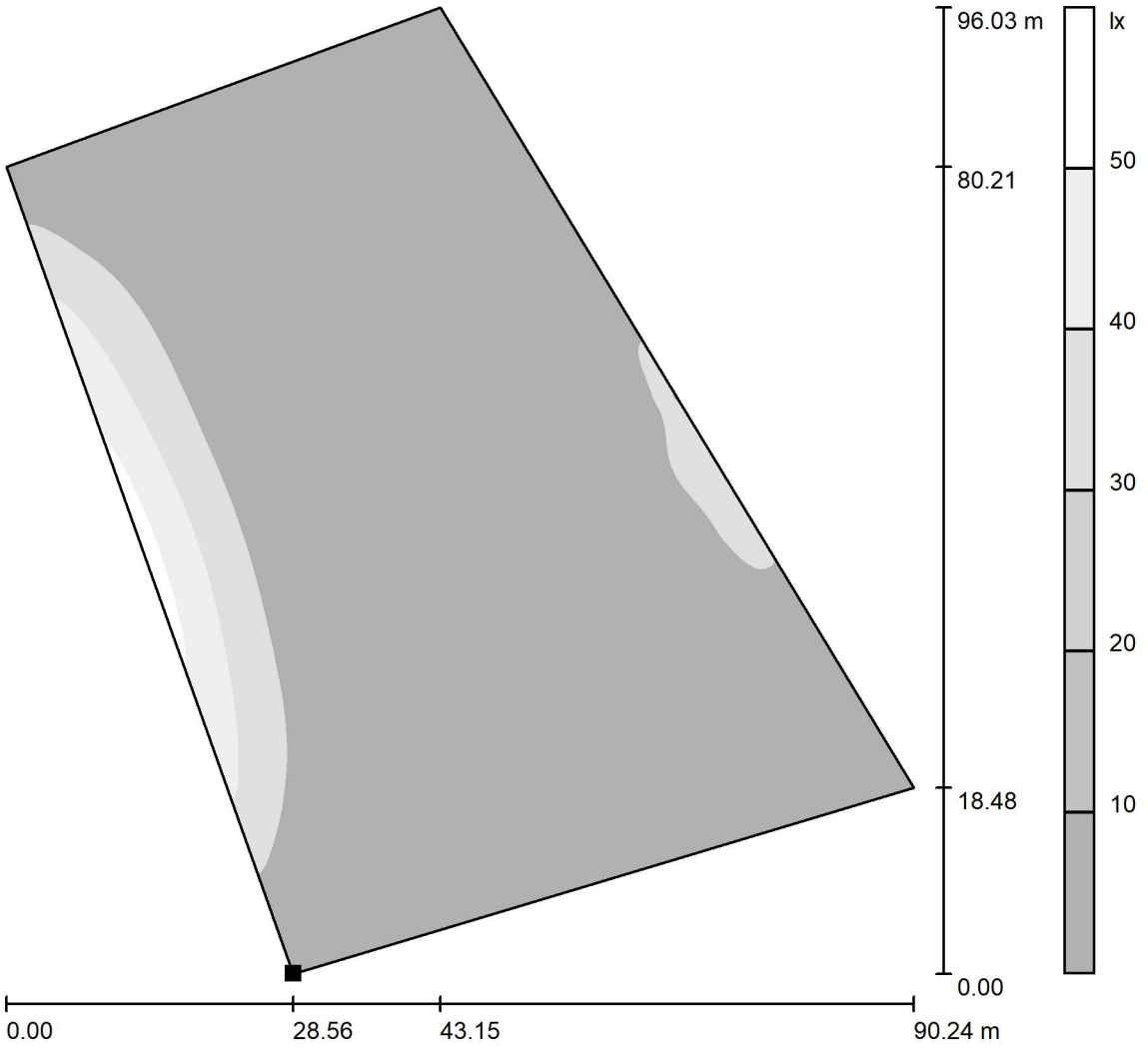
Loading Bay / PV Store / Loading Bay 20lux Target / Greyscale (E, Perpendicular)



Scale 1 : 751

Position of surface in external scene:
Marked point:
(754.408 m, 1139.935 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	8.49	53	0.405	0.159

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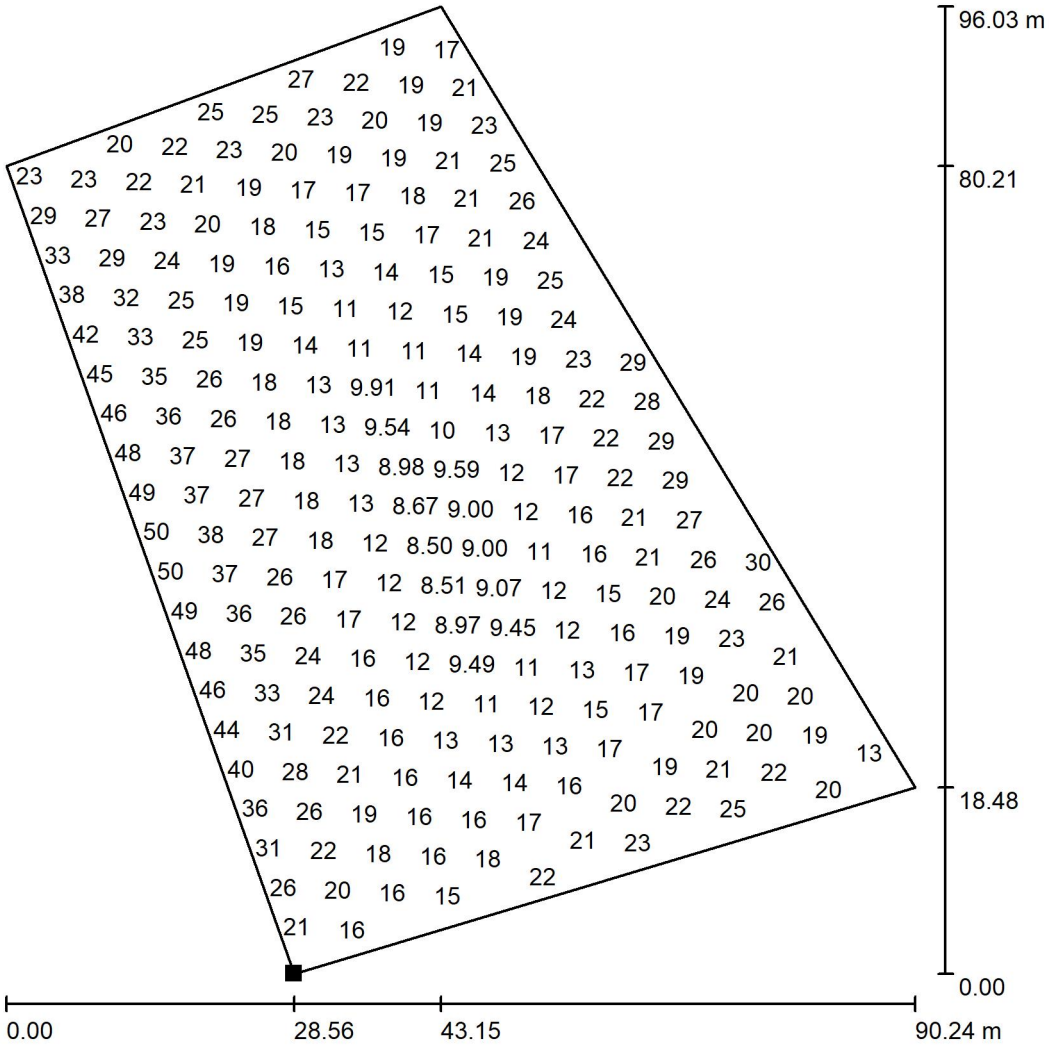
Loading Bay / PV Store / Loading Bay 20lux Target / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 751

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(754.408 m, 1139.935 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	8.49	53	0.405	0.159

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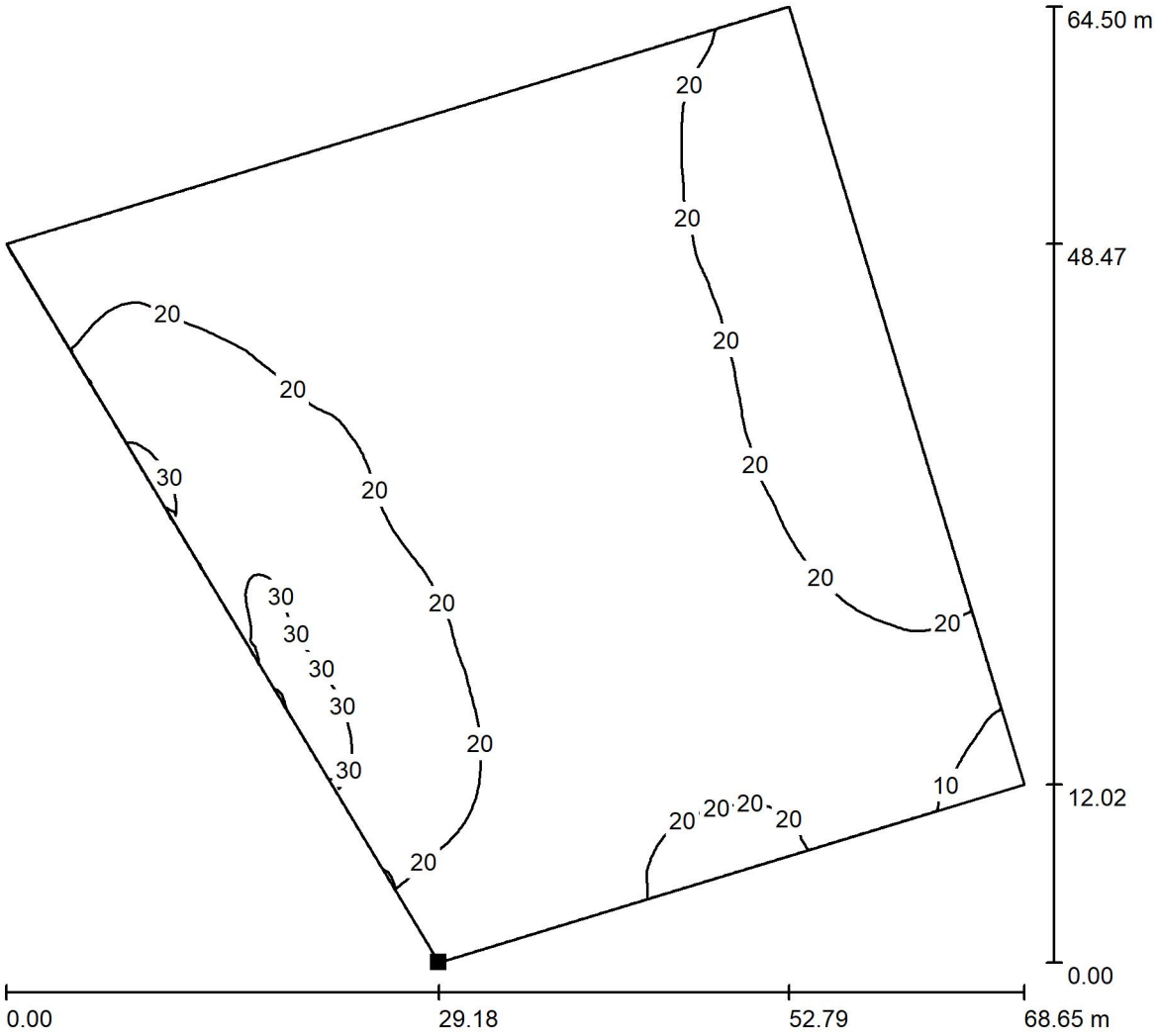
Loading Bay / PV Store / Emergency Muster / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 505

Position of surface in external scene:
Marked point:
(810.454 m, 1206.981 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
19	7.76	33	0.400	0.235

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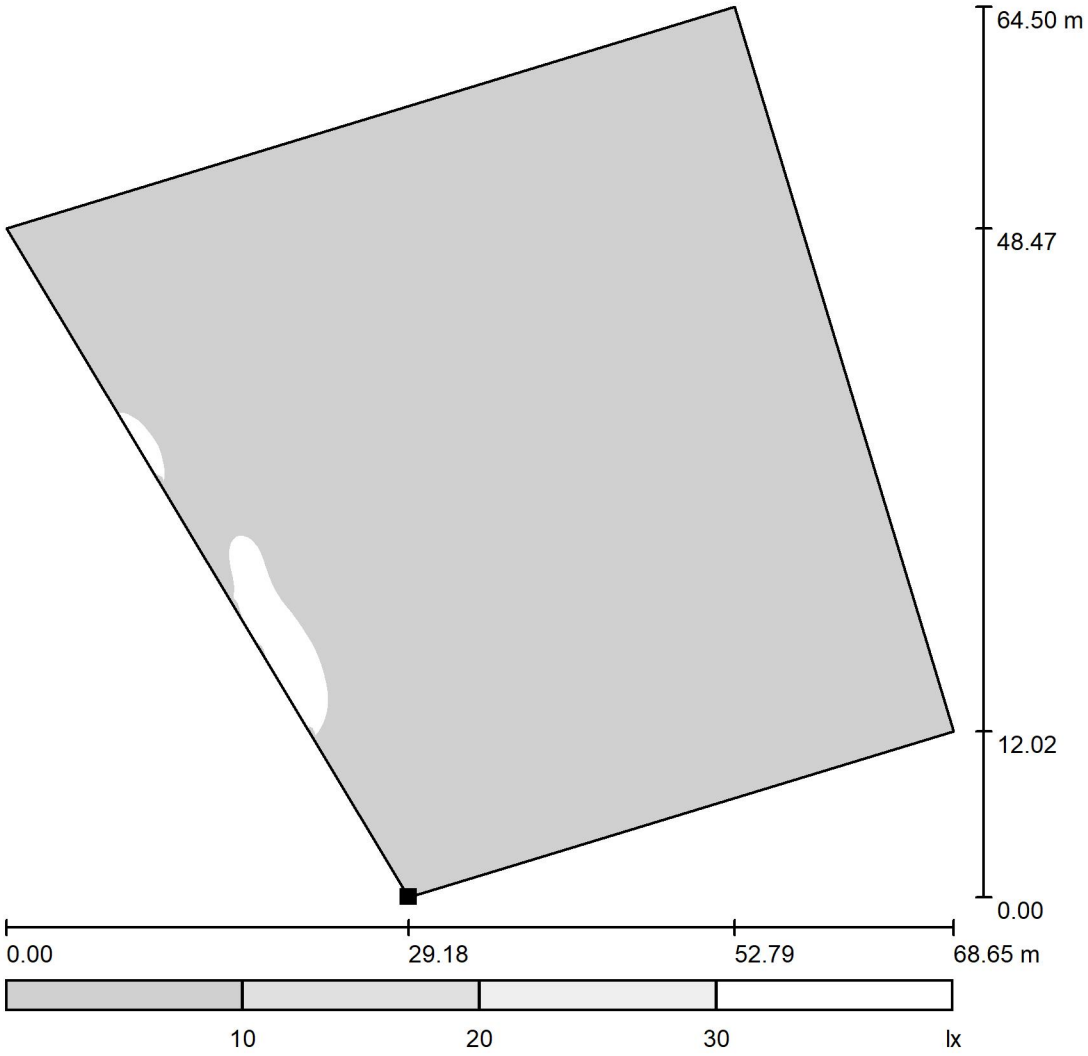
Loading Bay / PV Store / Emergency Muster / Greyscale (E, Perpendicular)



Scale 1 : 548

Position of surface in external scene:
Marked point:
(810.454 m, 1206.981 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
19	7.76	33	0.400	0.235

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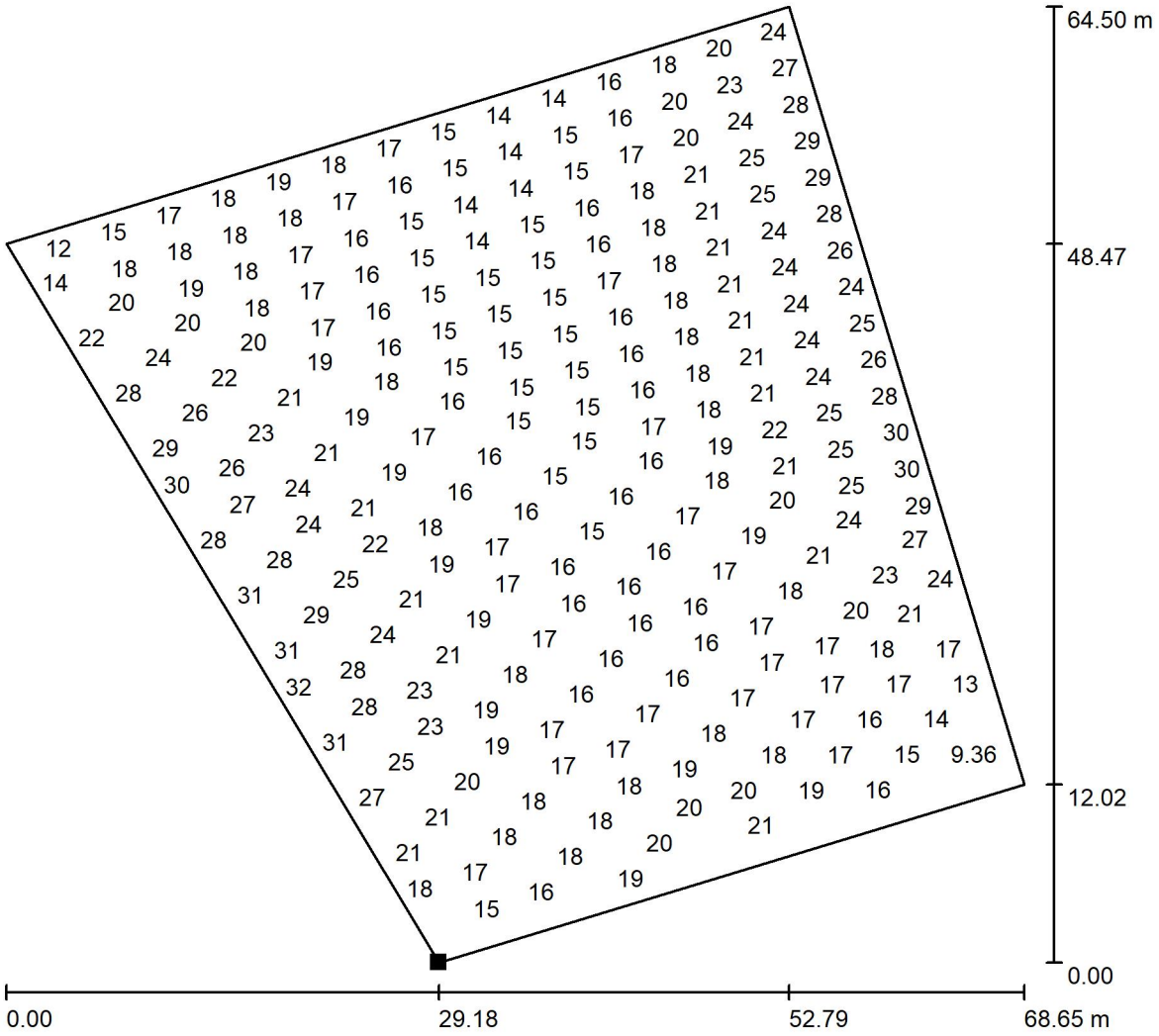
Loading Bay / PV Store / Emergency Muster / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 505

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(810.454 m, 1206.981 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
19	7.76	33	0.400	0.235

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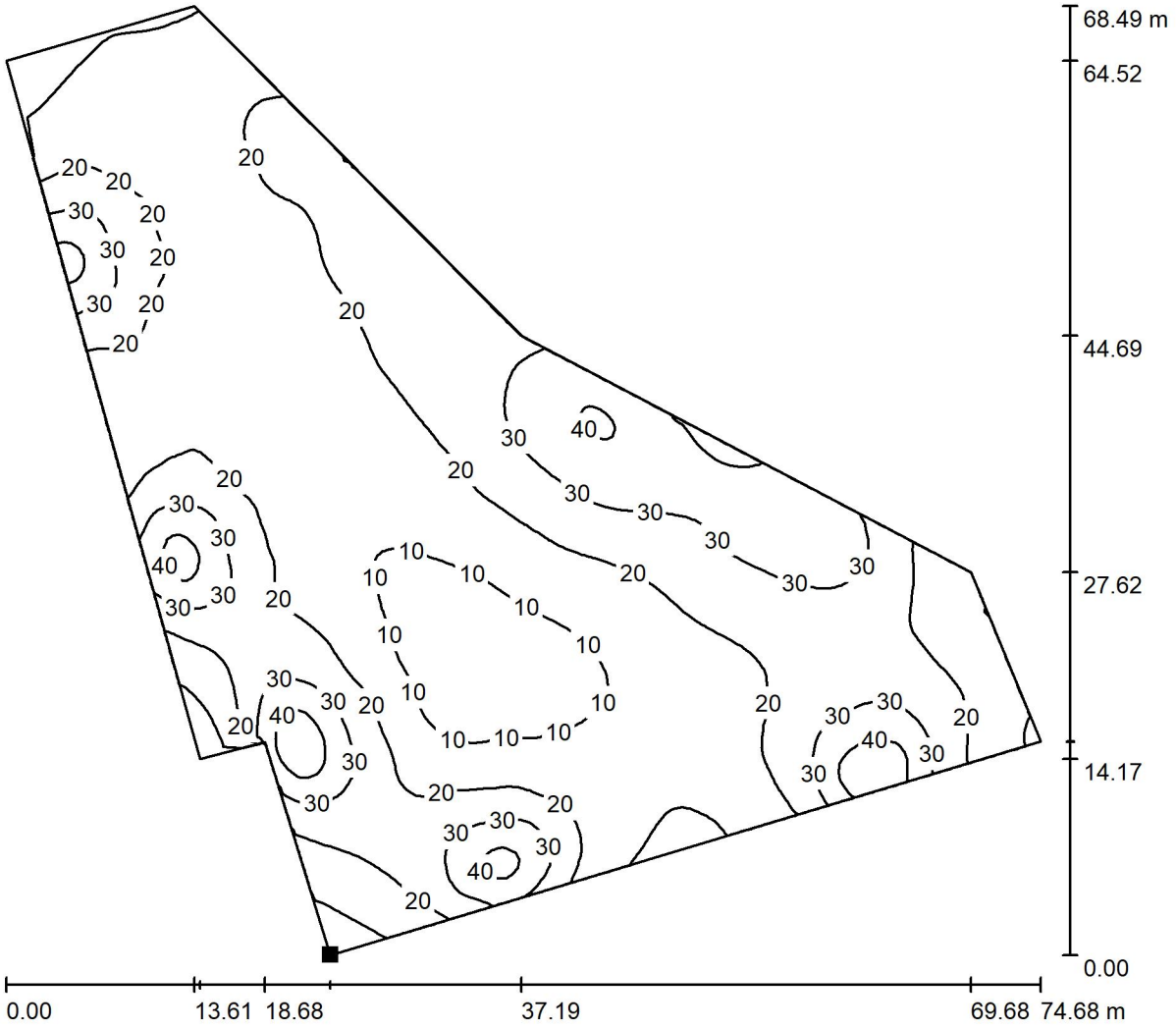
Loading Bay / PV Store / Loading Bay (PV) 20lux / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 536

Position of surface in external scene:
Marked point:
(1303.212 m, 1192.784 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
20	5.09	47	0.249	0.109

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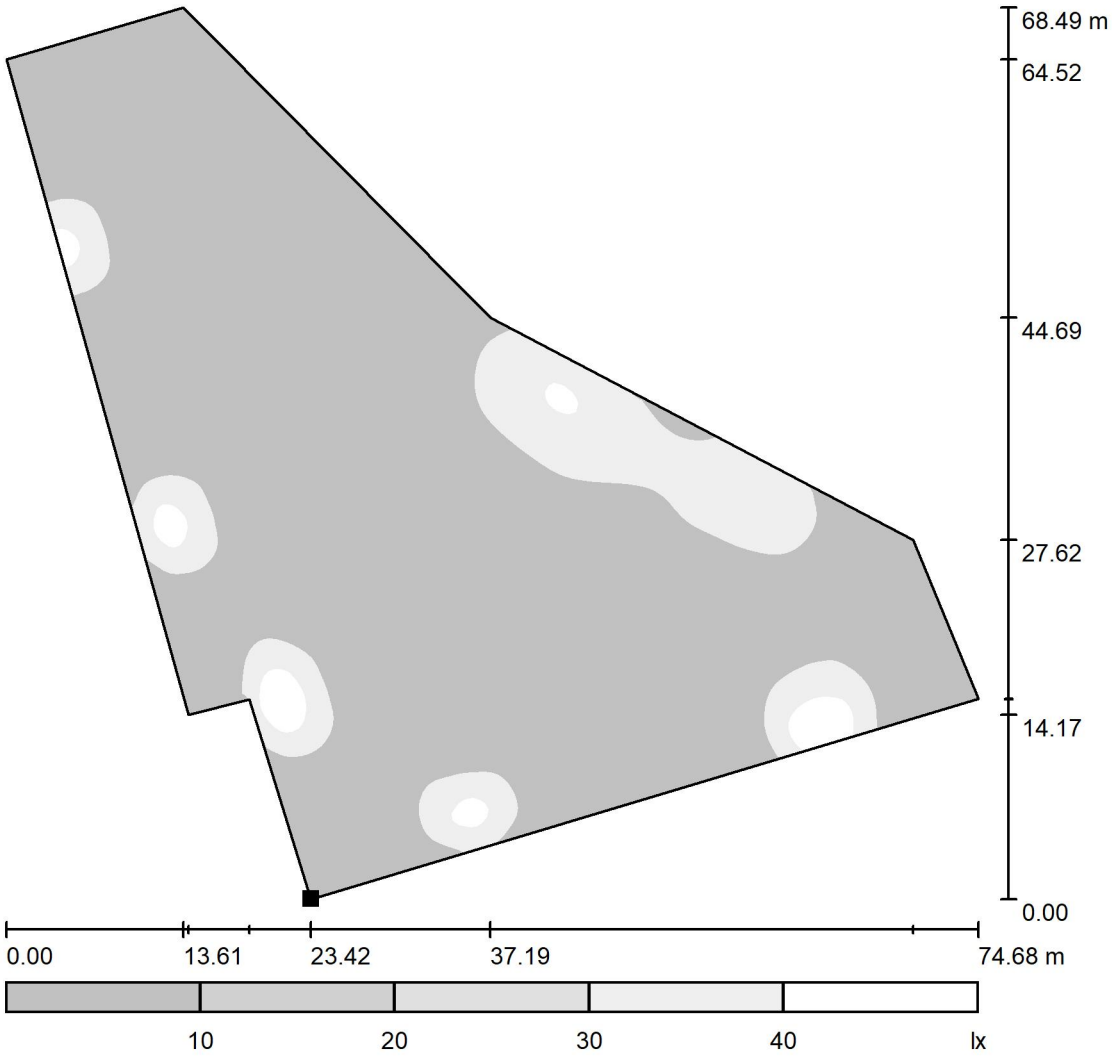
Loading Bay / PV Store / Loading Bay (PV) 20lux / Greyscale (E, Perpendicular)



Scale 1 : 581

Position of surface in external scene:
Marked point:
(1303.212 m, 1192.784 m, 0.750 m)

Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
20	5.09	47	0.249	0.109

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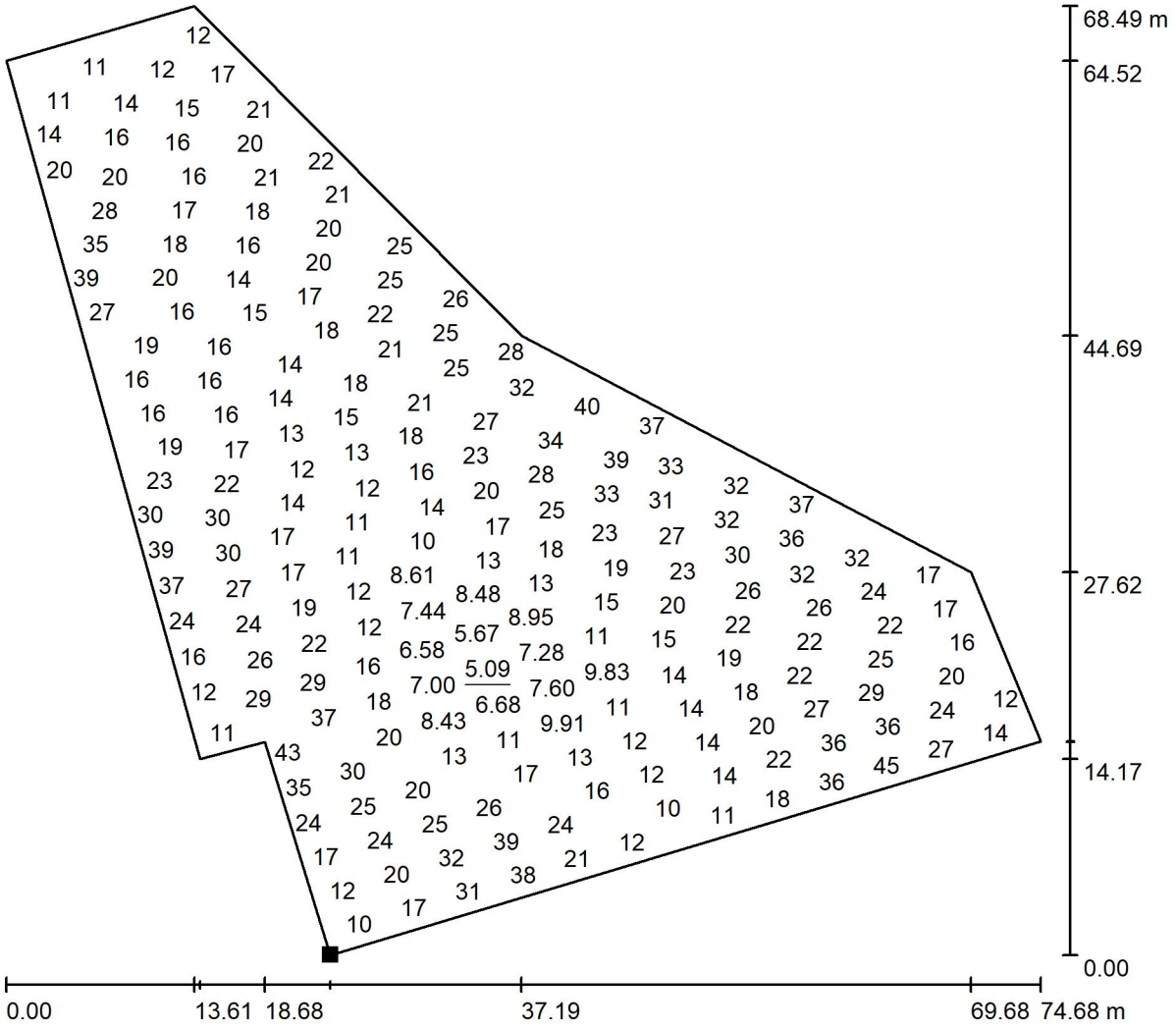
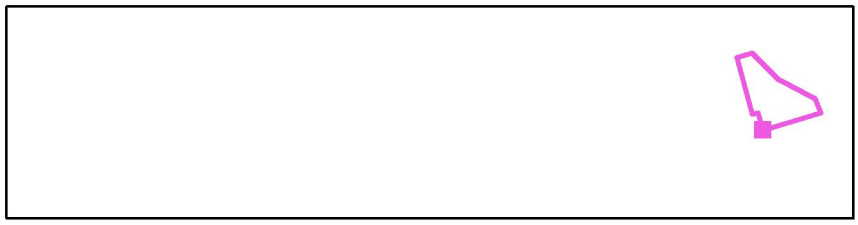
Loading Bay / PV Store / Loading Bay (PV) 20lux / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 536

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(1303.212 m, 1192.784 m, 0.750 m)



Grid: 128 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
20	5.09	47	0.249	0.109

Luton Airport Expansion

Long Stay Car Park 2779 Spaces

Date: 28.06.2019
Operator: Katerina Konsta

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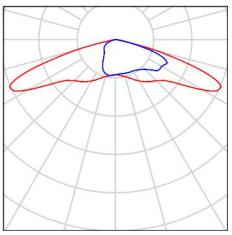
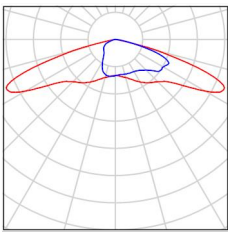
Luton Airport Expansion / Luminaire parts list

30 Pieces WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K
Article No.: 108-1493
Luminous flux (Luminaire): 1450 lm
Luminous flux (Lamps): 1614 lm
Luminaire Wattage: 14.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90
Fitting: 12 x LED-12/12W/840 - 4000K
(Correction Factor 1.000).



19 Pieces WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K
Article No.: 108-1495
Luminous flux (Luminaire): 2555 lm
Luminous flux (Lamps): 2951 lm
Luminaire Wattage: 28.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87
Fitting: 12 x LED-12/24W/840 - 4000K
(Correction Factor 1.000).



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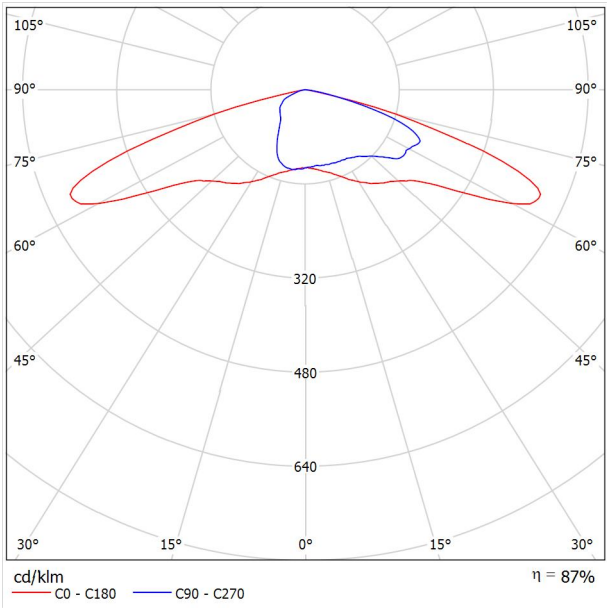
WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

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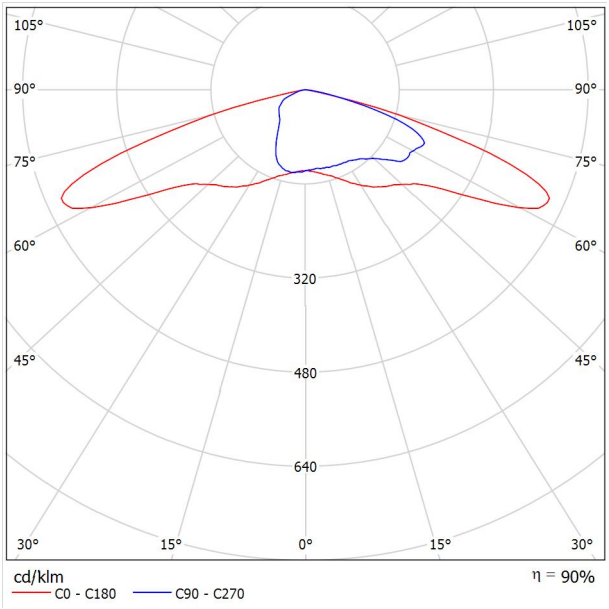
WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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Long Stay Car Park 2779 Spaces / Planning data

Maintenance factor: 0.57, ULR (Upward Light Ratio): 0.0%

Scale 1:3454

Long Stay Car Park
Average Illuminance Level:
5 lux
Uniformity: 0.25

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	30	WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K (1.000)	1450	1614	14.0
2	19	WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K (1.000)	2555	2951	28.0
			Total: 92042	Total: 104489	952.0

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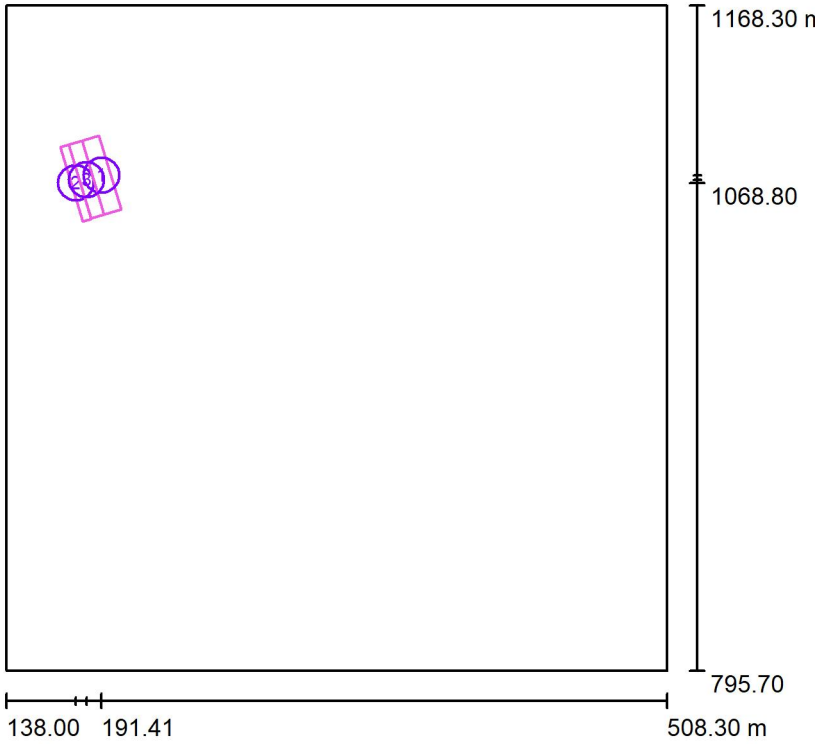
Long Stay Car Park 2779 Spaces / Calculation surfaces (results overview)



Scale 1 : 4240

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Typical Calculation - Parking Double Row	perpendicular	32 x 128	7.33	3.68	10	0.502	0.353
2	Typical Calculation - Parking Single Row	perpendicular	32 x 128	7.29	4.58	9.17	0.628	0.499
3	Typical Calculation - Parking Access Road	perpendicular	32 x 128	5.55	4.49	6.94	0.809	0.648

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	3	6.72	3.68	10	0.55	0.35

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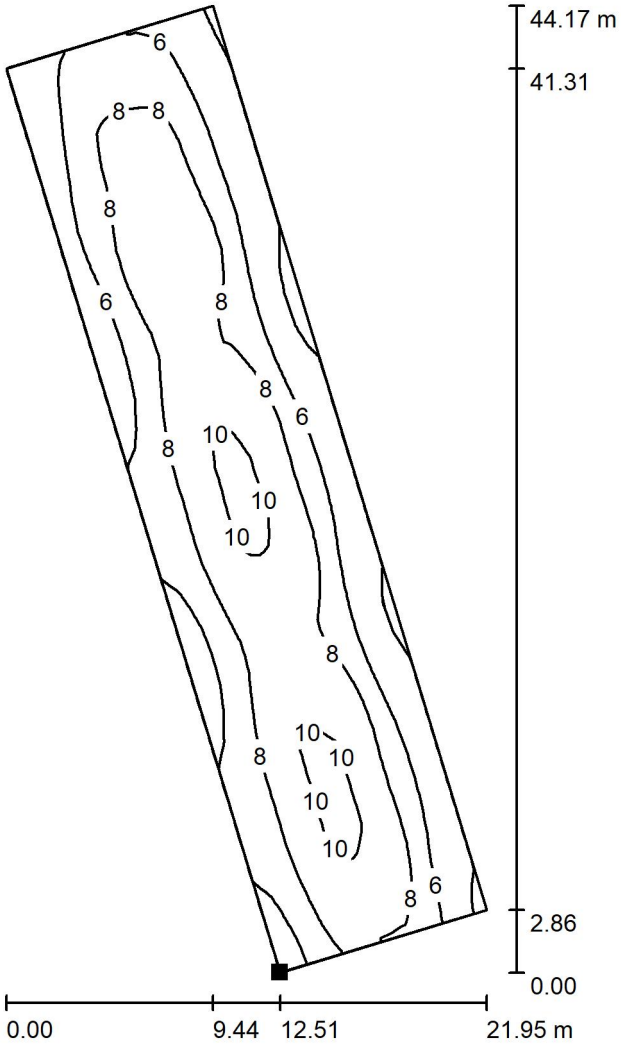
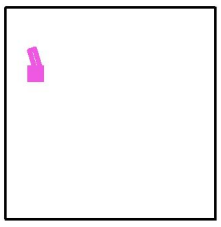
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Double Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 346

Position of surface in external scene:
Marked point:
(192.949 m, 1051.080 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.33	3.68	10	0.502	0.353

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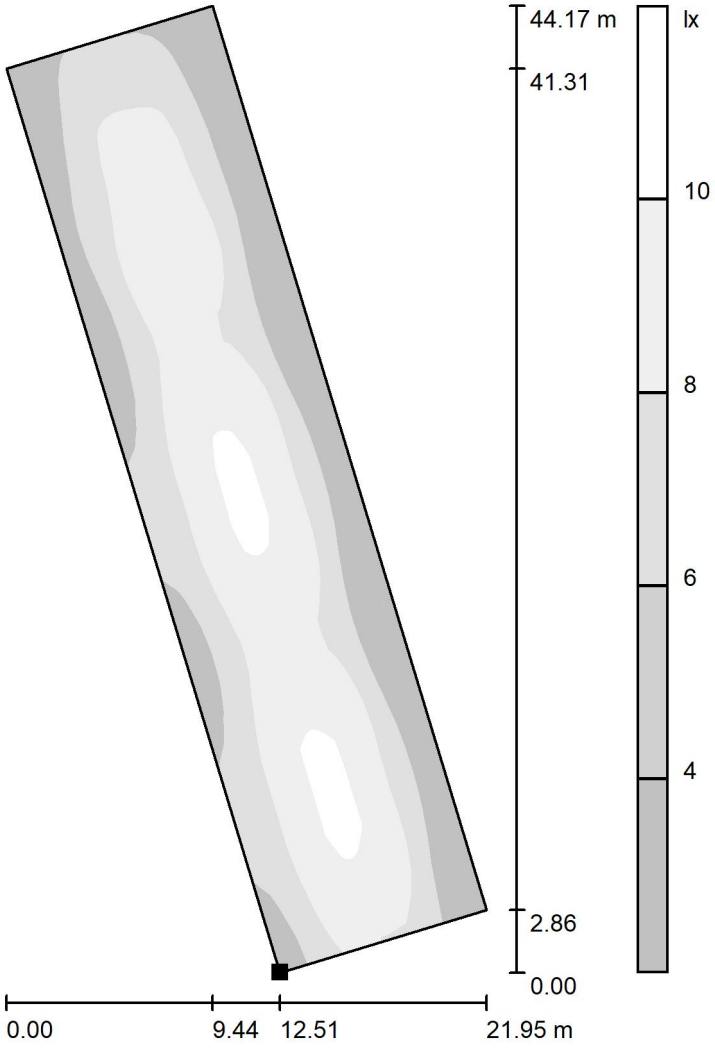
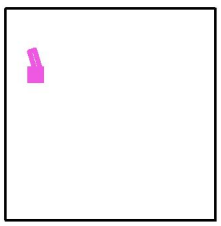
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Double Row / Greyscale (E, Perpendicular)



Scale 1 : 346

Position of surface in external scene:
Marked point:
(192.949 m, 1051.080 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.33	3.68	10	0.502	0.353

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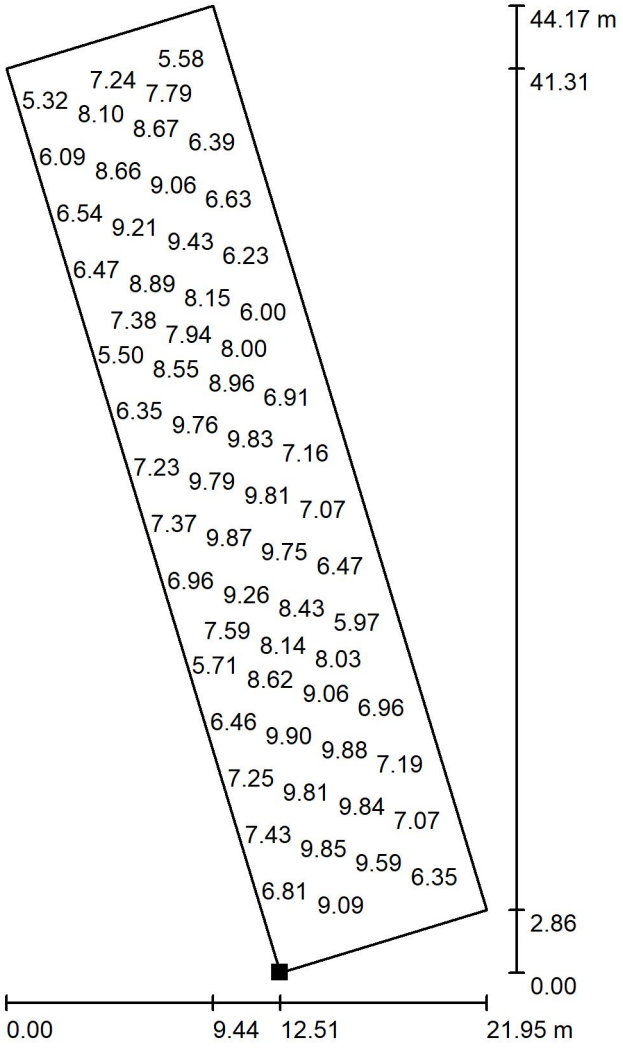
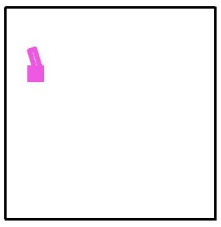
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Double Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 346

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(192.949 m, 1051.080 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.33	3.68	10	0.502	0.353

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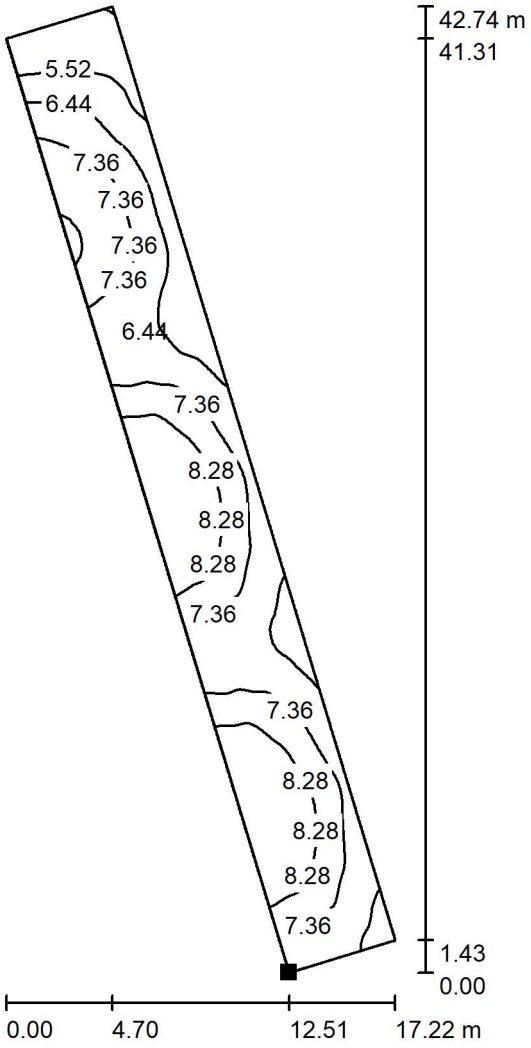
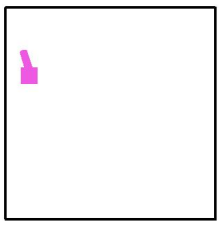
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Single Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 335

Position of surface in external scene:
Marked point:
(180.964 m, 1047.431 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.29	4.58	9.17	0.628	0.499

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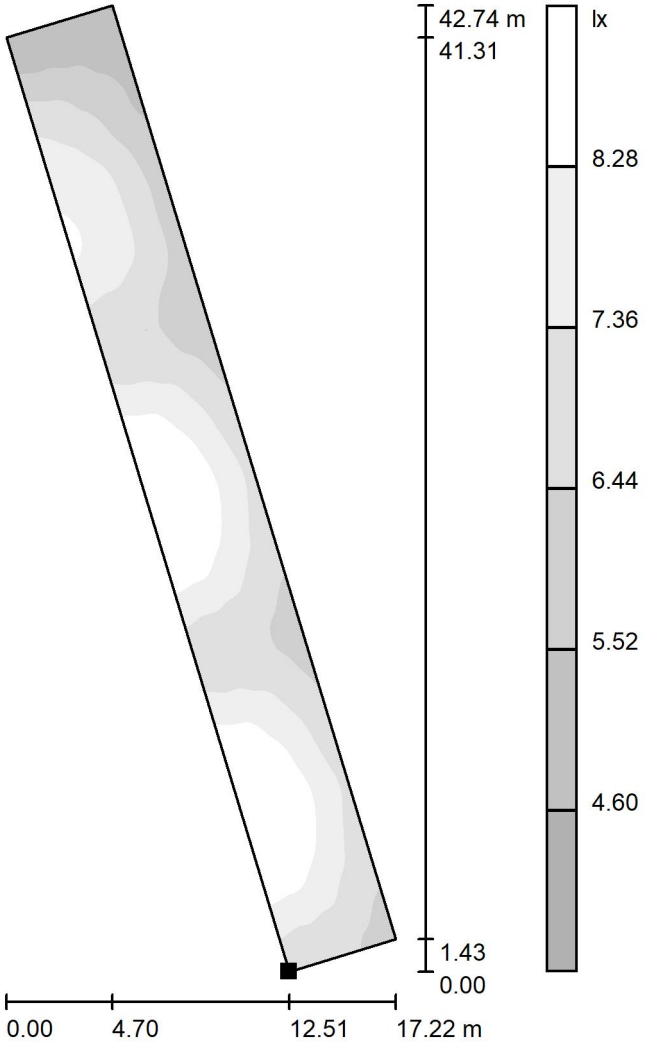
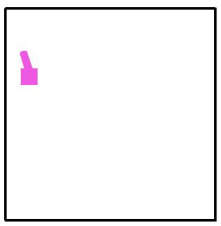
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Single Row / Greyscale (E, Perpendicular)



Scale 1 : 335

Position of surface in external scene:
Marked point:
(180.964 m, 1047.431 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.29	4.58	9.17	0.628	0.499

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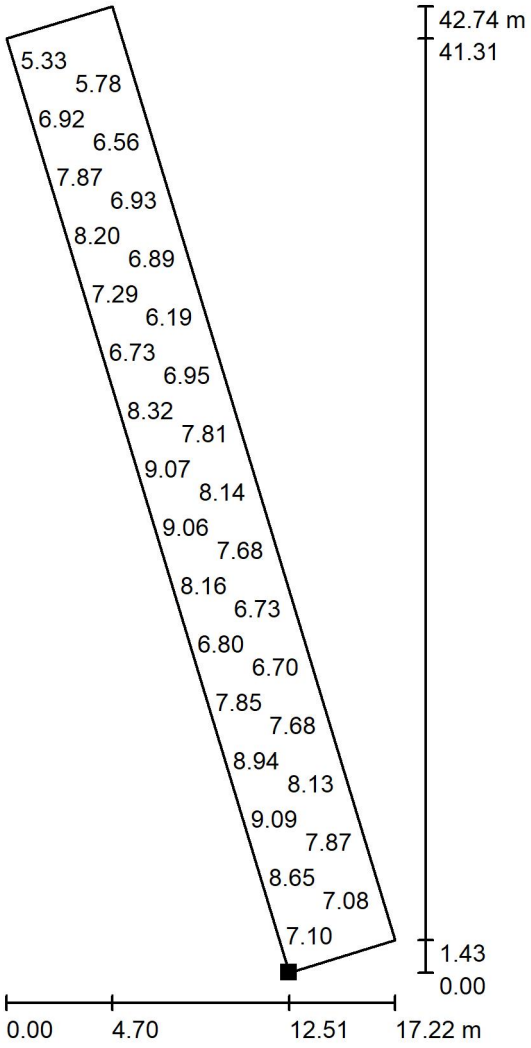
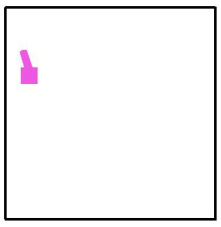
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Single Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 335

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(180.964 m, 1047.431 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
7.29	4.58	9.17	0.628	0.499

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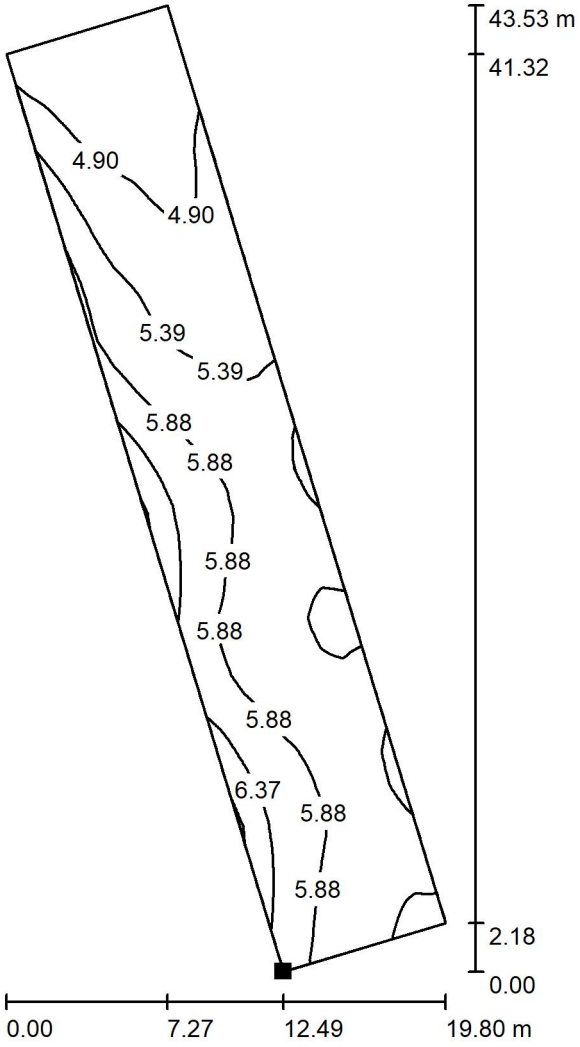
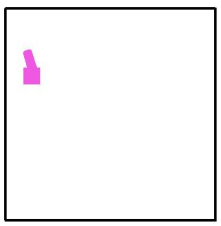
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Access Road / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 341

Position of surface in external scene:
Marked point:
(185.653 m, 1048.864 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.55	4.49	6.94	0.809	0.648

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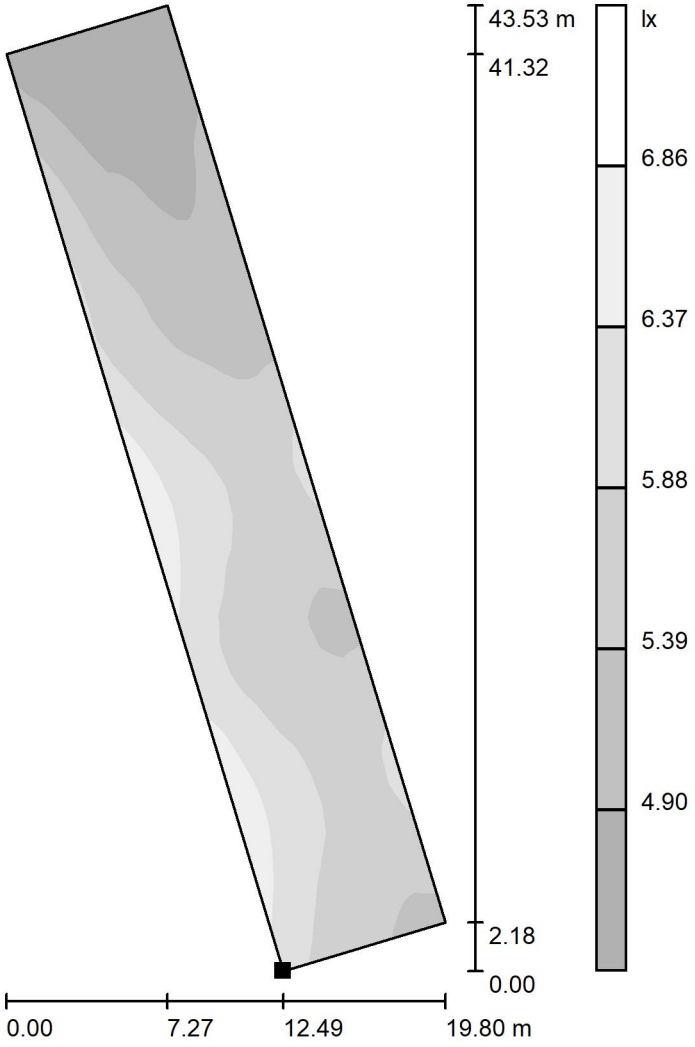
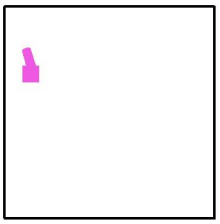
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Access Road / Greyscale (E, Perpendicular)



Scale 1 : 341

Position of surface in external scene:
Marked point:
(185.653 m, 1048.864 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.55	4.49	6.94	0.809	0.648

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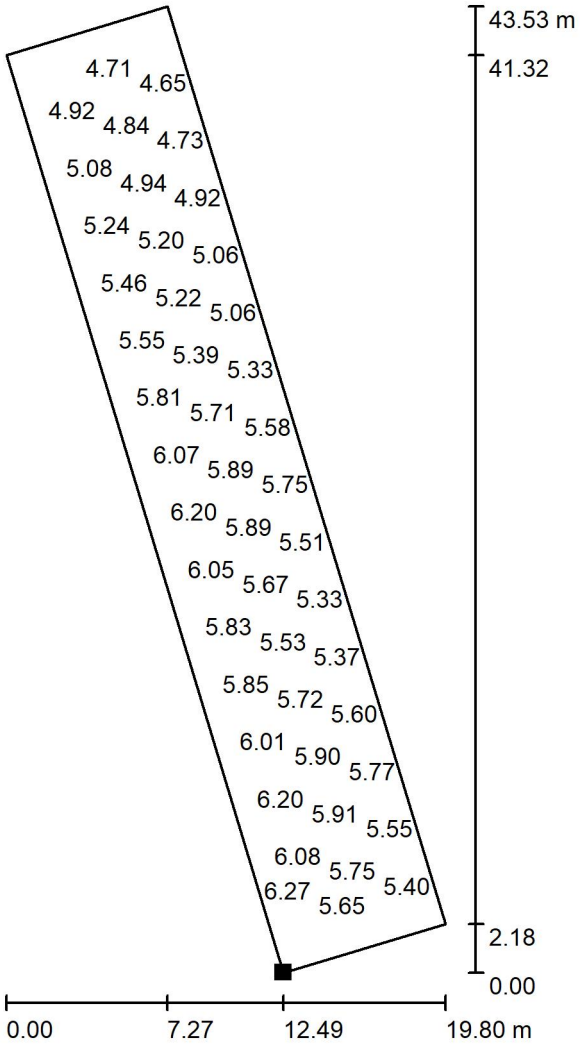
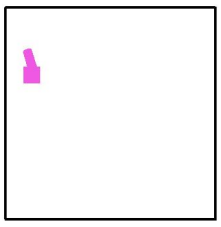
Long Stay Car Park 2779 Spaces / Typical Calculation - Parking Access Road / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 341

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(185.653 m, 1048.864 m, 0.000 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.55	4.49	6.94	0.809	0.648

Luton Airport Expansion

Long Stay Single Level Deck Car Park 964 Spaces - Deck Level

Date: 28.06.2019
Operator: Katerina Konsta

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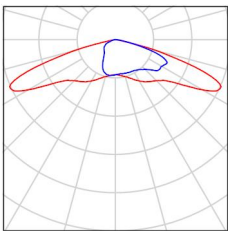
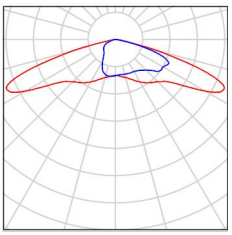
Luton Airport Expansion / Luminaire parts list

36 Pieces WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K
Article No.: 108-1493
Luminous flux (Luminaire): 1450 lm
Luminous flux (Lamps): 1614 lm
Luminaire Wattage: 14.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90
Fitting: 12 x LED-12/12W/840 - 4000K
(Correction Factor 1.000).



8 Pieces WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K
Article No.: 108-1495
Luminous flux (Luminaire): 2555 lm
Luminous flux (Lamps): 2951 lm
Luminaire Wattage: 28.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87
Fitting: 12 x LED-12/24W/840 - 4000K
(Correction Factor 1.000).



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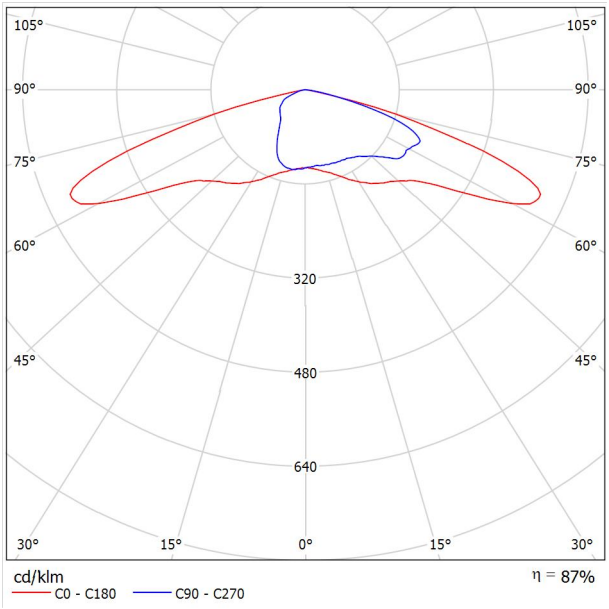
WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

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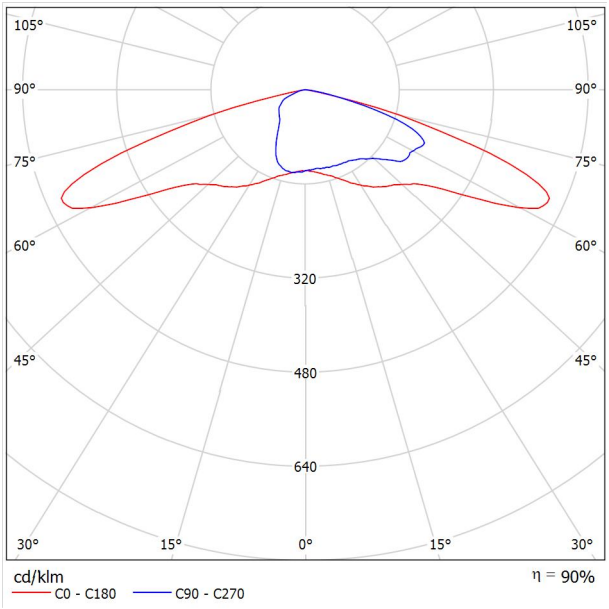
WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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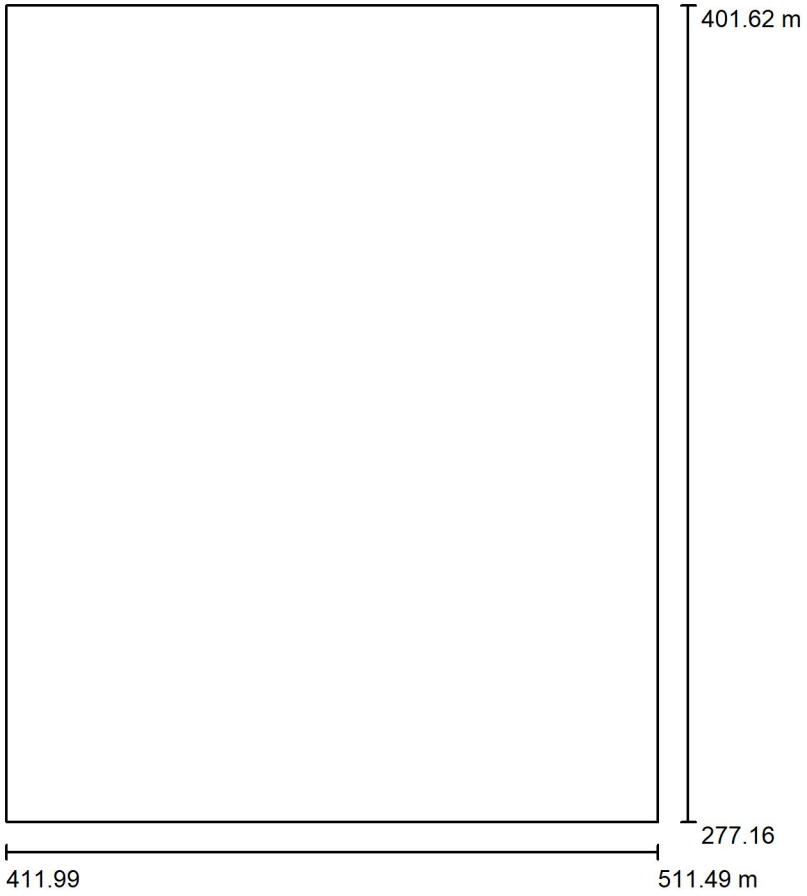
Long Stay Single Level Deck Car Park 964 Spaces / Planning data



Maintenance factor: 0.57, ULR (Upward Light Ratio): 0.0%

Scale 1:1154

Long Stay Car Park - Deck Level
Average Illuminance Level:
5lux
Uniformity:0.25

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	36	WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K (1.000)	1450	1614	14.0
2	8	WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K (1.000)	2555	2951	28.0
			Total: 72633	Total: 81712	728.0

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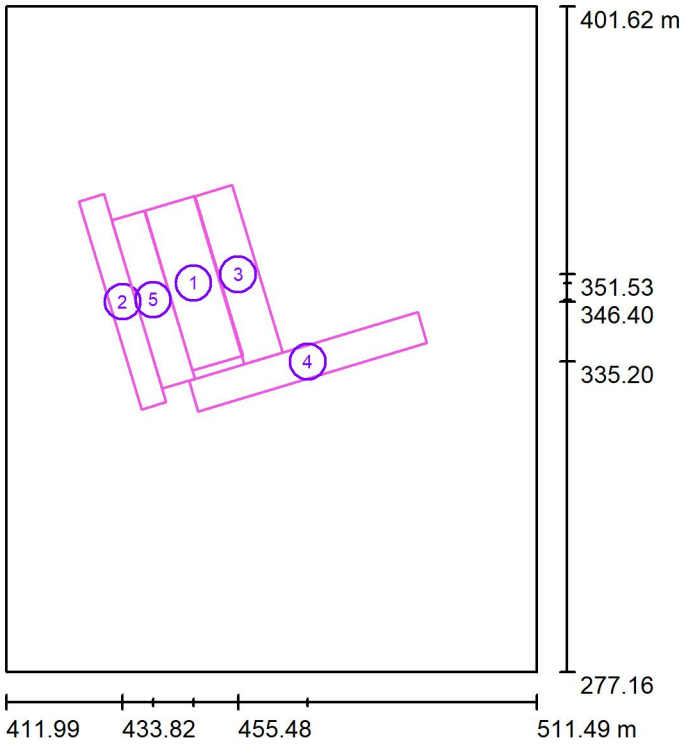
Long Stay Single Level Deck Car Park 964 Spaces / Calculation surfaces (results overview)



Scale 1 : 1417

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Typical Calculation - Parking Double Row	perpendicular	128 x 64	9.94	4.83	20	0.486	0.247
2	Typical Calculation - Parking Single Row	perpendicular	128 x 32	8.77	5.20	15	0.593	0.346
3	Typical Calculation - Traffic Lane Area 01	perpendicular	128 x 32	5.02	3.92	8.74	0.780	0.448
4	Typical Calculation - Traffic Lane Area 02	perpendicular	128 x 32	6.62	3.37	12	0.510	0.273
5	Typical Calculation - Traffic Lane Area 03	perpendicular	128 x 32	5.49	4.42	7.06	0.805	0.626

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	5	7.28	3.37	20	0.46	0.17

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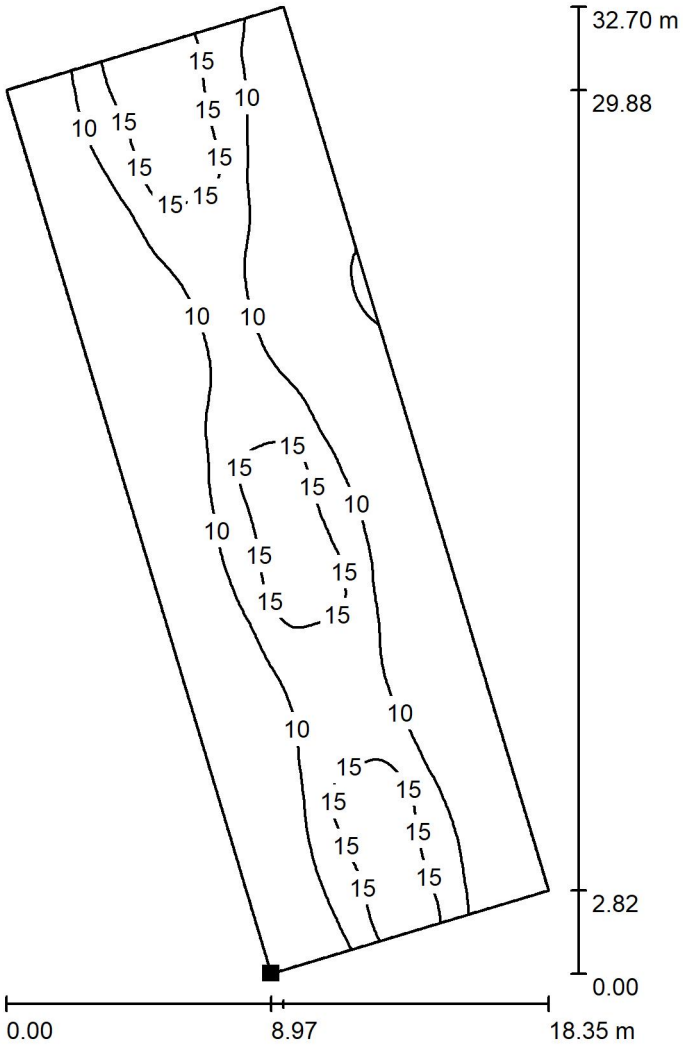
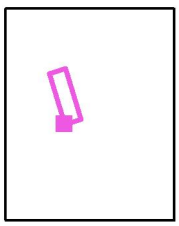
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Double Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 256

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
9.94	4.83	20	0.486	0.247

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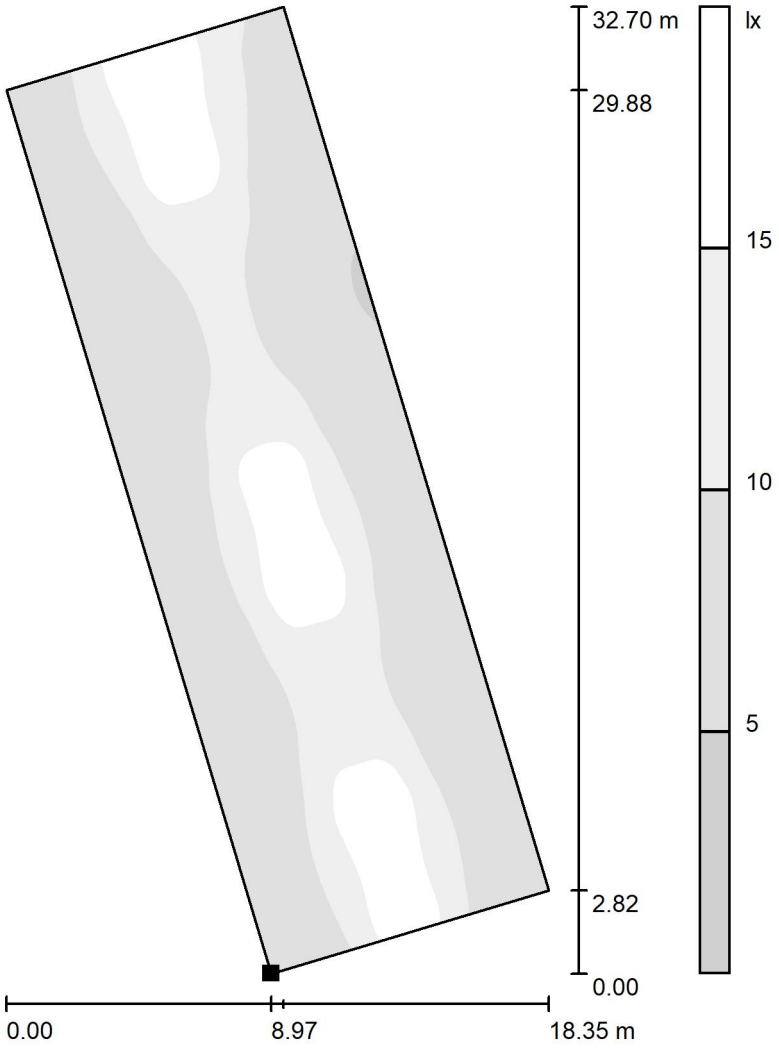
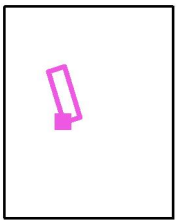
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Double Row / Greyscale (E, Perpendicular)



Scale 1 : 256

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
9.94	4.83	20	0.486	0.247

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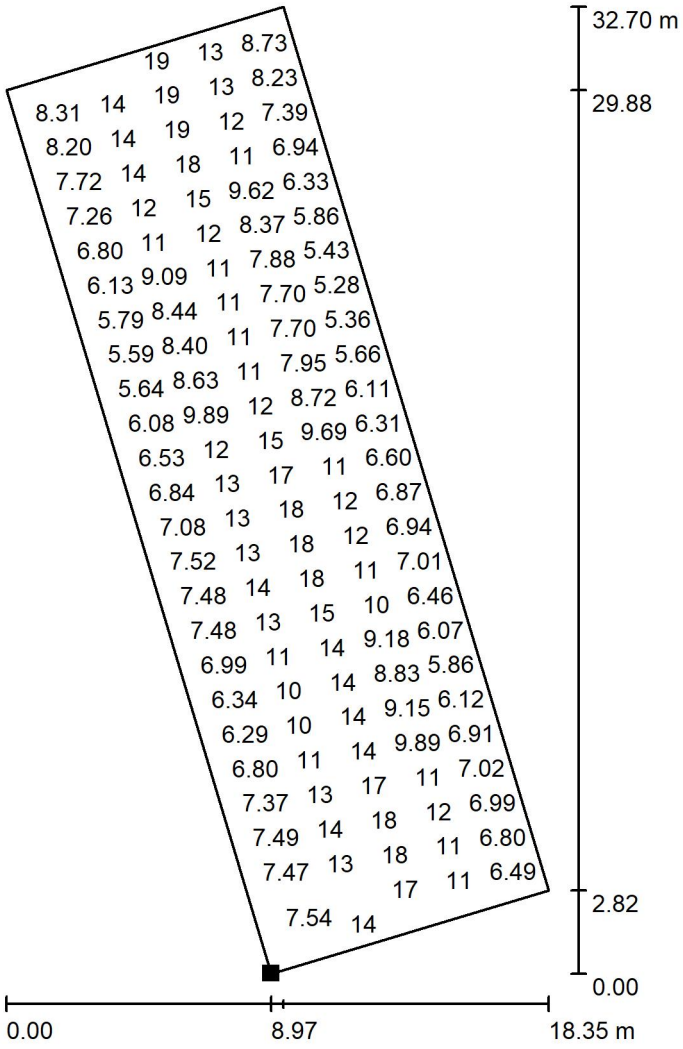
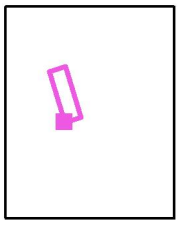
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Double Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 256

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
9.94	4.83	20	0.486	0.247

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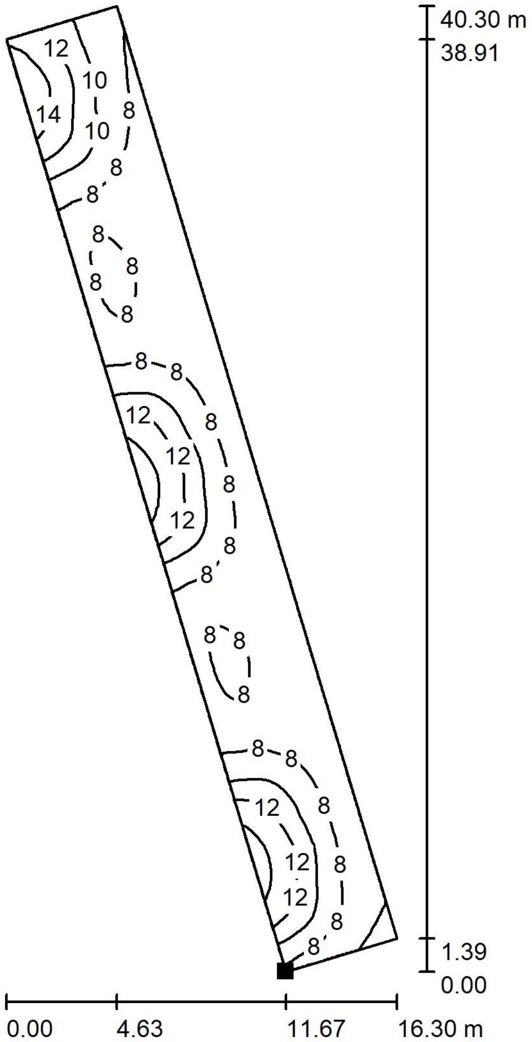
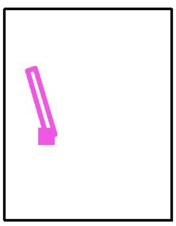
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Single Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 316

Position of surface in external scene:
Marked point:
(437.342 m, 326.247 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
8.77	5.20	15	0.593	0.346

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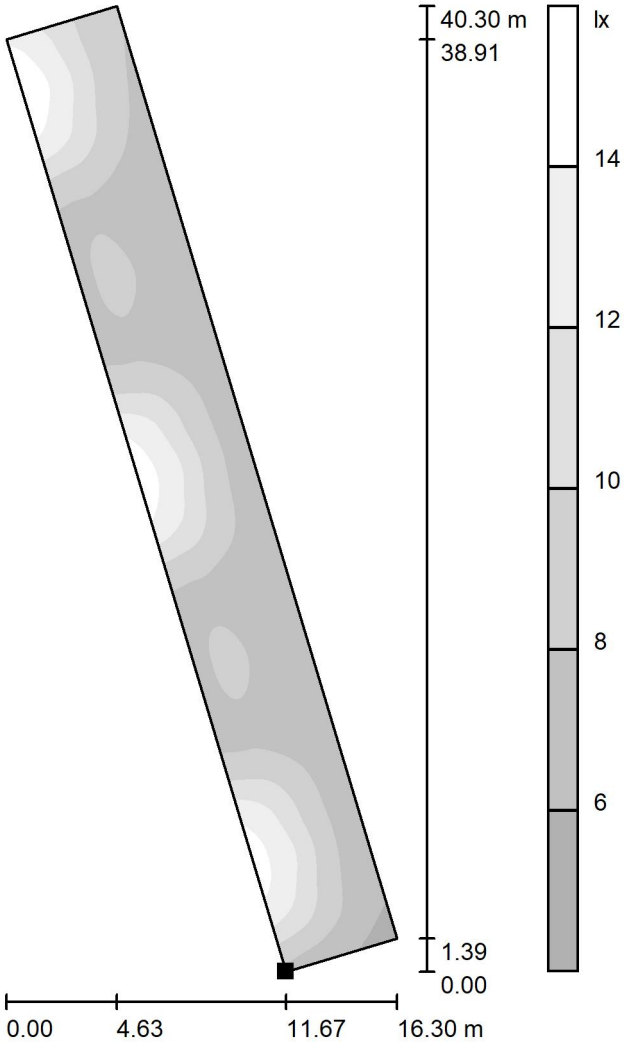
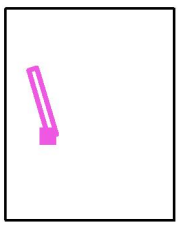
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Single Row / Greyscale (E, Perpendicular)



Scale 1 : 316

Position of surface in external scene:
Marked point:
(437.342 m, 326.247 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
8.77	5.20	15	0.593	0.346

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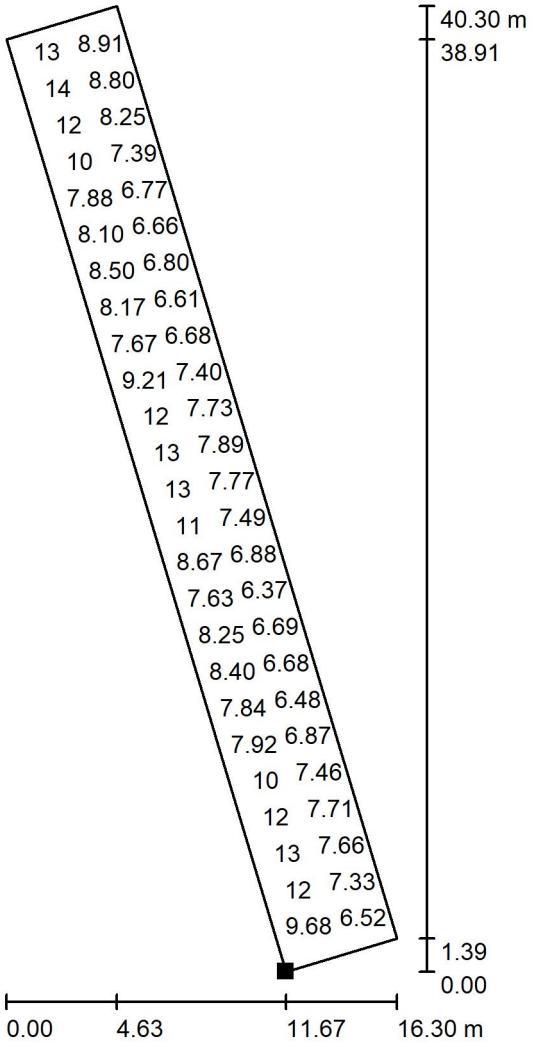
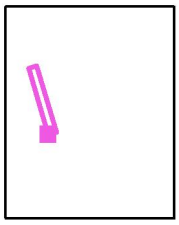
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Parking Single Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 316

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(437.342 m, 326.247 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
8.77	5.20	15	0.593	0.346

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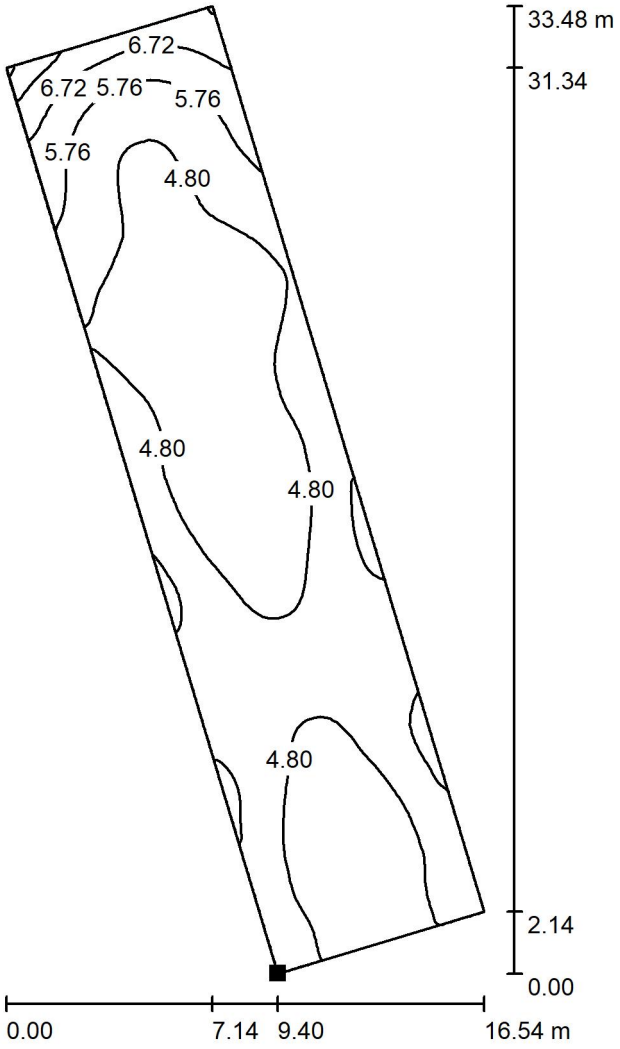
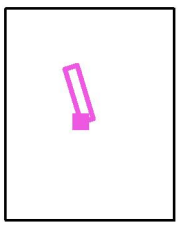
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane
Area 01 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 262

Position of surface in external scene:
Marked point:
(456.614 m, 334.786 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.02	3.92	8.74	0.780	0.448

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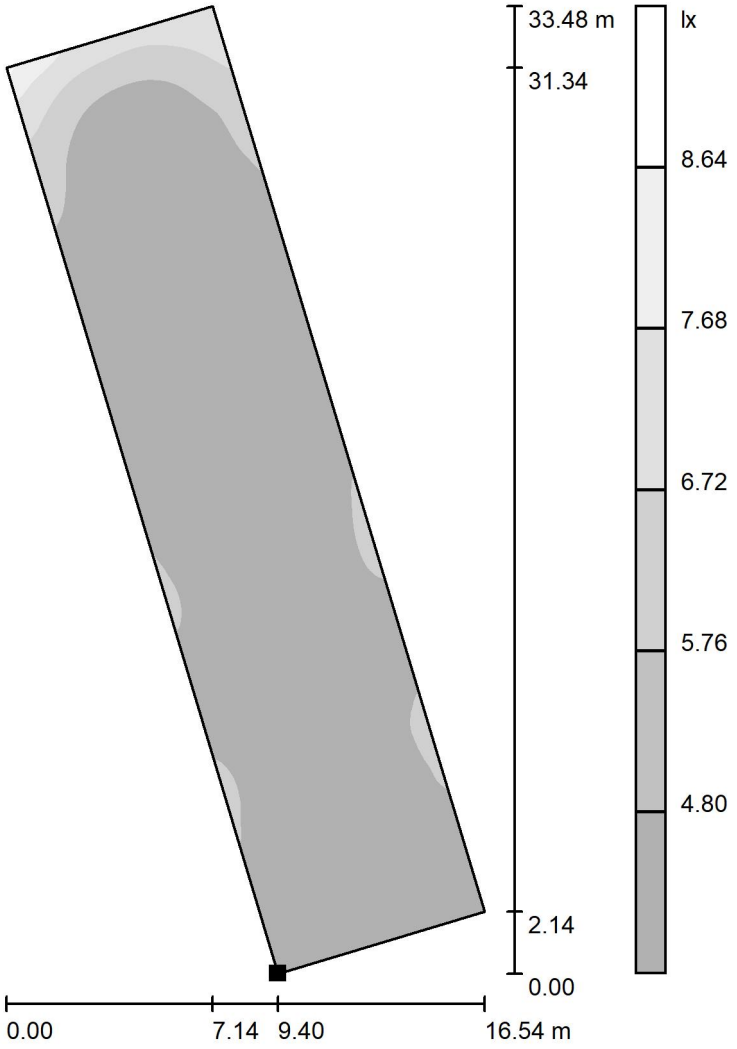
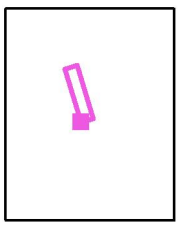
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane Area 01 / Greyscale (E, Perpendicular)



Scale 1 : 262

Position of surface in external scene:
Marked point:
(456.614 m, 334.786 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.02	3.92	8.74	0.780	0.448

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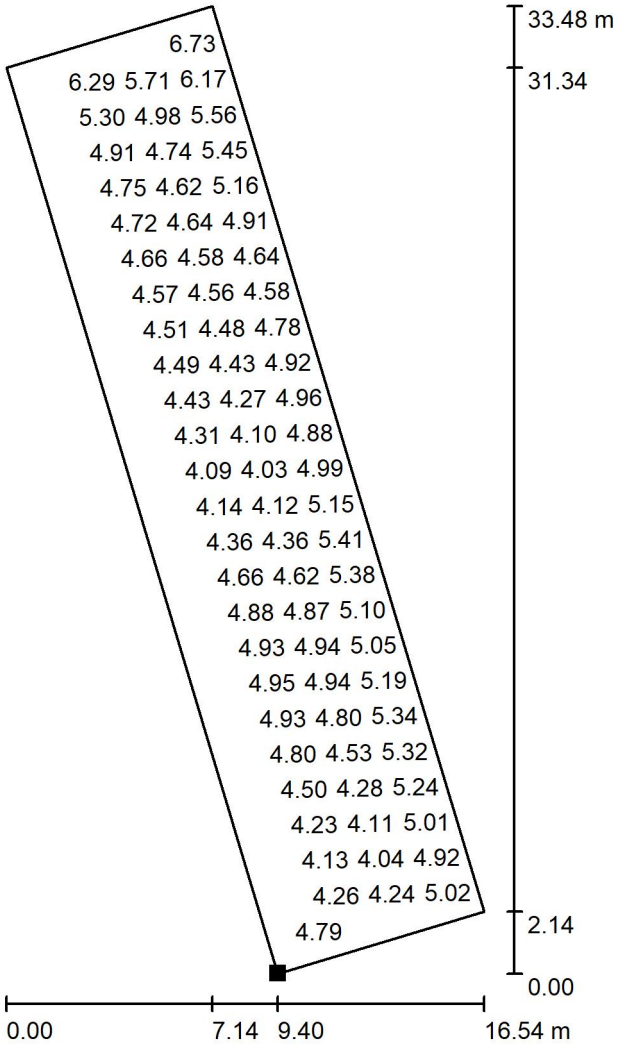
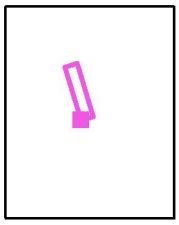
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane
Area 01 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 262

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(456.614 m, 334.786 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.02	3.92	8.74	0.780	0.448

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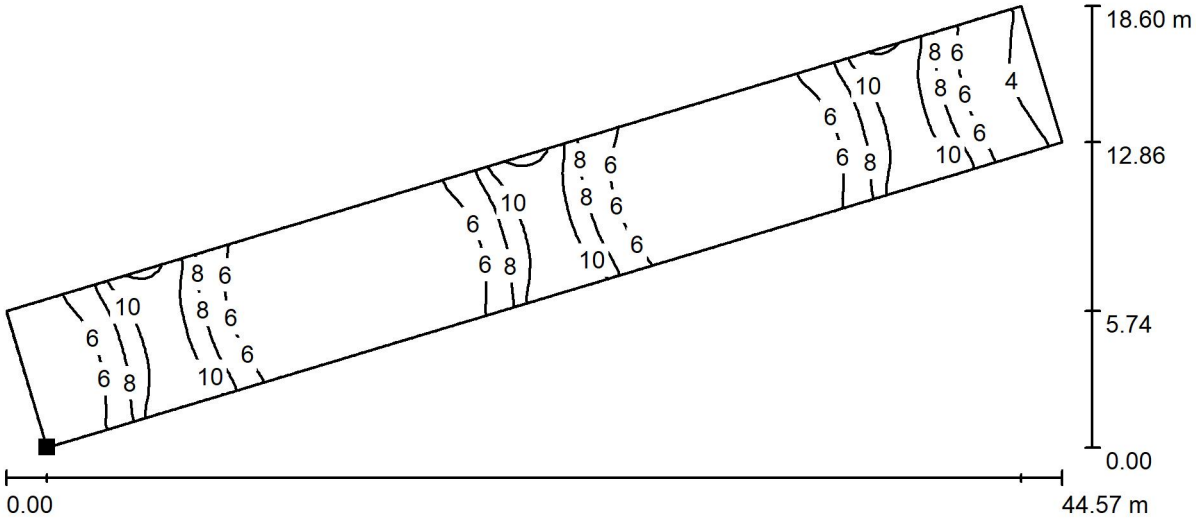
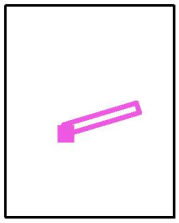
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane
Area 02 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 319

Position of surface in external scene:
Marked point:
(447.964 m, 325.901 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.62	3.37	12	0.510	0.273

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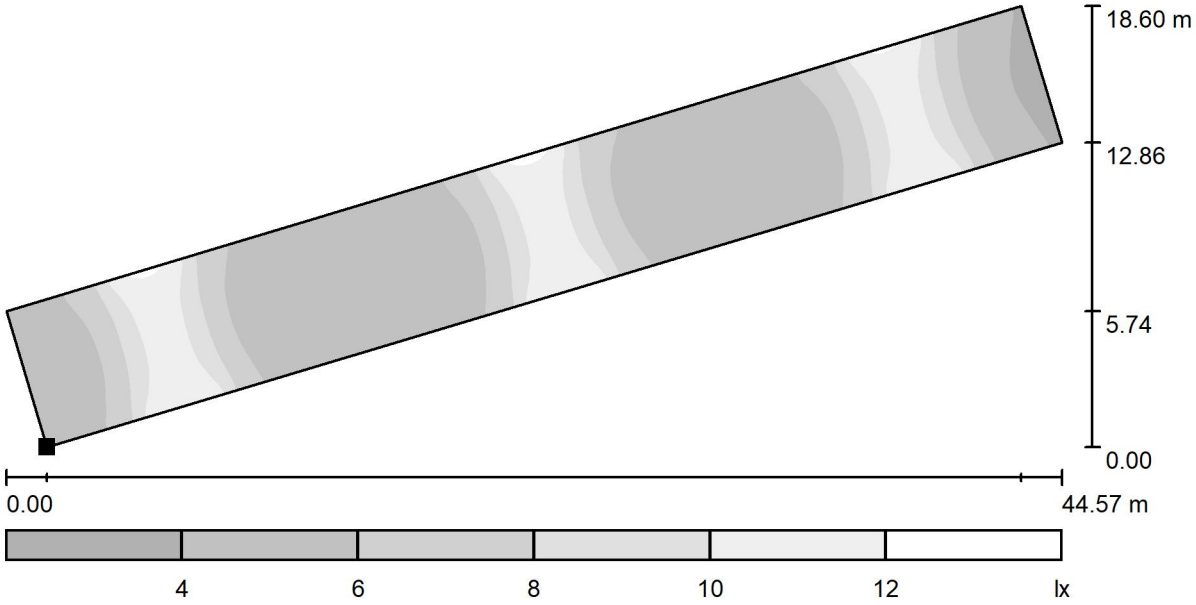
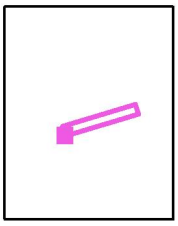
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane Area 02 / Greyscale (E, Perpendicular)



Scale 1 : 319

Position of surface in external scene:
Marked point:
(447.964 m, 325.901 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.62	3.37	12	0.510	0.273

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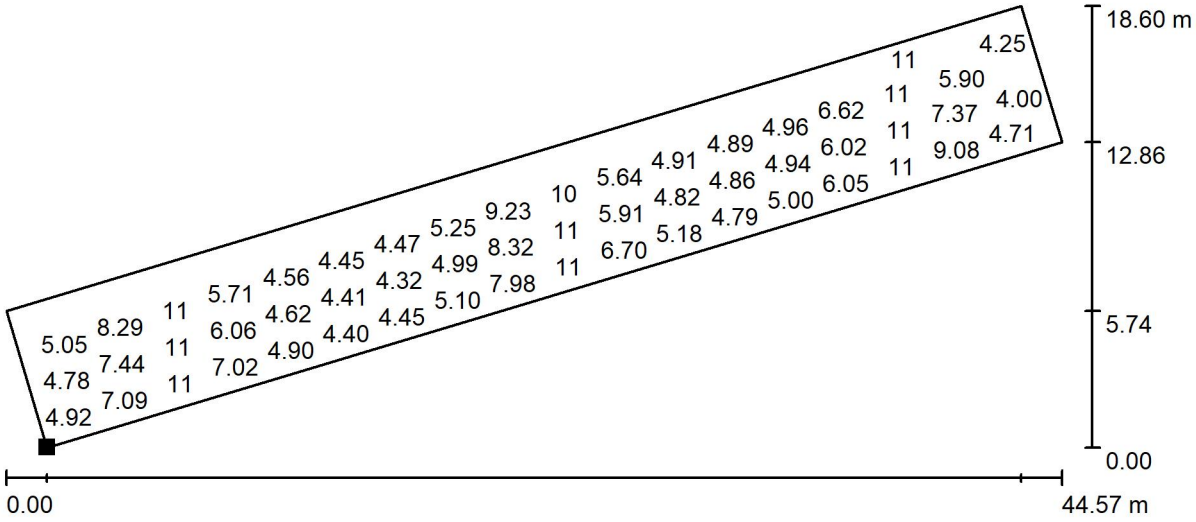
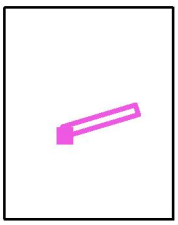
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane Area 02 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 319

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(447.964 m, 325.901 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.62	3.37	12	0.510	0.273

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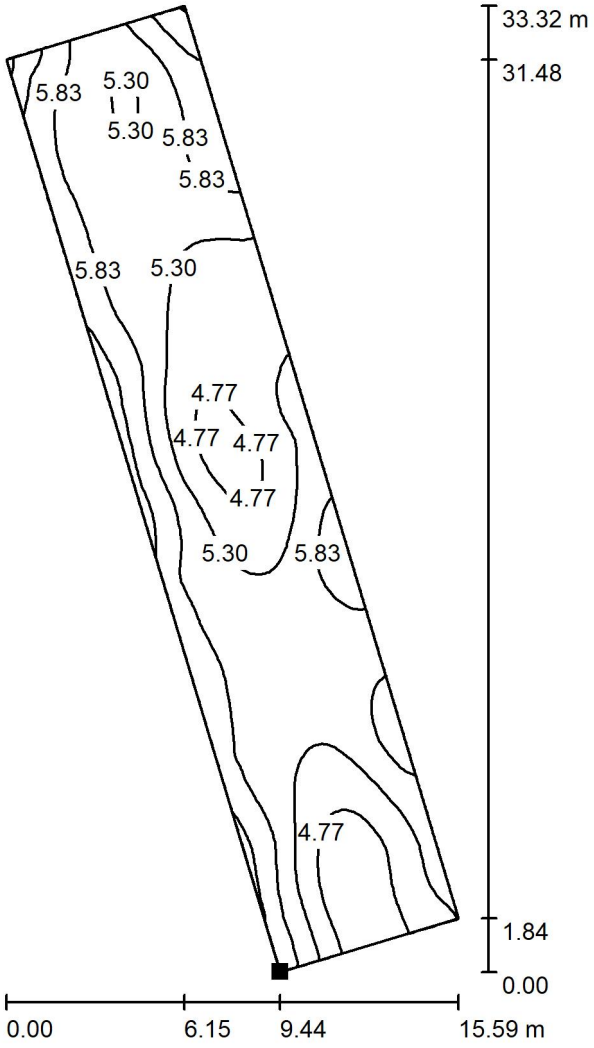
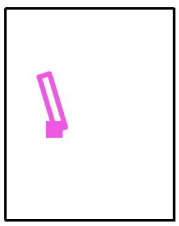
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane
Area 03 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 261

Position of surface in external scene:
Marked point:
(441.206 m, 330.142 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.49	4.42	7.06	0.805	0.626

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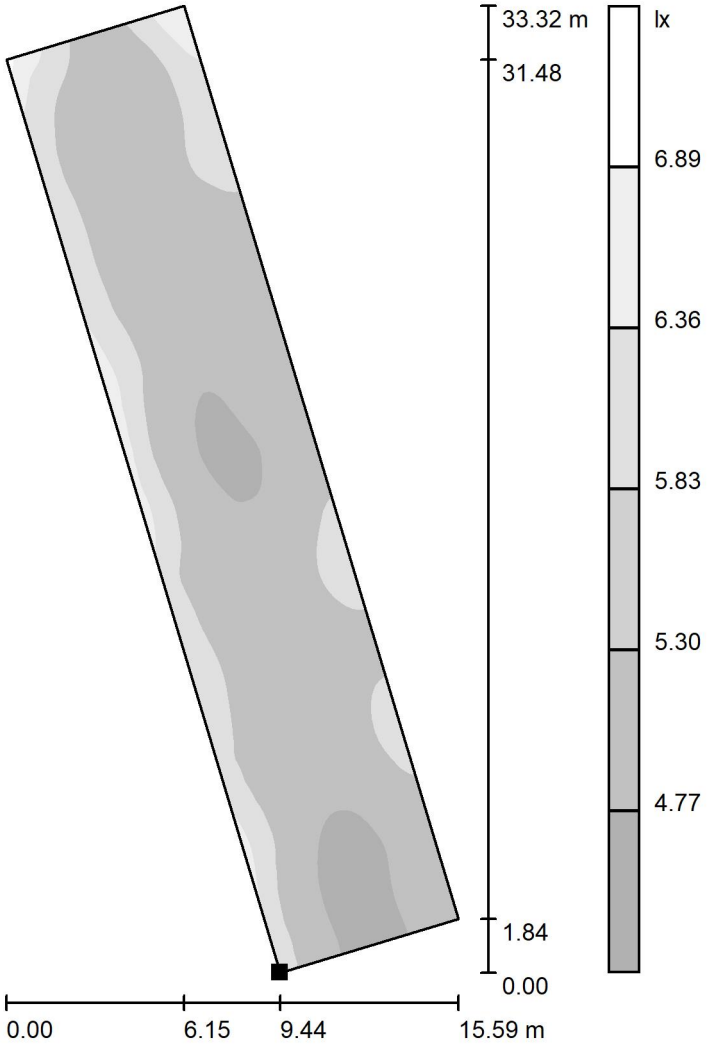
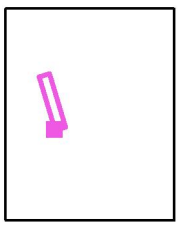
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane Area 03 / Greyscale (E, Perpendicular)



Scale 1 : 261

Position of surface in external scene:
Marked point:
(441.206 m, 330.142 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.49	4.42	7.06	0.805	0.626

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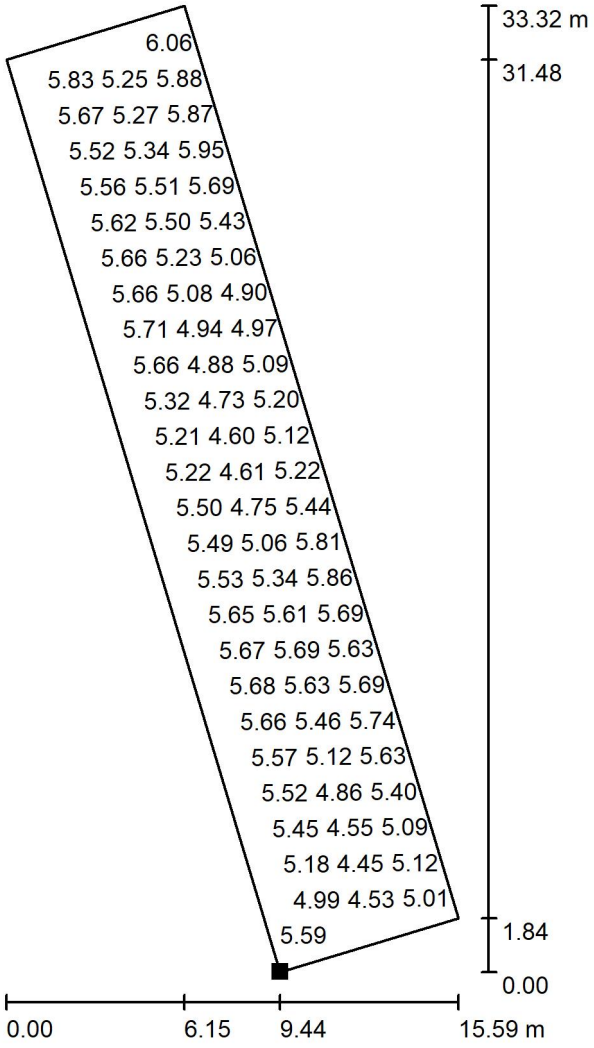
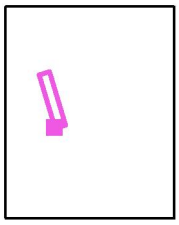
Long Stay Single Level Deck Car Park 964 Spaces / Typical Calculation - Traffic Lane
Area 03 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 261

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(441.206 m, 330.142 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
5.49	4.42	7.06	0.805	0.626

Luton Airport Expansion

Long Stay Single Level Deck Car Park 967 Spaces - Surface Level Exterior and Interior (Under the Deck)

Date: 28.06.2019
Operator: Katerina Konsta

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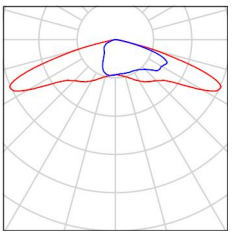
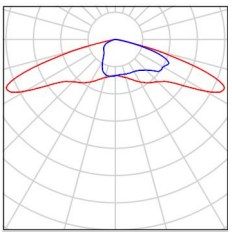
Luton Airport Expansion / Luminaire parts list

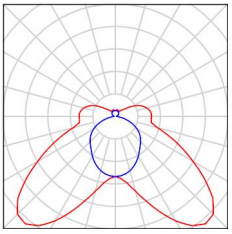
6 Pieces WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K
Article No.: 108-1493
Luminous flux (Luminaire): 1450 lm
Luminous flux (Lamps): 1614 lm
Luminaire Wattage: 14.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90
Fitting: 12 x LED-12/12W/840 - 4000K (Correction Factor 1.000).



7 Pieces WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K
Article No.: 108-1495
Luminous flux (Luminaire): 2555 lm
Luminous flux (Lamps): 2951 lm
Luminaire Wattage: 28.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87
Fitting: 12 x LED-12/24W/840 - 4000K (Correction Factor 1.000).



30 Pieces Zumtobel 42930419 AMP L LT 10000-840 PC WB IVG TEC [STD]
Article No.: 42930419
Luminous flux (Luminaire): 9990 lm
Luminous flux (Lamps): 9990 lm
Luminaire Wattage: 74.2 W
Luminaire classification according to CIE: 83
CIE flux code: 34 70 90 83 100
Fitting: 1 x LED-Z42186567 74C2W (Correction Factor 1.000).



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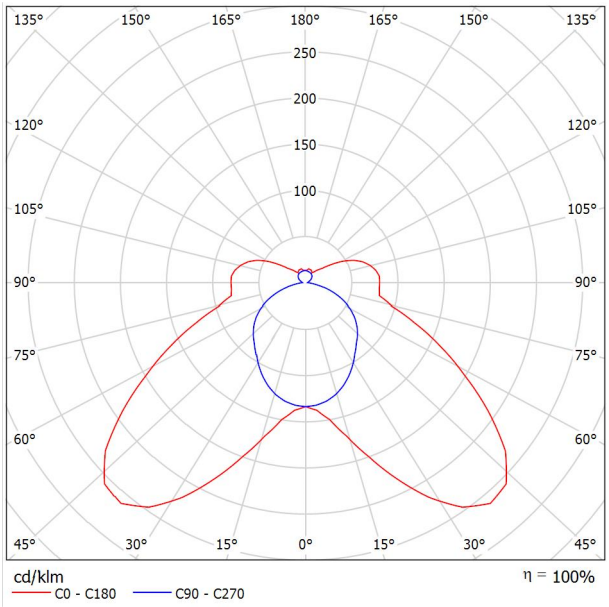
Zumtobel 42930419 AMP L LT 10000-840 PC WB IVG TEC [STD] / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 83
CIE flux code: 34 70 90 83 100

LED Moisture-proof diffuser luminaire with IP66 protection rating and drip-edge effect for minimising dirt and collection of dust for maximum hygienic requirements. Total power: 74.2 W, with dimmable constant current LED driver, especially suitable for industrial applications in adverse surroundings such as cold store halls and factories with increased ambient temperatures; patented InvisiClick for clipless mounting and opening of the cover. Cover and basic diffuser made of impact-resistant polycarbonate, temperature- and UV-resistant, made as a single injection-moulded piece. LED service life lasts 50000 h before luminous flux is reduced to 90% of the initial value. Chromaticity tolerance (initial MacAdam): 3. Luminaire luminous flux: 9990 lm, Luminaire efficacy: 135 lm/W. Colour rendering Ra > 80, colour temperature 4000 K. Luminaire with symmetric wide light distribution (wide beam). High quality direct/indirect lighting concept for optimum lighting solutions in parking garages and industrial applications.. Luminaire with TECTON adapter for simple and straightforward installation of luminaire on the TECTON continuous-row lighting system. ambient temperature: -40°C to +25°C. Approved for indoor use with vertical or horizontal wall mounting (see installation instructions). Note: please contact your consultant if you are planning to use the luminaire in environments with chemical pollutants, high or condensing humidity and major variations in temperature. Complies with International Food Standard specifications. Designed for BESA box. Permissible for use in environments where the deposition of conductive dust on the luminaire can be expected (EN 60598-2-24). Class of protection: , 850°C glow-wire tested. Luminaire wired with halogen-free leads and contains no silicone, Dimensions: 1611 x 152 x 92 mm; weight: 3.4 kg.

Luminous emittance 1:

Glare Evaluation According to UGR

ρ Ceiling		70	70	50	50	30	70	70	50	50	30
ρ Walls		50	30	50	30	30	50	30	50	30	30
ρ Floor		20	20	20	20	20	20	20	20	20	20
Room Size X	Y	Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
2H	2H	21.4	22.6	21.9	23.2	23.8	17.1	18.3	17.6	18.9	19.5
	3H	22.6	23.8	23.2	24.3	24.9	18.4	19.5	18.9	20.1	20.7
	4H	23.1	24.1	23.6	24.7	25.3	18.8	19.9	19.4	20.4	21.1
	6H	23.5	24.4	24.0	25.0	25.7	19.0	20.0	19.6	20.6	21.3
	8H	23.7	24.6	24.3	25.2	25.9	19.1	20.0	19.7	20.6	21.3
	12H	23.9	24.8	24.5	25.4	26.1	19.1	20.0	19.7	20.6	21.3
4H	2H	21.8	22.9	22.4	23.4	24.1	18.9	19.9	19.4	20.5	21.1
	3H	23.2	24.1	23.8	24.7	25.4	20.4	21.3	21.0	21.9	22.6
	4H	23.8	24.6	24.4	25.2	25.9	20.9	21.7	21.5	22.3	23.0
	6H	24.3	25.0	25.0	25.7	26.4	21.1	21.8	21.8	22.5	23.2
	8H	24.6	25.3	25.3	25.9	26.7	21.2	21.8	21.8	22.5	23.3
	12H	24.9	25.5	25.6	26.2	27.0	21.2	21.8	21.9	22.5	23.3
8H	4H	23.9	24.6	24.6	25.2	26.0	21.4	22.0	22.0	22.7	23.4
	6H	24.6	25.1	25.3	25.8	26.6	21.8	22.3	22.5	23.0	23.8
	8H	25.0	25.5	25.7	26.2	27.0	21.9	22.4	22.6	23.1	23.9
	12H	25.5	25.9	26.2	26.6	27.5	22.0	22.4	22.7	23.1	24.0
12H	4H	23.9	24.5	24.6	25.2	25.9	21.4	22.0	22.1	22.7	23.5
	6H	24.6	25.1	25.3	25.8	26.6	21.9	22.4	22.6	23.1	23.9
	8H	25.1	25.5	25.8	26.2	27.0	22.1	22.5	22.8	23.3	24.1

Variation of the observer position for the luminaire distances S

S = 1.0H	+0.1 / -0.1	+0.1 / -0.1
S = 1.5H	+0.4 / -0.4	+0.5 / -0.5
S = 2.0H	+0.6 / -0.9	+1.2 / -1.2
Standard table	BK05	BK05
Correction Summand	0.3	-2.9

Corrected Glare Indices referring to 9990lm Total Luminous Flux

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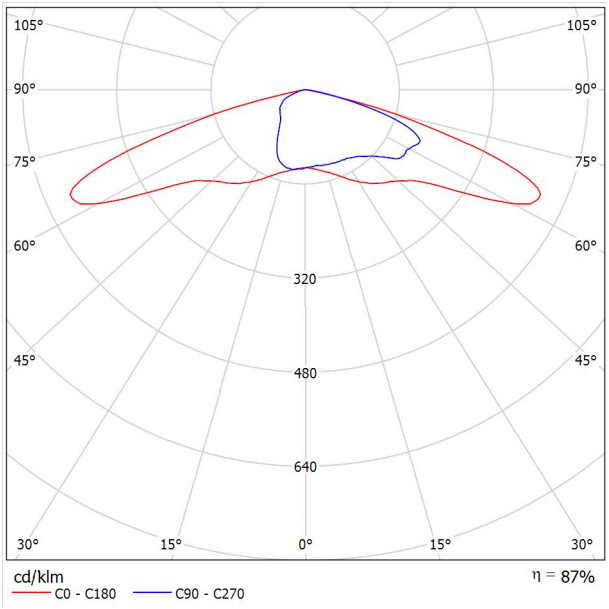
WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 87

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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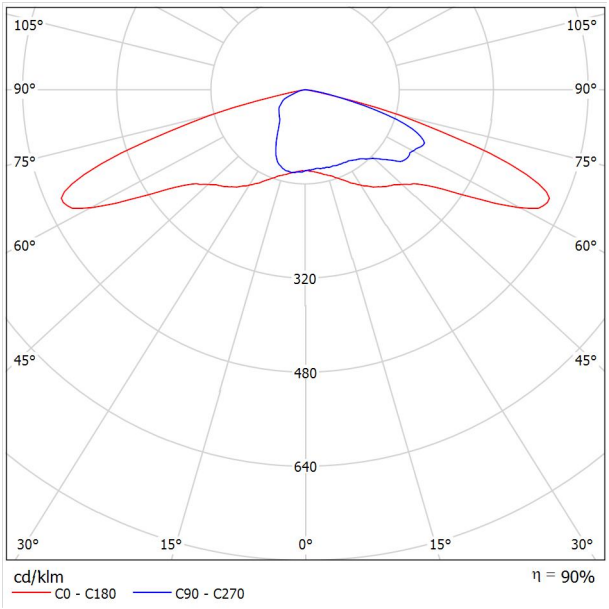
WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 93 100 90

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D: 76 x 80 mm (optional 60 x 80 mm).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

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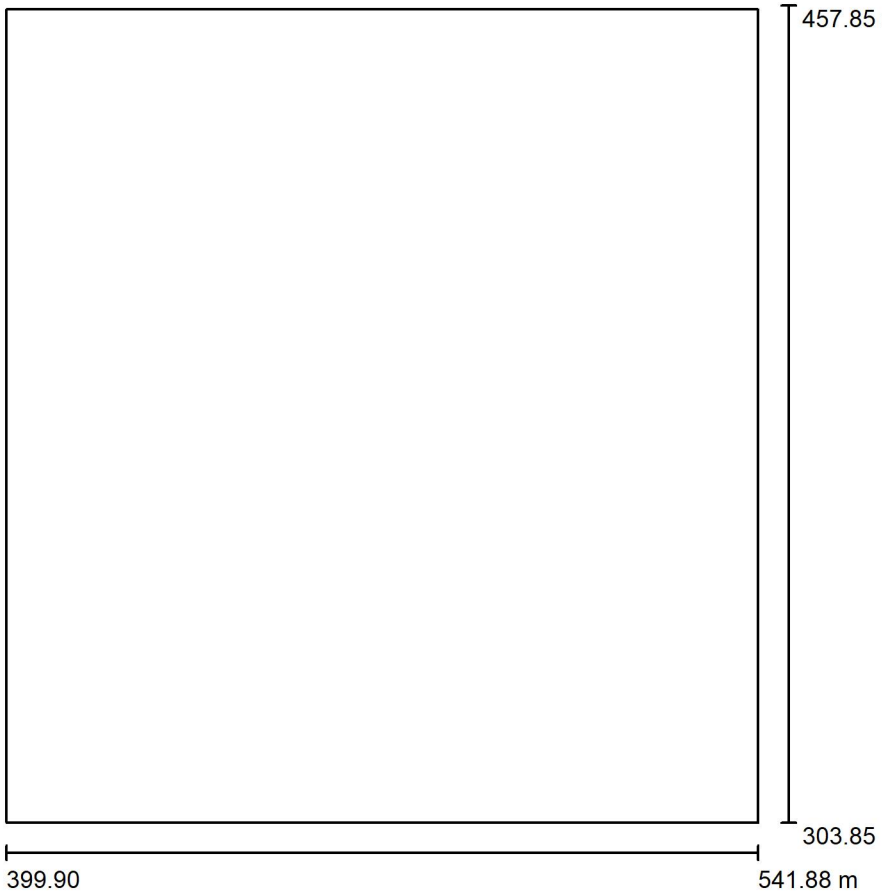
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Planning data



Maintenance factor: 0.57, ULR (Upward Light Ratio): 15.5%

Scale 1:1428

Exterior Parking Areas
Average Illuminance: 5lux
Uniformity: 0.25

Interior Parking Areas
Average Illuminance:75lux
Uniformity: 0.4

(...)

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	WE-EF 108-1493 VFL520 [R65] IP66:LED-12/12W/4K (1.000)	1450	1614	14.0
2	7	WE-EF 108-1495 VFL520 [R65] IP66:LED-12/24W/4K (1.000)	2555	2951	28.0
3	30	Zumtobel 42930419 AMP L LT 10000-840 PC WB IVG TEC [STD] (1.000)	9990	9990	74.2
			Total: 326285	Total: 330041	2506.0

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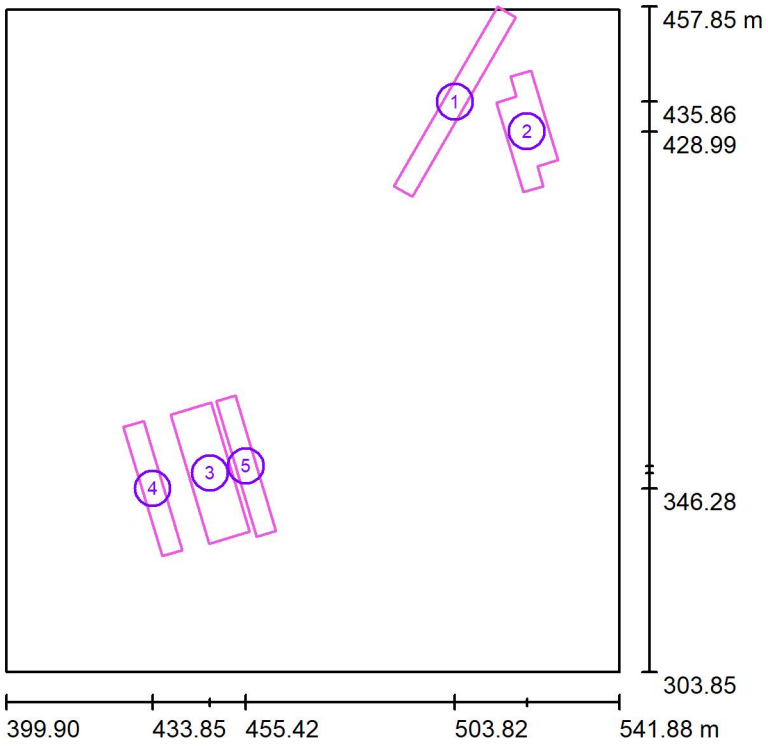
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Calculation surfaces (results overview)



Scale 1 : 1753

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Typical Calculation - Parking Single Row	perpendicular	128 x 32	6.55	2.12	9.50	0.324	0.224
2	Typical Calculation - Parking Double Row	perpendicular	32 x 16	6.64	2.48	10	0.373	0.247
3	Typical Calculation - Parking Double Row Interior/Under the Deck	perpendicular	128 x 64	75	31	143	0.415	0.218
4	Typical Calculation - Parking Single Row Interior/Under the Deck	perpendicular	128 x 32	85	41	130	0.486	0.318
5	Typical Calculation - Traffic Lane Interior/Under the Deck	perpendicular	128 x 32	85	47	132	0.558	0.360

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	5	49	2.12	143	0.04	0.01

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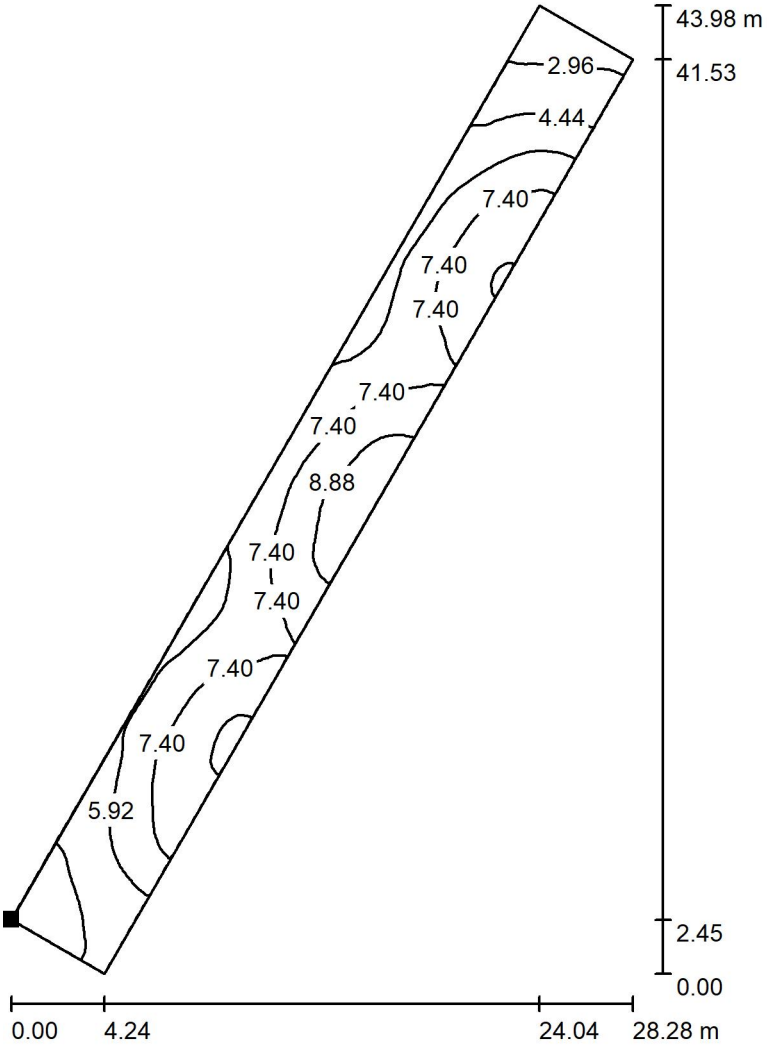
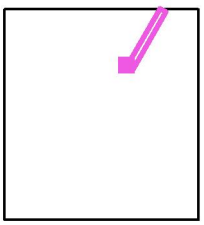
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Single Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 344

Position of surface in external scene:
Marked point:
(489.675 m, 416.319 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.55	2.12	9.50	0.324	0.224

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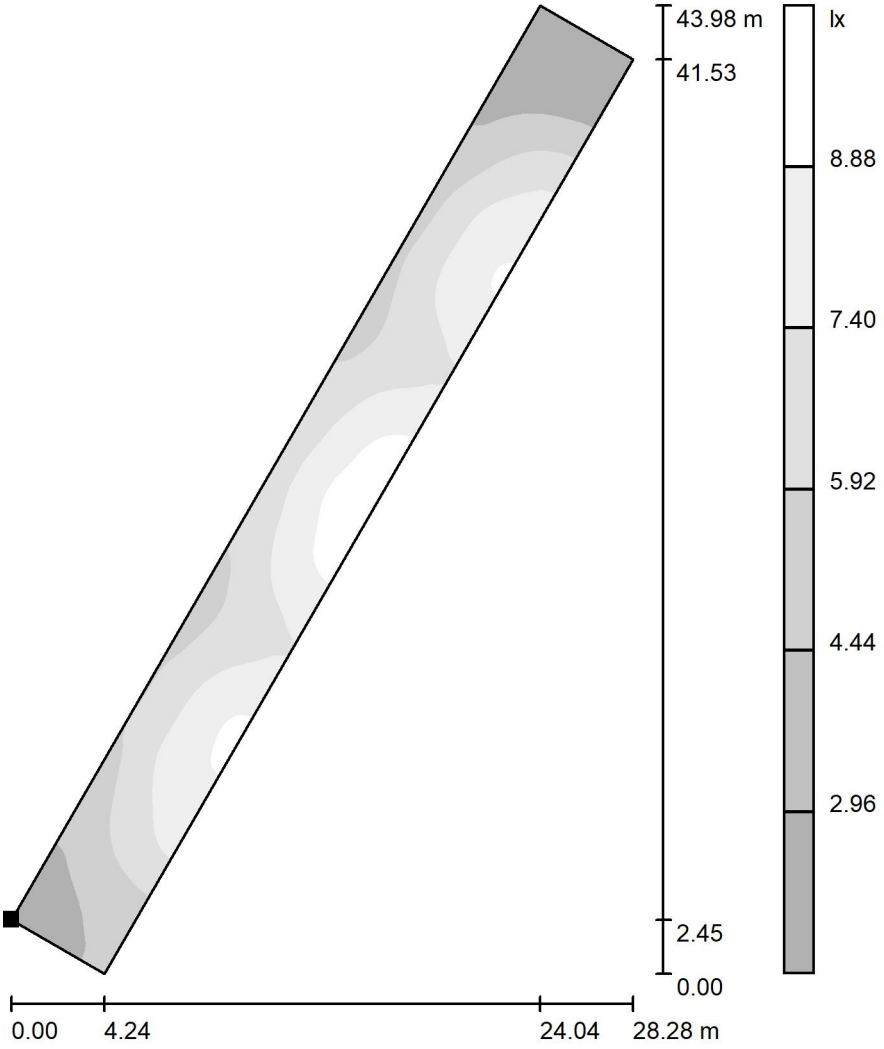
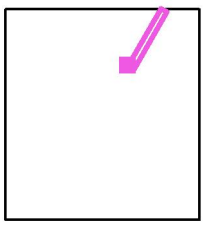
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Single Row / Greyscale (E, Perpendicular)



Scale 1 : 344

Position of surface in external scene:
Marked point:
(489.675 m, 416.319 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.55	2.12	9.50	0.324	0.224

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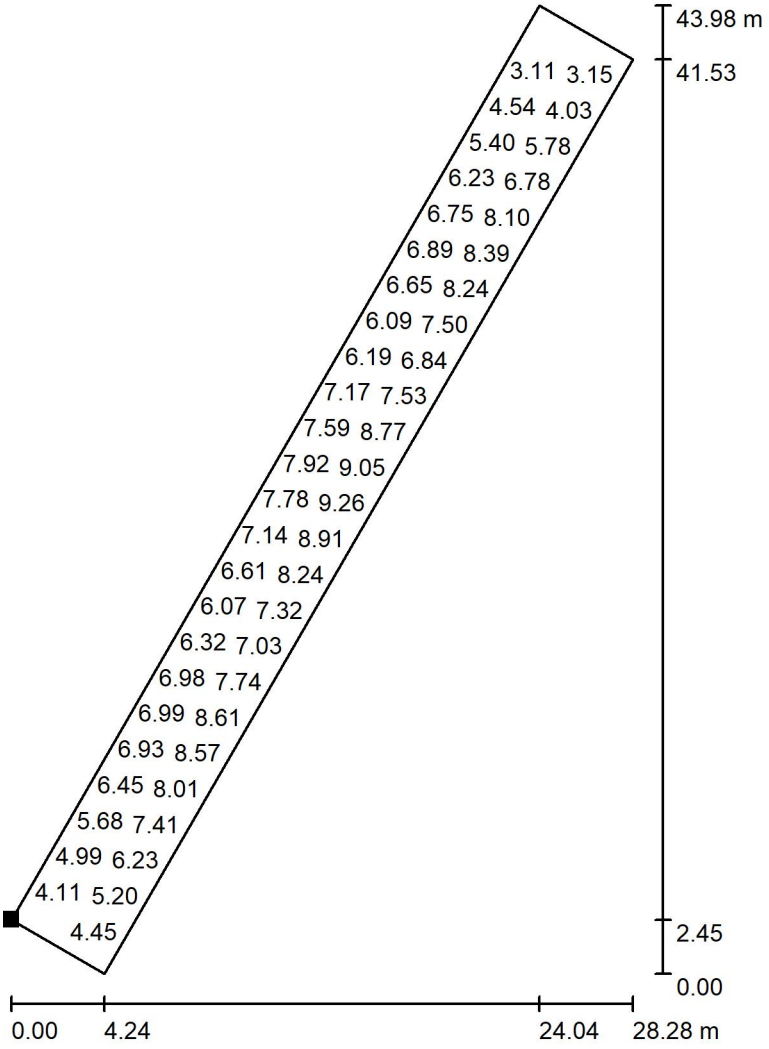
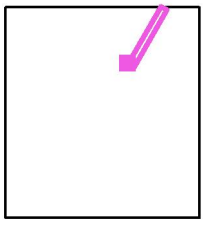
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Single Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 344

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(489.675 m, 416.319 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.55	2.12	9.50	0.324	0.224

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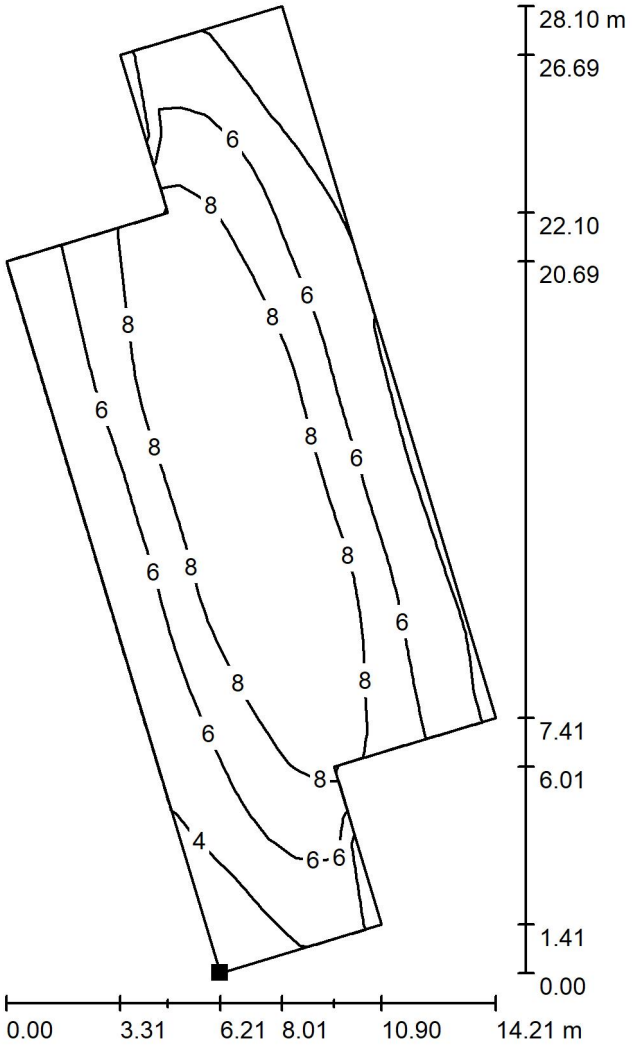
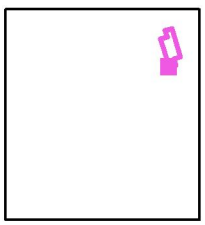
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 220

Position of surface in external scene:
Marked point:
(519.624 m, 414.941 m, 0.000 m)



Grid: 32 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.64	2.48	10	0.373	0.247

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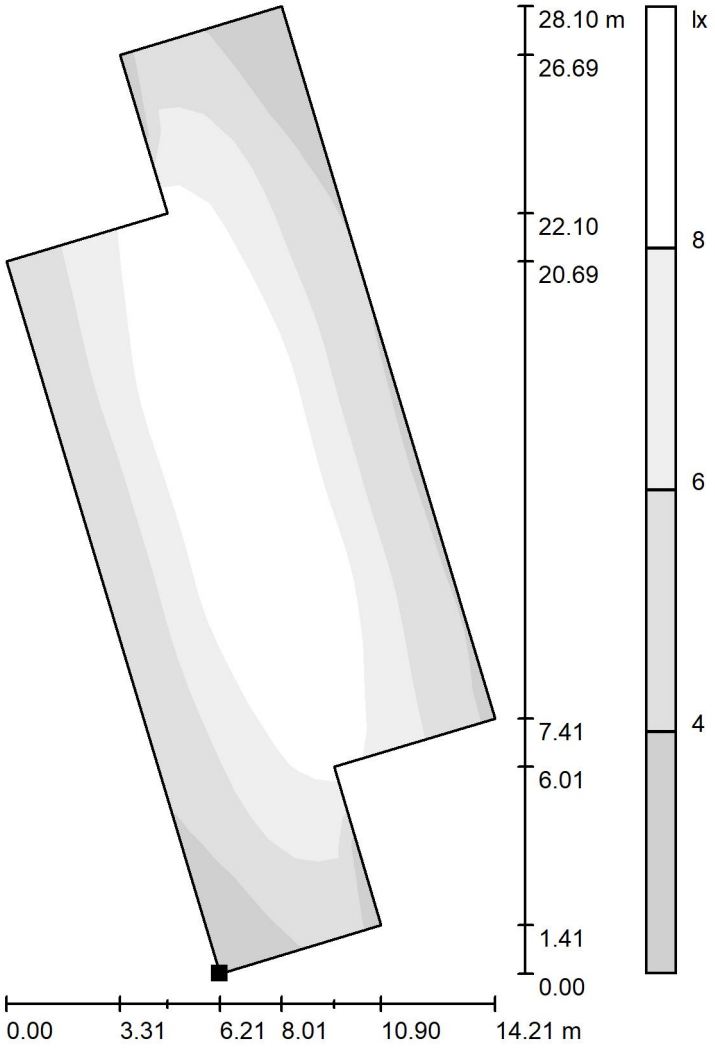
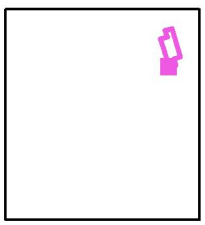
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row / Greyscale (E, Perpendicular)



Scale 1 : 220

Position of surface in external scene:
Marked point:
(519.624 m, 414.941 m, 0.000 m)



Grid: 32 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.64	2.48	10	0.373	0.247

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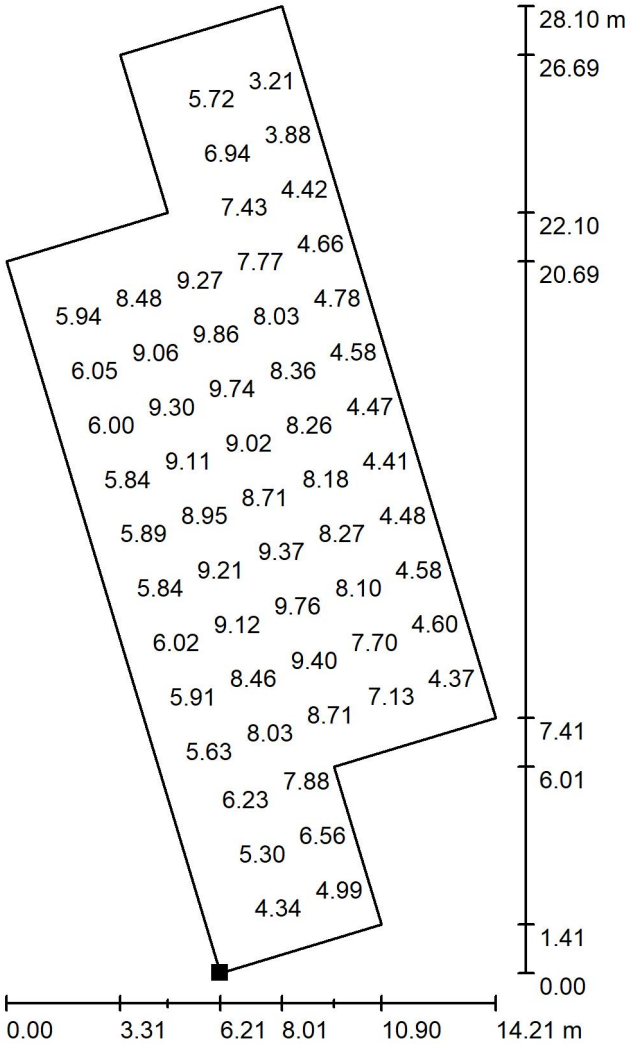
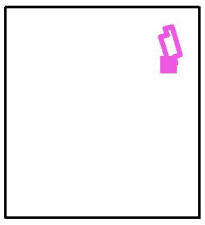
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 220

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(519.624 m, 414.941 m, 0.000 m)



Grid: 32 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
6.64	2.48	10	0.373	0.247

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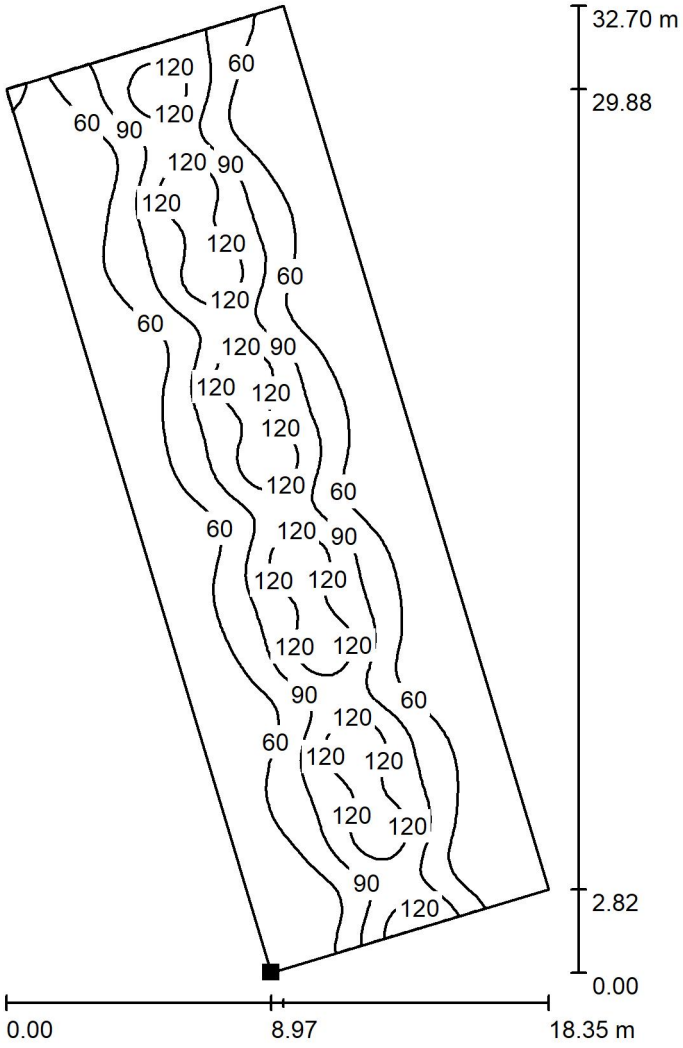
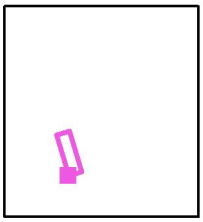
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row Interior/Under the Deck / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 256

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
75	31	143	0.415	0.218

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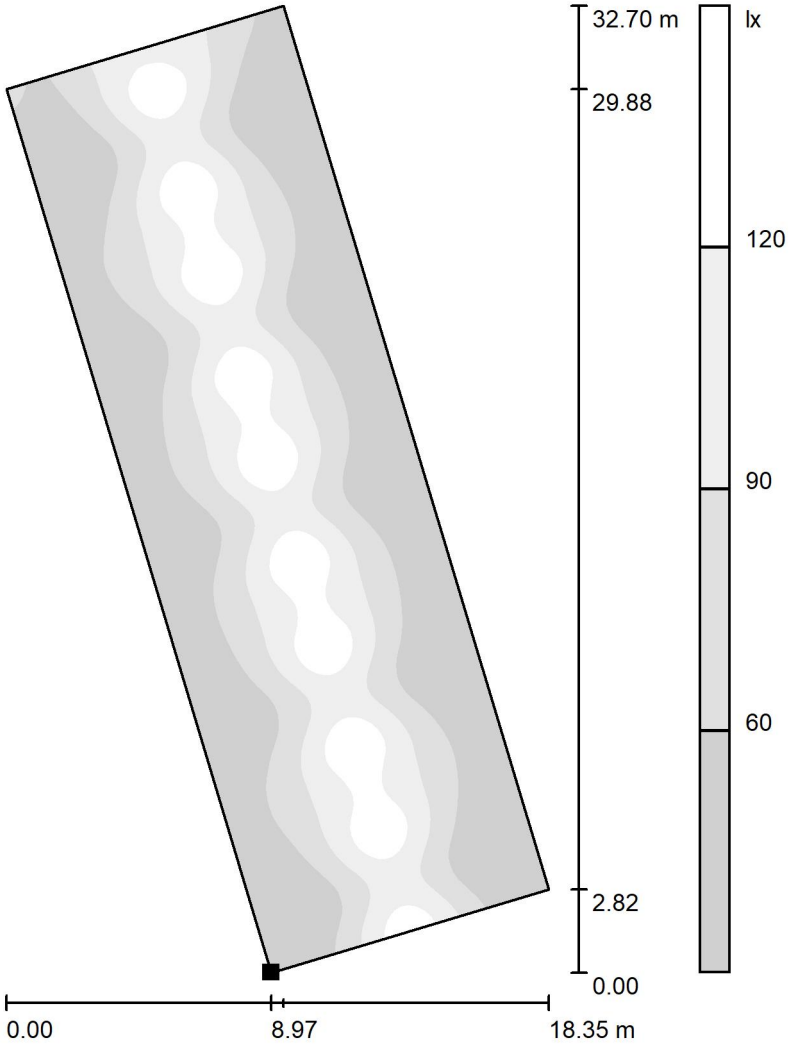
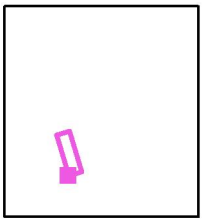
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row Interior/Under the Deck / Greyscale (E, Perpendicular)



Scale 1 : 256

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
75	31	143	0.415	0.218

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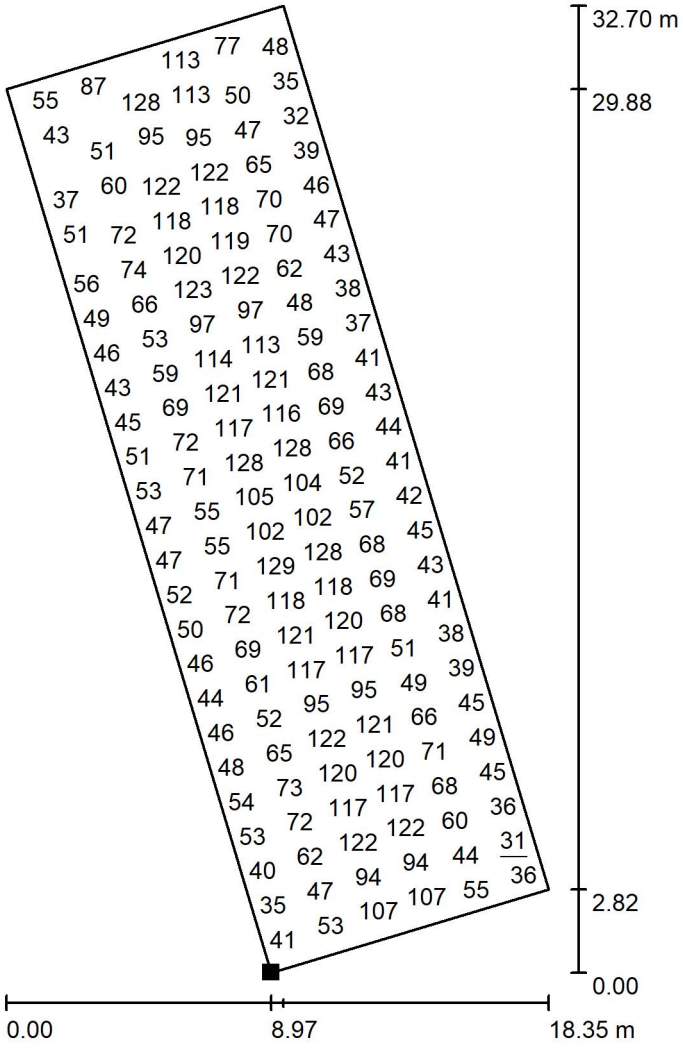
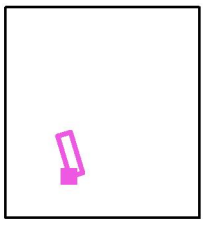
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Double Row Interior/Under the Deck / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 256

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(446.918 m, 333.545 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
75	31	143	0.415	0.218

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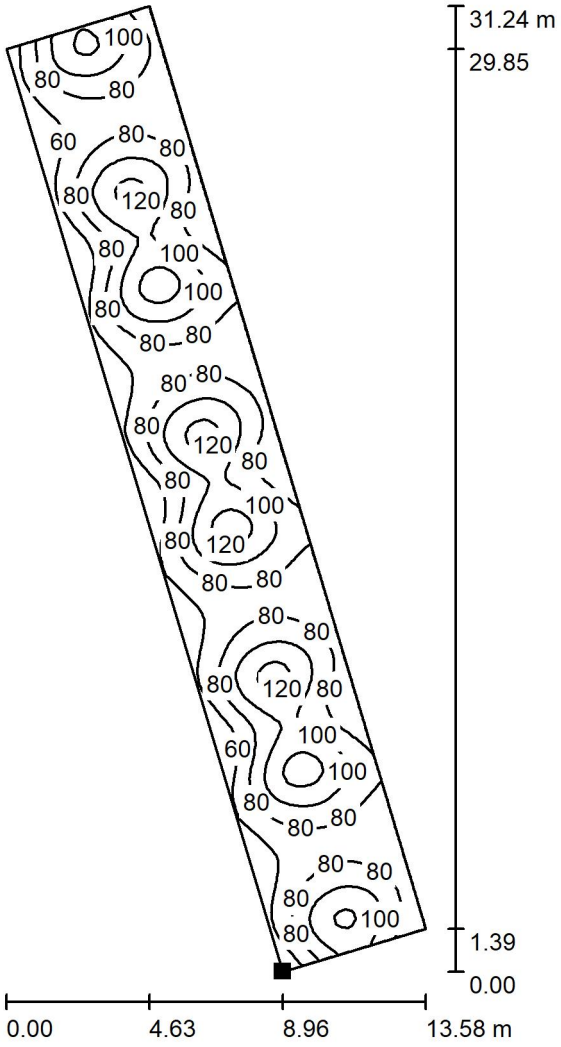
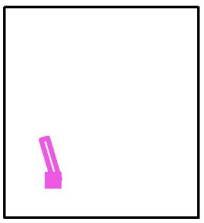
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Single Row Interior/Under the Deck / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 245

Position of surface in external scene:
Marked point:
(436.016 m, 330.665 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	41	130	0.486	0.318

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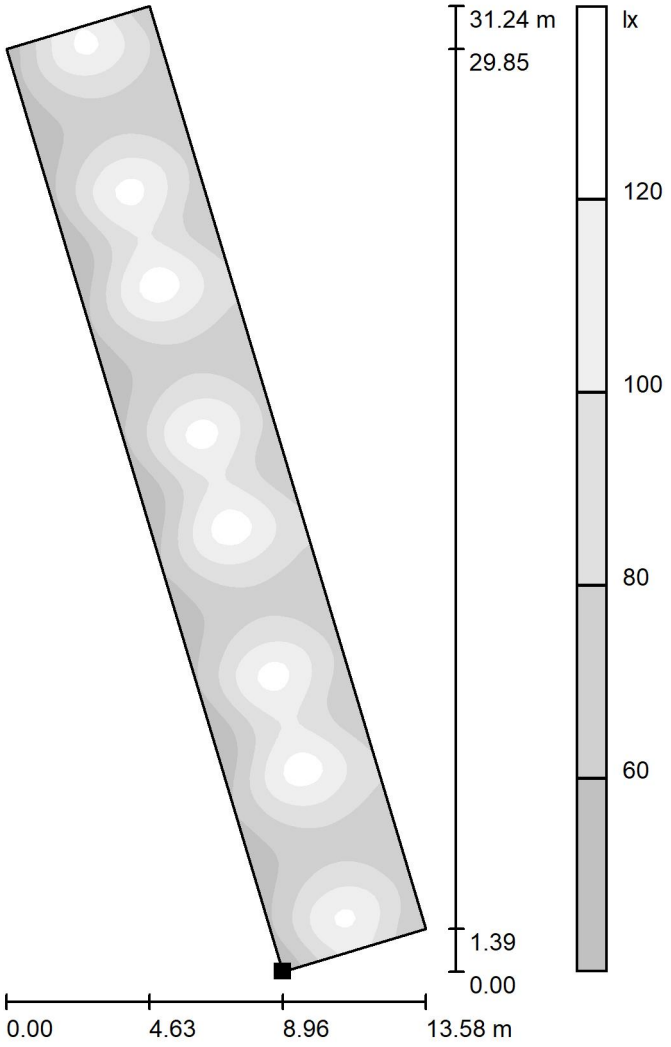
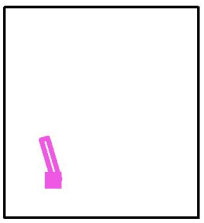
Long Stay Single Level Deck Car Park 967 Spaces - Surface Level / Typical Calculation - Parking Single Row Interior/Under the Deck / Greyscale (E, Perpendicular)



Scale 1 : 245

Position of surface in external scene:
Marked point:
(436.016 m, 330.665 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	41	130	0.486	0.318

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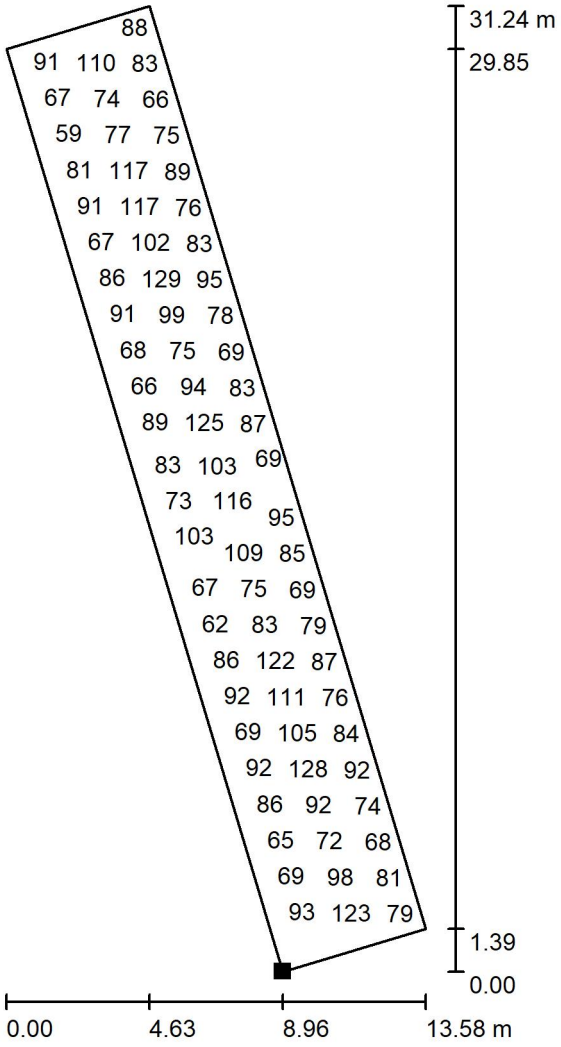
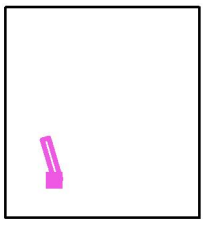


Values in Lux, Scale 1 : 245

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(436.016 m, 330.665 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	41	130	0.486	0.318

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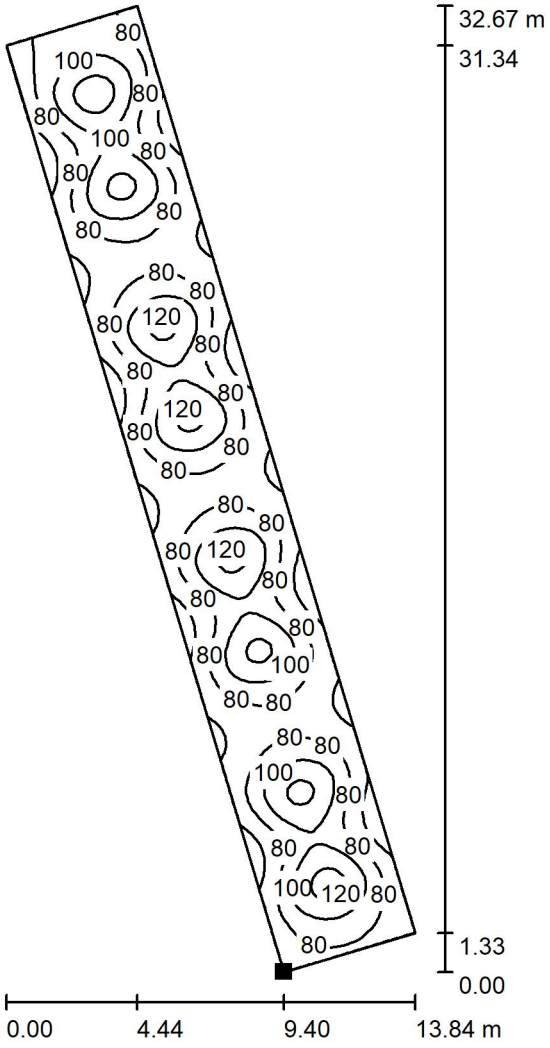
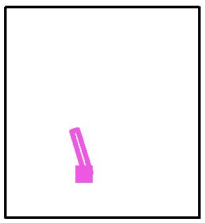


Values in Lux, Scale 1 : 256

Position of surface in external scene:
Marked point:
(457.905 m, 335.174 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	47	132	0.558	0.360

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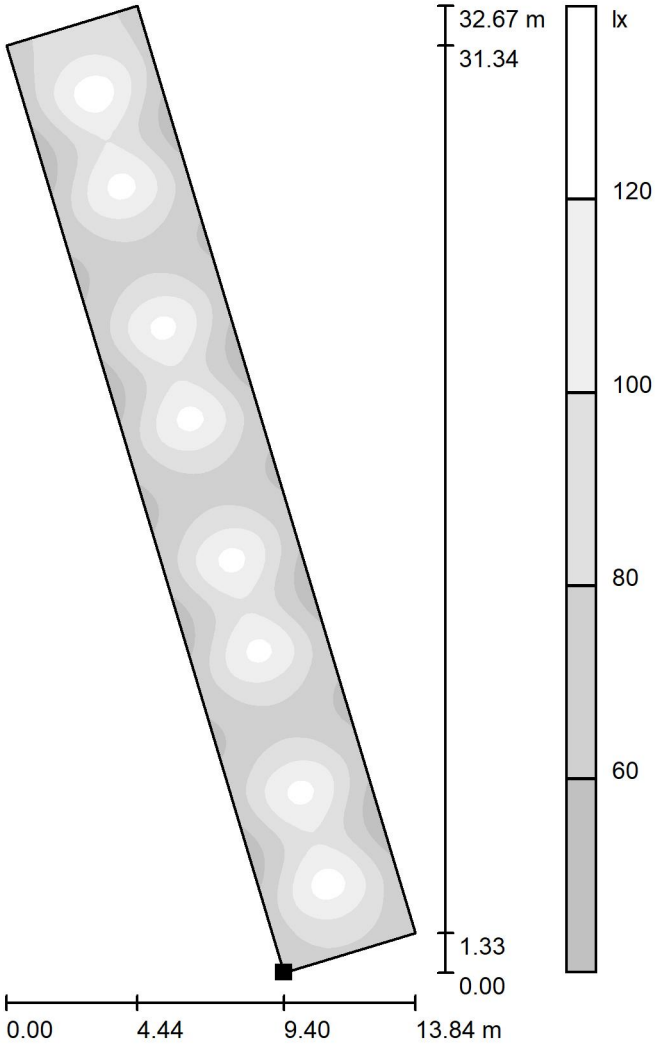
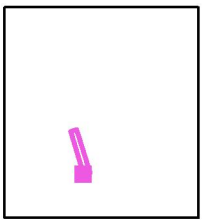


Scale 1 : 256

Position of surface in external scene:
Marked point:
(457.905 m, 335.174 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	47	132	0.558	0.360

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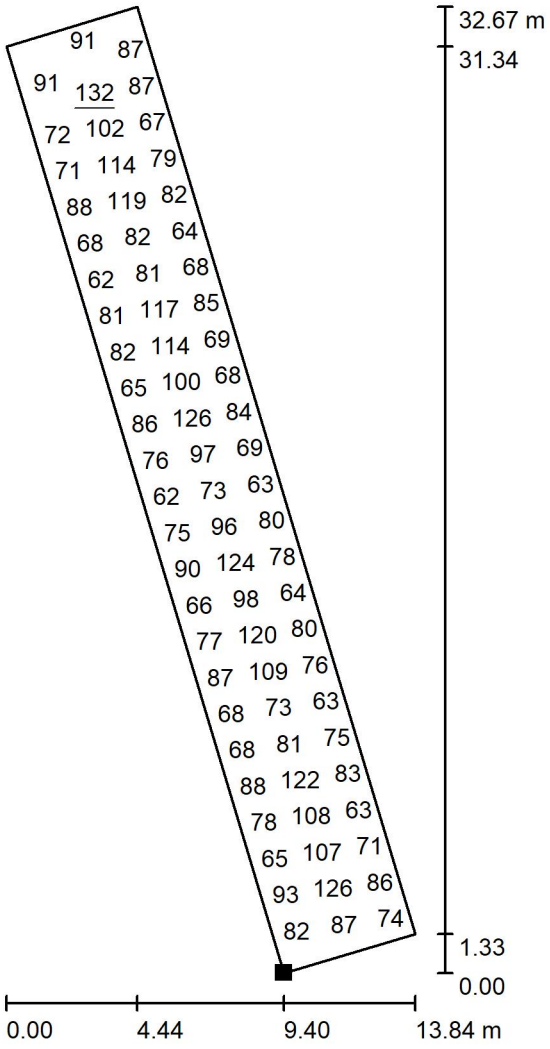
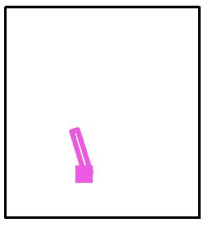


Values in Lux, Scale 1 : 256

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(457.905 m, 335.174 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
85	47	132	0.558	0.360

Luton Airport Expansion

Pedestrian Crossings

Date: 28.06.2019
Operator: Katerina Konsta

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      - Greyscale (E, Perpendicular) 17
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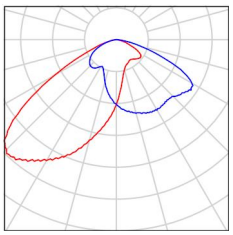
Luton Airport Expansion / Luminaire parts list

2 Pieces WE-EF 108-1984 VFL540 [P45L] IP66:LED-36/72W/4K
Article No.: 108-1984
Luminous flux (Luminaire): 7741 lm
Luminous flux (Lamps): 8854 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 38 79 97 100 88
Fitting: 36 x LED-36/72W/840 - 4000K
(Correction Factor 1.000).



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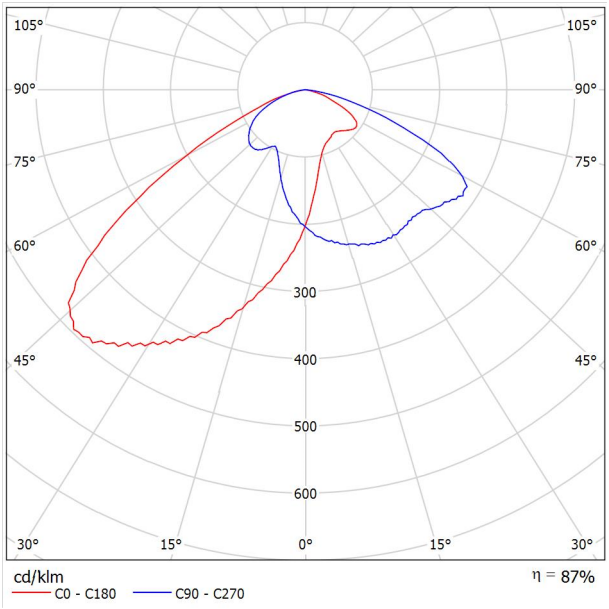
WE-EF 108-1984 VFL540 [P45L] IP66:LED-36/72W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 38 79 97 100 88

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D = 60 x 80 mm or D = 76 x 80 mm (to be specified at order placement).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

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Pedestrian Crossings / Planning data

Maintenance factor: 0.80, ULR (Upward Light Ratio): 0.0%

Scale 1:121

Average horizontal illuminance on pedestrian crossing at ground level: E ≥ 52.5 lux
Uniformity of horizontal illuminance (Uo): 0.60
Rear grid: 22.5 lux
Kerb grid: 30 lux
Middle grid: 30 lux

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	WE-EF 108-1984 VFL540 [P45L] IP66:LED-36/72W/4K (1.000)	7741	8854	81.0
			Total: 15482	Total: 17708	162.0

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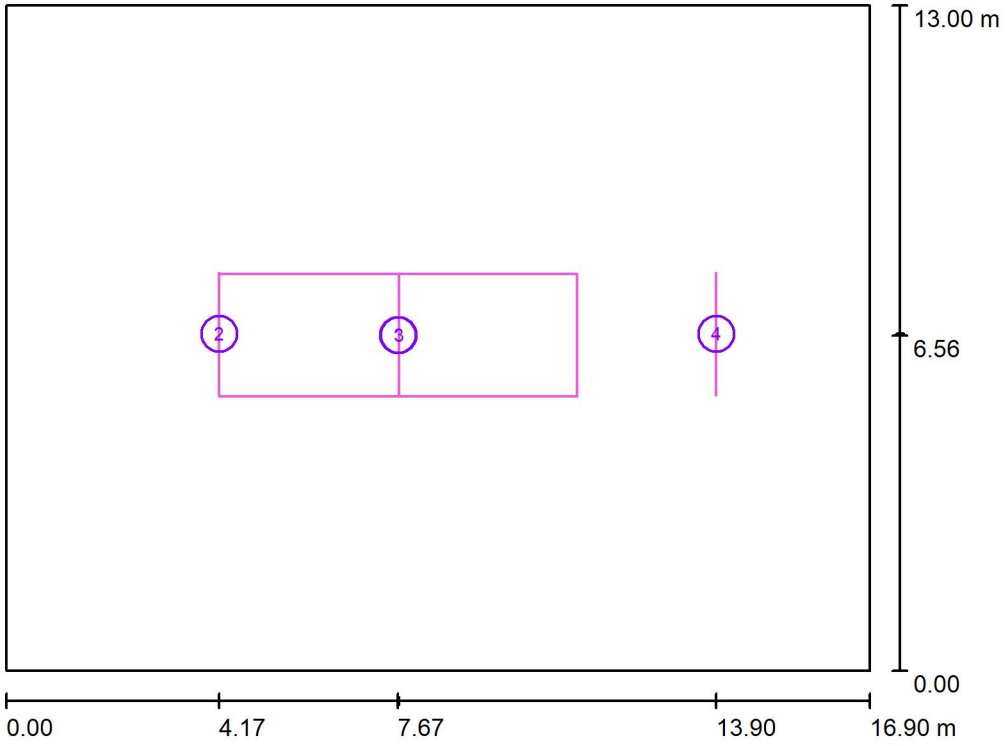
Pedestrian Crossings / Calculation surfaces (results overview)



Scale 1 : 148

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Horizontal at ground level	perpendicular	16 x 32	95	81	110	0.853	0.741
2	Along the kerb edge	perpendicular	8 x 8	34	27	39	0.810	0.693
3	At the centre of the crossing	perpendicular	16 x 16	42	29	61	0.682	0.476
4	At the rear of the waiting area	perpendicular	8 x 8	32	30	34	0.931	0.865

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	4	72	27	110	0.38	0.25

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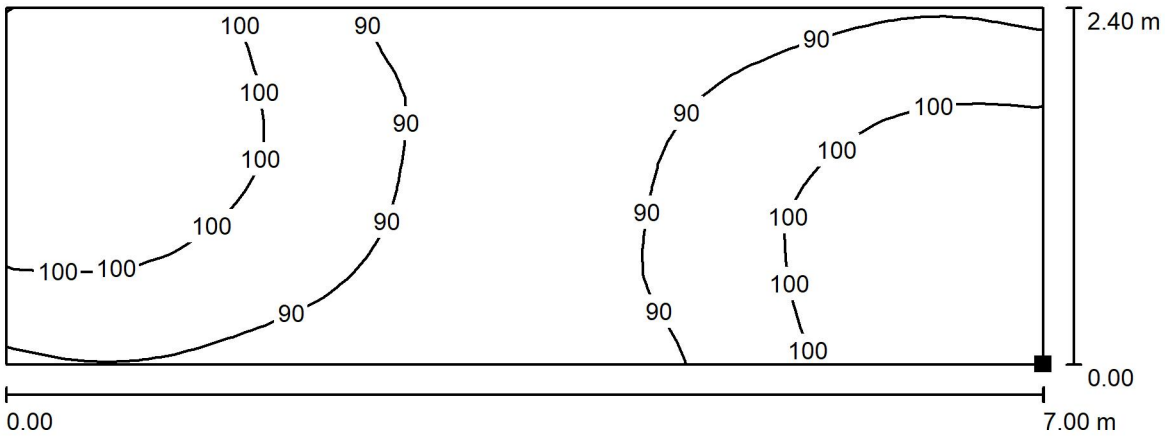
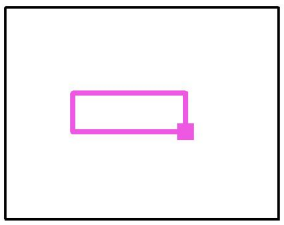
Pedestrian Crossings / Horizontal at ground level / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 51

Position of surface in external scene:
Marked point:
(11.170 m, 5.356 m, 1.000 m)



Grid: 16 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
95	81	110	0.853	0.741

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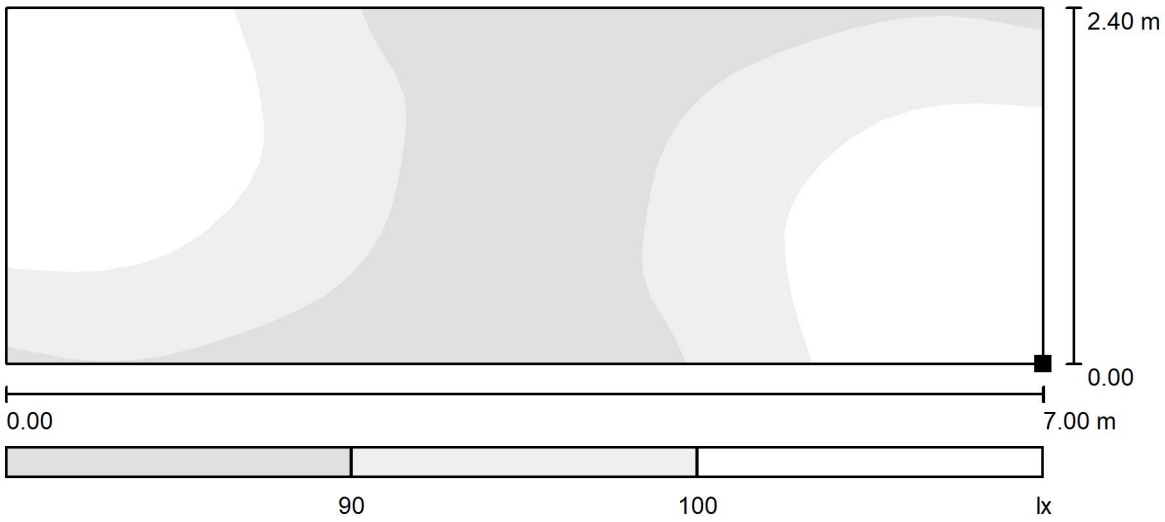
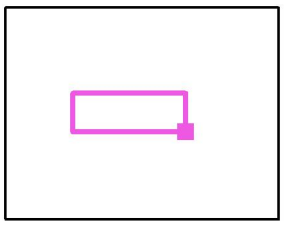
Pedestrian Crossings / Horizontal at ground level / Greyscale (E, Perpendicular)



Scale 1 : 51

Position of surface in external scene:
Marked point:
(11.170 m, 5.356 m, 1.000 m)



Grid: 16 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
95	81	110	0.853	0.741

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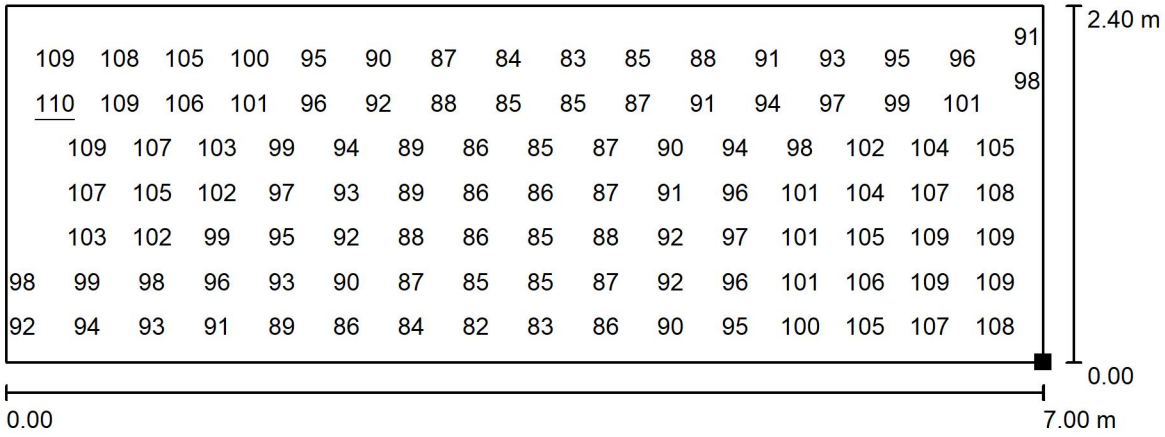
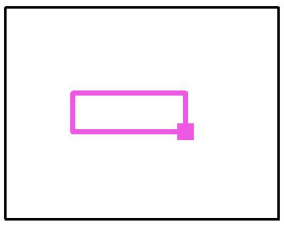
Pedestrian Crossings / Horizontal at ground level / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 51

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(11.170 m, 5.356 m, 1.000 m)



Grid: 16 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
95	81	110	0.853	0.741

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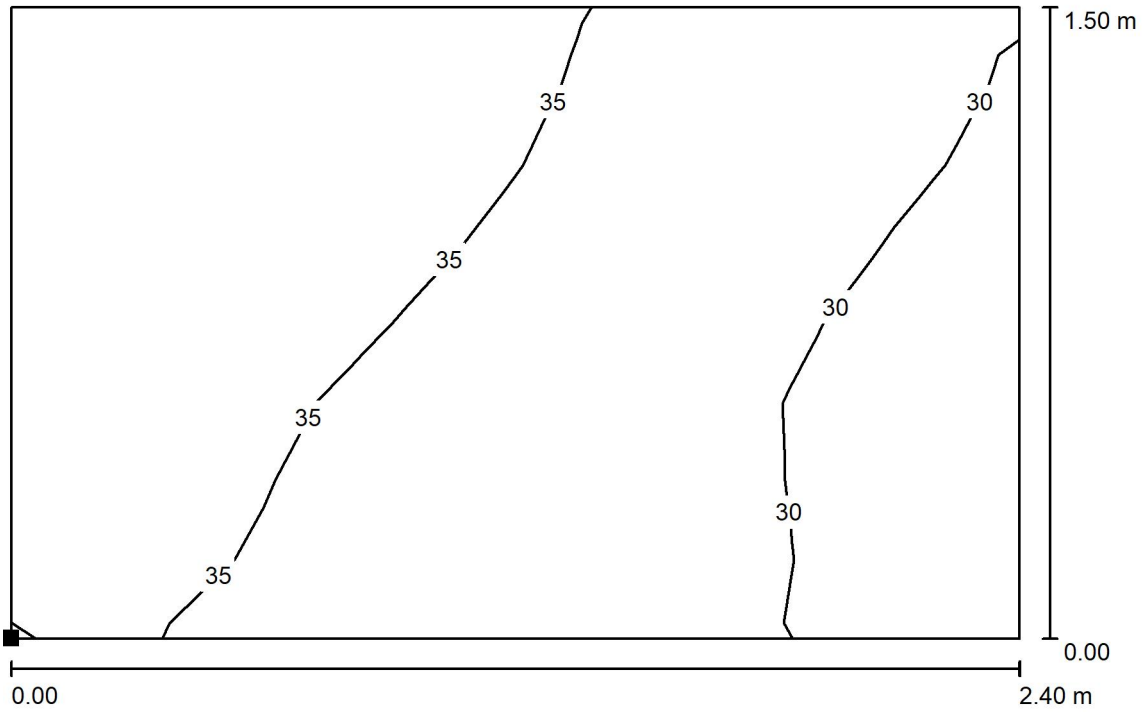
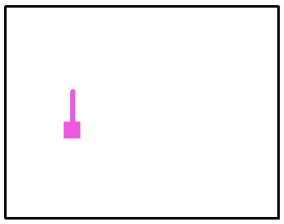
Pedestrian Crossings / Along the kerb edge / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 18

Position of surface in external scene:
Marked point:
(4.173 m, 5.381 m, 0.000 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
34	27	39	0.810	0.693

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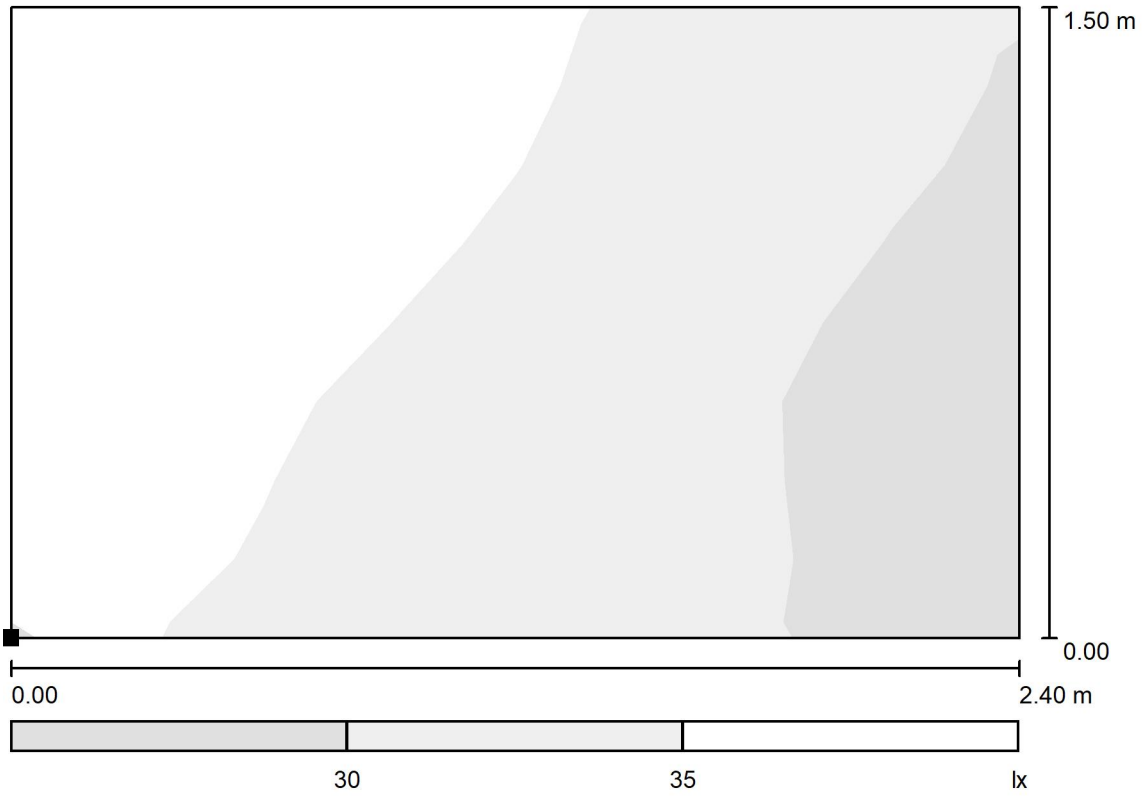
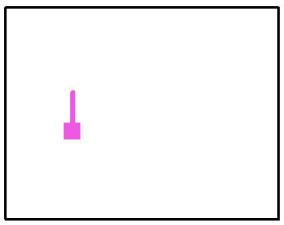
Pedestrian Crossings / Along the kerb edge / Greyscale (E, Perpendicular)



Scale 1 : 18

Position of surface in external scene:
Marked point:
(4.173 m, 5.381 m, 0.000 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
34	27	39	0.810	0.693

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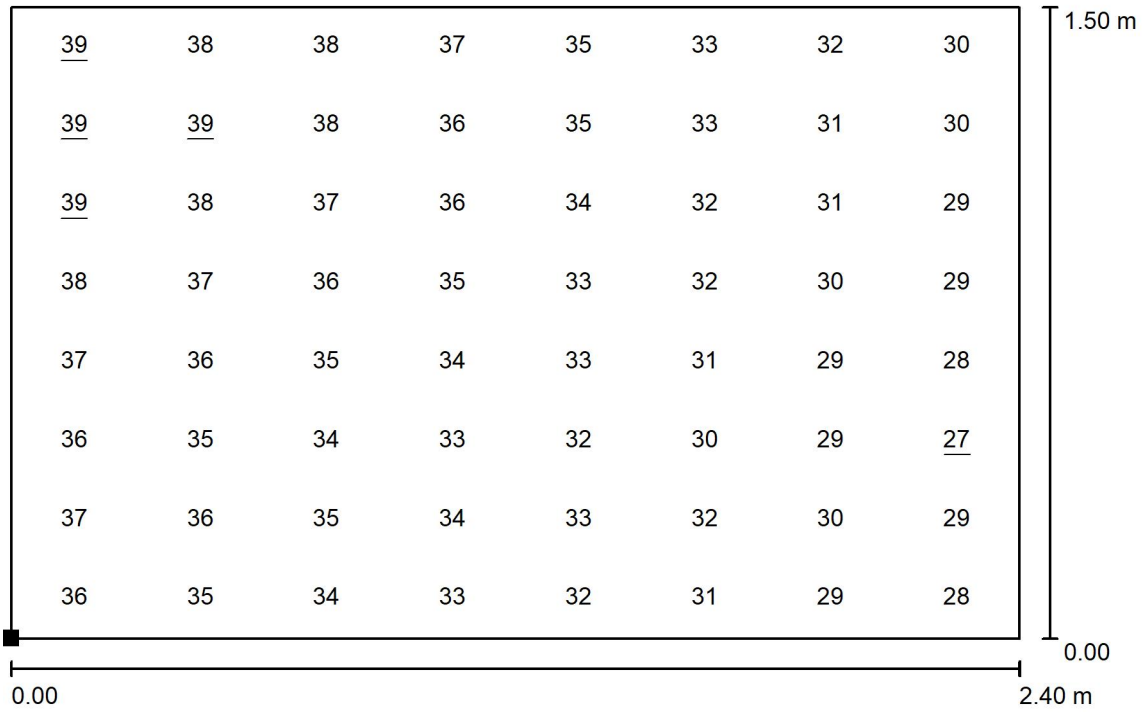
Pedestrian Crossings / Along the kerb edge / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 18

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Marked point:
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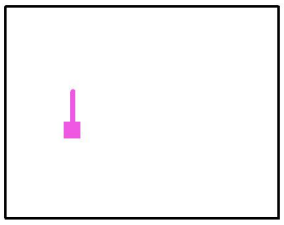

Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
34	27	39	0.810	0.693

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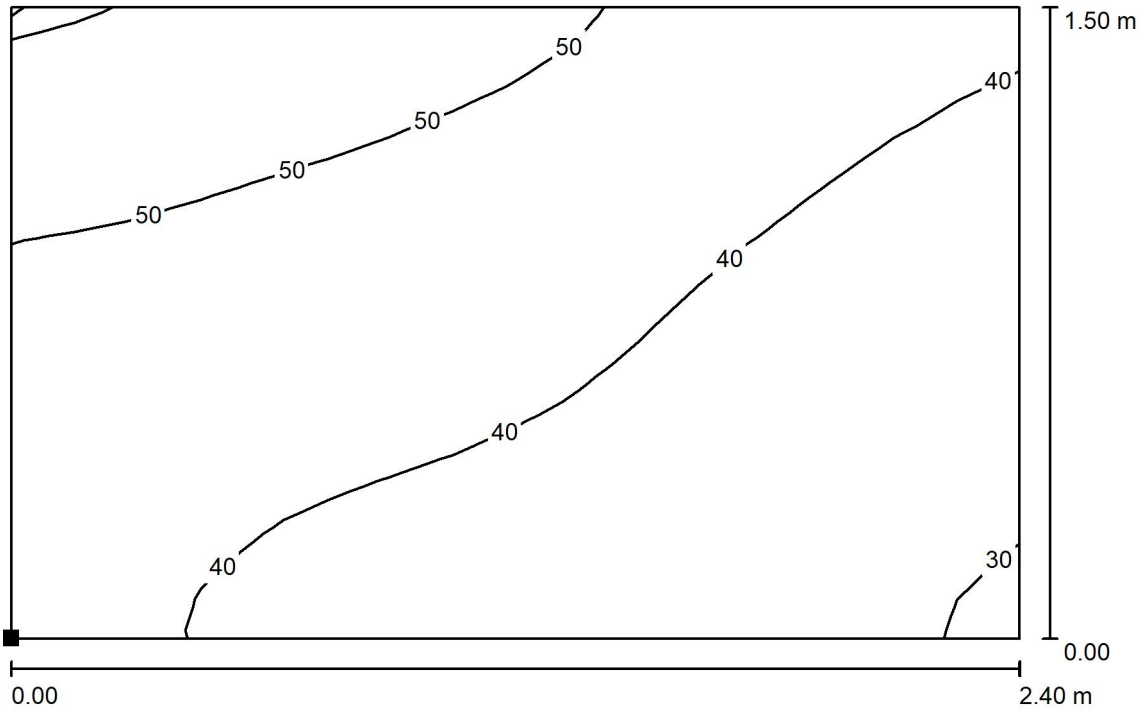
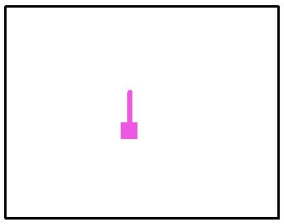
Pedestrian Crossings / At the centre of the crossing / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 18

Position of surface in external scene:
Marked point:
(7.688 m, 5.357 m, 0.000 m)



Grid: 16 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
42	29	61	0.682	0.476

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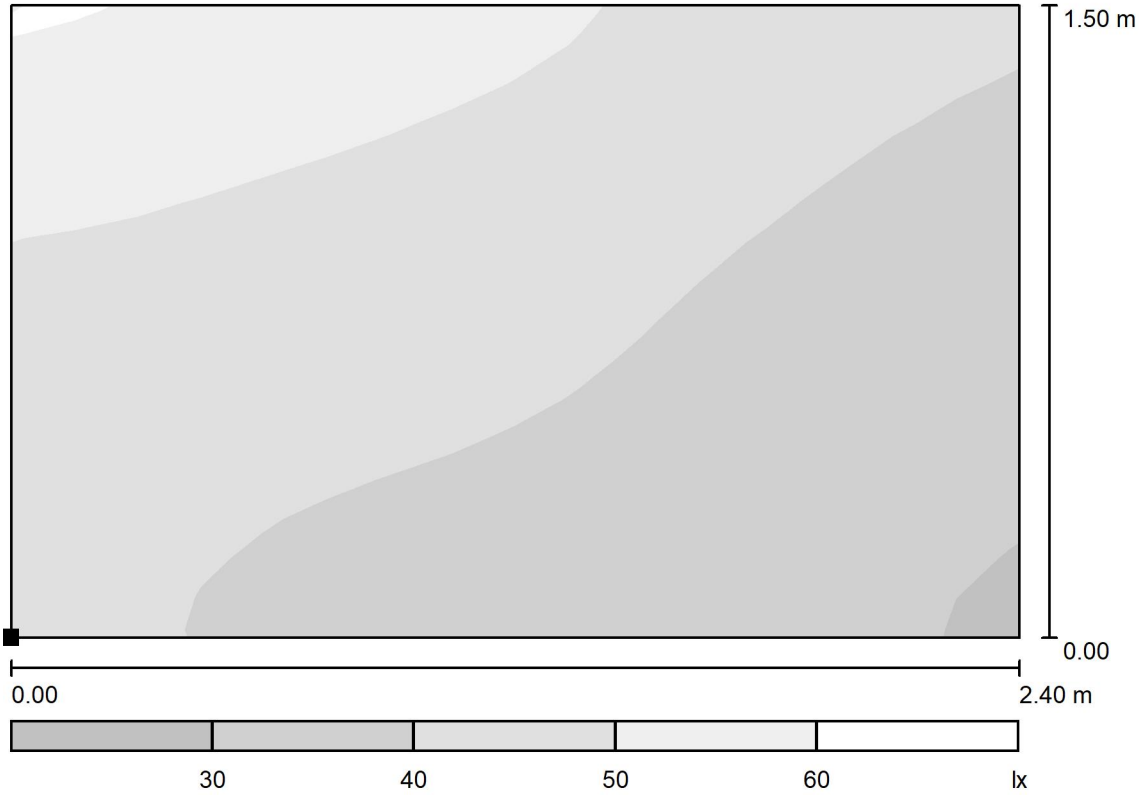
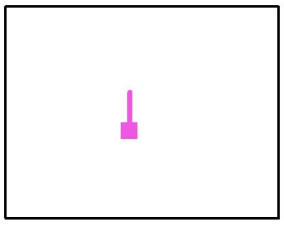


Scale 1 : 18

Position of surface in external scene:
Marked point:
(7.688 m, 5.357 m, 0.000 m)



Grid: 16 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
42	29	61	0.682	0.476

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Pedestrian Crossings / At the centre of the crossing / Value Chart (E, Perpendicular)

61	60	59	58	56	56	54	53	50	50	48	48	44	44	41	41
59	58	57	56	55	54	53	52	50	50	48	48	44	44	41	41
56	55	54	54	52	52	50	50	47	47	45	45	42	42	39	39
55	54	53	52	51	51	50	50	47	47	45	45	42	42	39	39
51	51	50	50	48	48	47	47	44	44	42	42	39	39	36	36
51	51	50	50	48	48	47	47	44	44	42	42	39	39	36	36
48	48	47	47	45	45	44	44	42	42	40	40	37	37	35	35
48	48	47	47	45	45	44	44	42	42	40	40	37	37	35	35
47	47	45	45	44	44	43	43	41	41	39	39	36	36	34	34
47	47	45	45	44	44	43	43	41	41	39	39	36	36	34	34
44	44	43	43	42	42	40	40	39	39	37	37	34	34	32	32
44	44	43	43	42	42	40	40	39	39	37	37	34	34	32	32
42	42	40	40	39	39	38	38	38	38	36	36	33	33	30	30
42	42	40	40	39	39	38	38	38	38	36	36	33	33	30	30
44	44	39	39	39	39	36	36	41	41	35	35	34	34	29	29
44	44	39	39	39	39	36	36	41	41	35	35	34	34	29	29

1.50 m

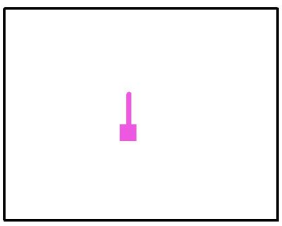
0.00

0.00

2.40 m

Values in Lux, Scale 1 : 18

Position of surface in external scene:
Marked point:
(7.688 m, 5.357 m, 0.000 m)



Grid: 16 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
42	29	61	0.682	0.476

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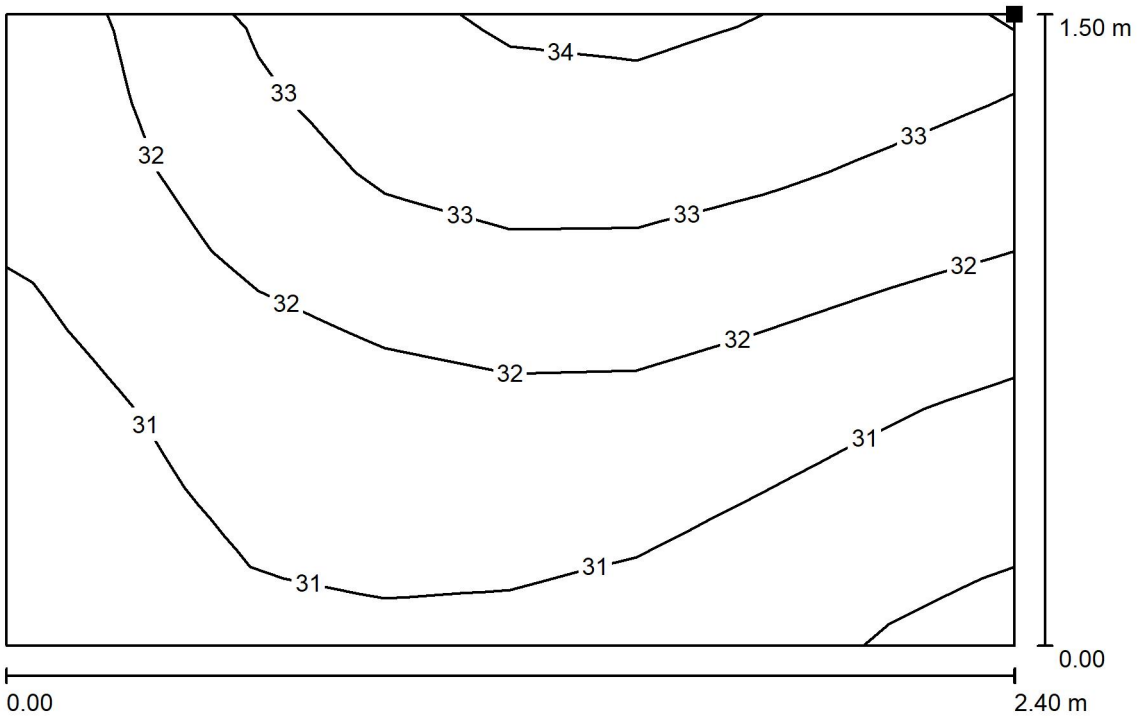
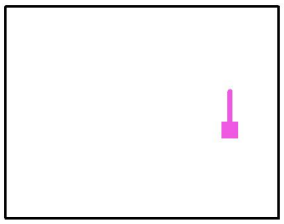
Pedestrian Crossings / At the rear of the waiting area / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 18

Position of surface in external scene:
Marked point:
(13.897 m, 5.378 m, 1.500 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
32	30	34	0.931	0.865

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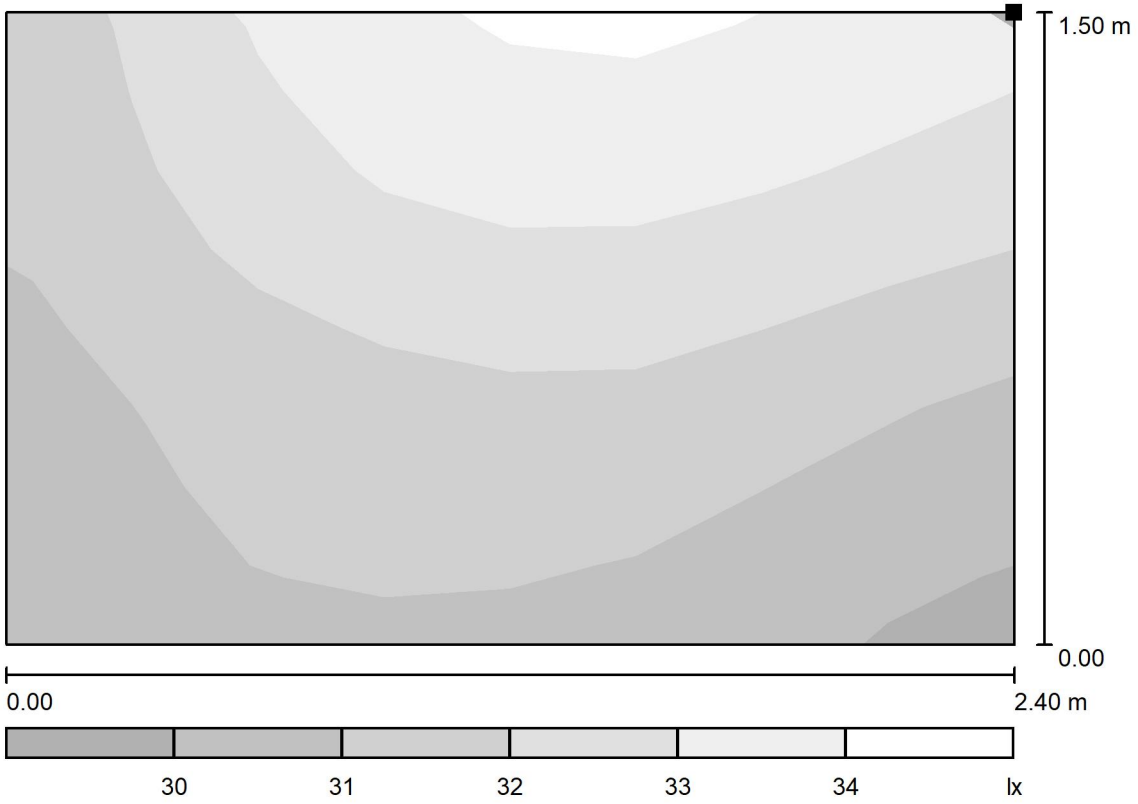
Pedestrian Crossings / At the rear of the waiting area / Greyscale (E, Perpendicular)



Scale 1 : 18

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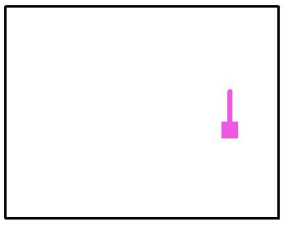
Marked point:
(13.897 m, 5.378 m, 1.500 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
32	30	34	0.931	0.865

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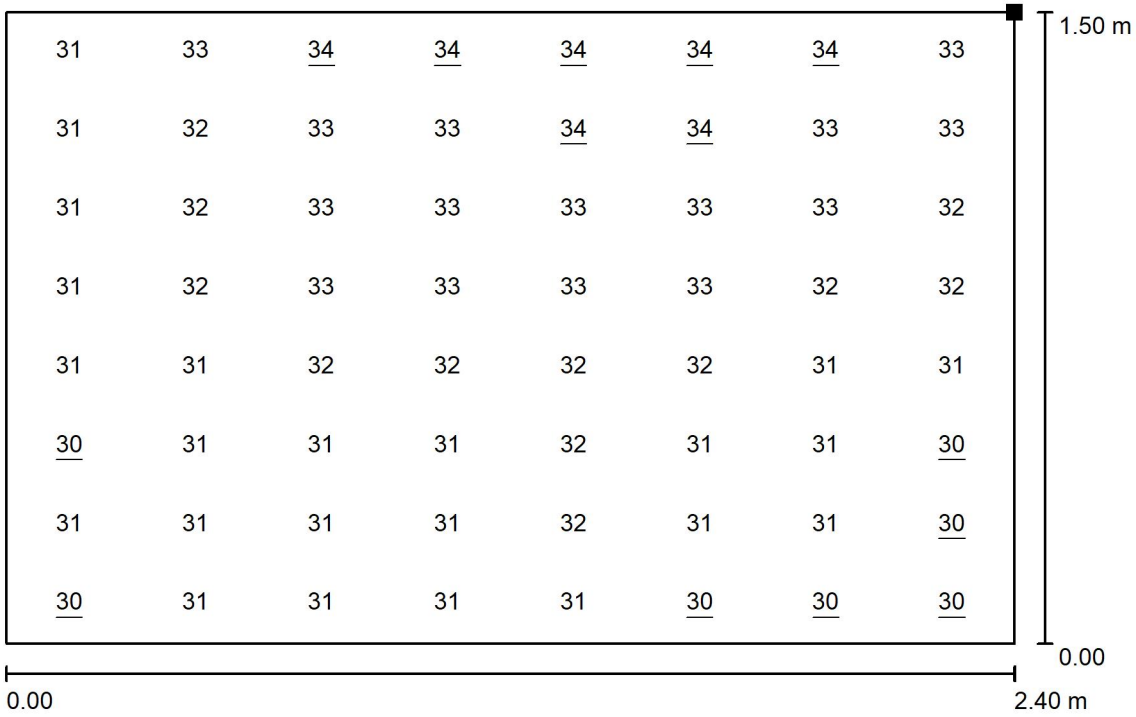
Pedestrian Crossings / At the rear of the waiting area / Value Chart (E, Perpendicular)



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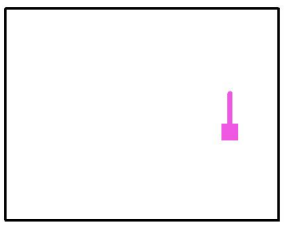

Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
32	30	34	0.931	0.865

Luton Airport Expansion

Short Stay Car Park 4000 Spaces

Date: 28.06.2019
Operator: Katerina Konsta

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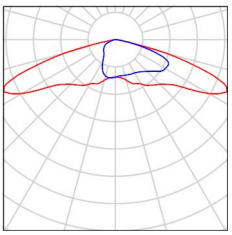
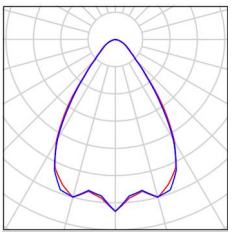
Luton Airport Expansion / Luminaire parts list

27 Pieces WE-EF 108-0975 VFL540 [R65] IP66:LED-36/36W/4K
Article No.: 108-0975
Luminous flux (Luminaire): 4324 lm
Luminous flux (Lamps): 4842 lm
Luminaire Wattage: 42.0 W
Luminaire classification according to CIE: 100
CIE flux code: 27 59 94 100 89
Fitting: 36 x LED-36/36W/840 - 4000K (Correction Factor 1.000).



33 Pieces Zumtobel 42183262 CRAFT S LED7500-840 PM WB LDO WH [STD]
Article No.: 42183262
Luminous flux (Luminaire): 7500 lm
Luminous flux (Lamps): 7500 lm
Luminaire Wattage: 58.0 W
Luminaire classification according to CIE: 100
CIE flux code: 77 95 99 100 100
Fitting: 1 x LED-Z42183262 58W (Correction Factor 1.000).



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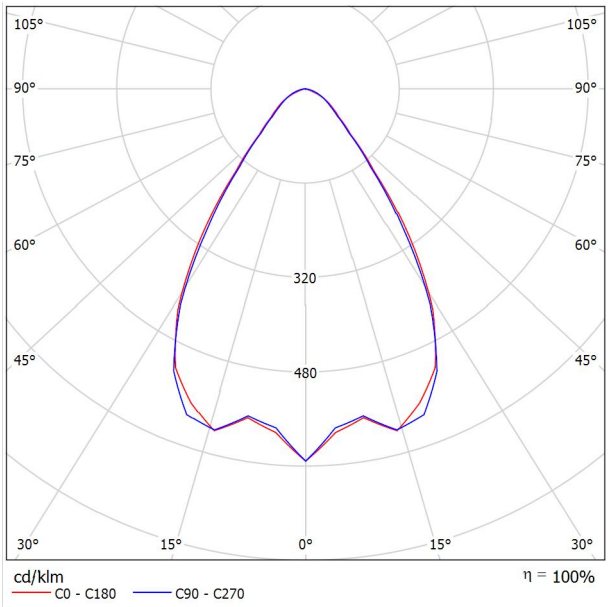
Zumtobel 42183262 CRAFT S LED7500-840 PM WB LDO WH [STD] / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 77 95 99 100 100

LED high-bay luminaire total power: 58 W, includes DALI- and emergency supply-compatible LED converter, die-cast aluminium housing in matt, white. Powder-coated cooling ribs for optimum thermal management and minimal dust accumulation. Cover of clear Polymethylmethacrylate (PM) and a supplementary glass cover (ESG) for challenging industrial applications. Slave luminaire for DALI control (DALI only) with LED converter. LED service life lasts 50000 h before luminous flux is reduced to 85% of the initial value over the entire ambient temperature range. Chromaticity tolerance (initial MacAdam): 4. Luminaire luminous flux: 7500 lm, Luminaire efficacy: 129 lm/W.Colour rendering Ra > 80, colour temperature 4000 K. Sealed, high-efficiency optical lens system, Luminaire with symmetric wide light distribution (wide beam) square, UGR <22. Pre-assembled 5 x 1mm² connecting cable, length 1.5m, with free ends, included in scope of supply (suspension with at least 65 mm distance to ceiling); Luminaire wired with halogen-free and silicone-free leads. Note: please contact your consultant if you are planning to use in ambient atmospheres with chemical load, high or condensing air humidity, large temperature fluctuations or projects with the necessary absence of silicone. Class of protection: SC1; degree of protection: IP65; ambient temperature: -25°C to +45°C; Dimensions: 339 x 165 x 100 mm. Weight: 2.82 kg.

Luminous emittance 1:

Glare Evaluation According to UGR

ρ Ceiling		70	70	50	50	30	70	70	50	50	30
ρ Walls		50	30	50	30	30	50	30	50	30	30
ρ Floor		20	20	20	20	20	20	20	20	20	20
Room Size X	Y	Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
2H	2H	18.4	19.3	18.7	19.5	19.7	17.7	18.6	18.0	18.8	19.1
	3H	18.9	19.7	19.2	19.9	20.2	18.7	19.5	19.0	19.8	20.0
	4H	18.9	19.6	19.2	19.9	20.2	19.1	19.8	19.4	20.1	20.4
	6H	18.8	19.5	19.1	19.8	20.1	19.3	20.0	19.6	20.3	20.5
	8H	18.8	19.5	19.1	19.8	20.1	19.3	20.0	19.6	20.3	20.6
	12H	18.7	19.4	19.1	19.7	20.0	19.3	20.0	19.7	20.3	20.6
4H	2H	18.7	19.5	19.0	19.7	20.0	18.1	18.9	18.5	19.2	19.4
	3H	19.3	20.0	19.7	20.3	20.6	19.3	20.0	19.7	20.3	20.6
	4H	19.3	19.9	19.7	20.2	20.6	19.8	20.3	20.1	20.7	21.0
	6H	19.3	19.8	19.7	20.1	20.5	20.0	20.5	20.4	20.9	21.3
	8H	19.3	19.7	19.7	20.1	20.5	20.1	20.5	20.5	20.9	21.3
	12H	19.2	19.6	19.7	20.0	20.4	20.1	20.5	20.6	20.9	21.3
8H	4H	19.4	19.8	19.8	20.2	20.6	19.8	20.2	20.2	20.6	21.0
	6H	19.4	19.7	19.8	20.1	20.6	20.1	20.4	20.5	20.9	21.3
	8H	19.3	19.6	19.8	20.1	20.5	20.2	20.5	20.7	20.9	21.4
	12H	19.3	19.6	19.8	20.0	20.5	20.3	20.5	20.7	21.0	21.5
12H	4H	19.4	19.7	19.8	20.1	20.6	19.8	20.1	20.2	20.5	21.0
	6H	19.3	19.6	19.8	20.1	20.5	20.1	20.4	20.5	20.8	21.3
	8H	19.3	19.6	19.8	20.0	20.5	20.2	20.4	20.7	20.9	21.4

Variation of the observer position for the luminaire distances S

S = 1.0H	+2.4 / -2.6	+2.2 / -2.0
S = 1.5H	+3.4 / -3.7	+3.1 / -2.8
S = 2.0H	+5.0 / -5.2	+4.7 / -3.5
Standard table	BK01	BK01
Correction Summand	-2.8	-2.8

Corrected Glare Indices referring to 7500lm Total Luminous Flux

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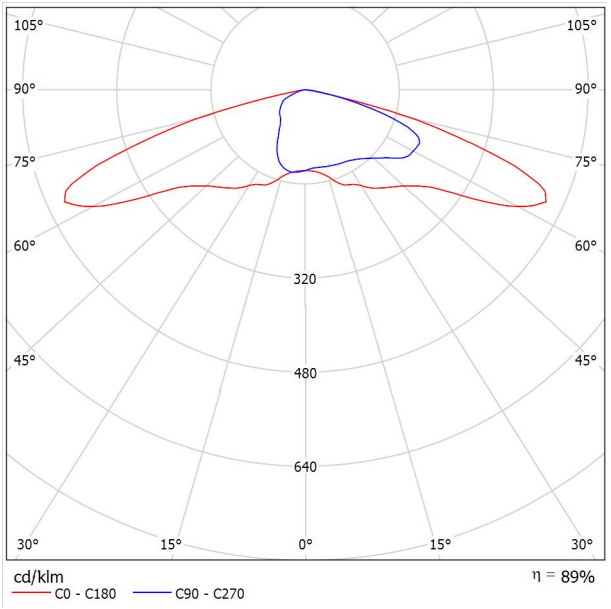
WE-EF 108-0975 VFL540 [R65] IP66:LED-36/36W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 27 59 94 100 89

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D = 60 x 80 mm or D = 76 x 80 mm (to be specified at order placement).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

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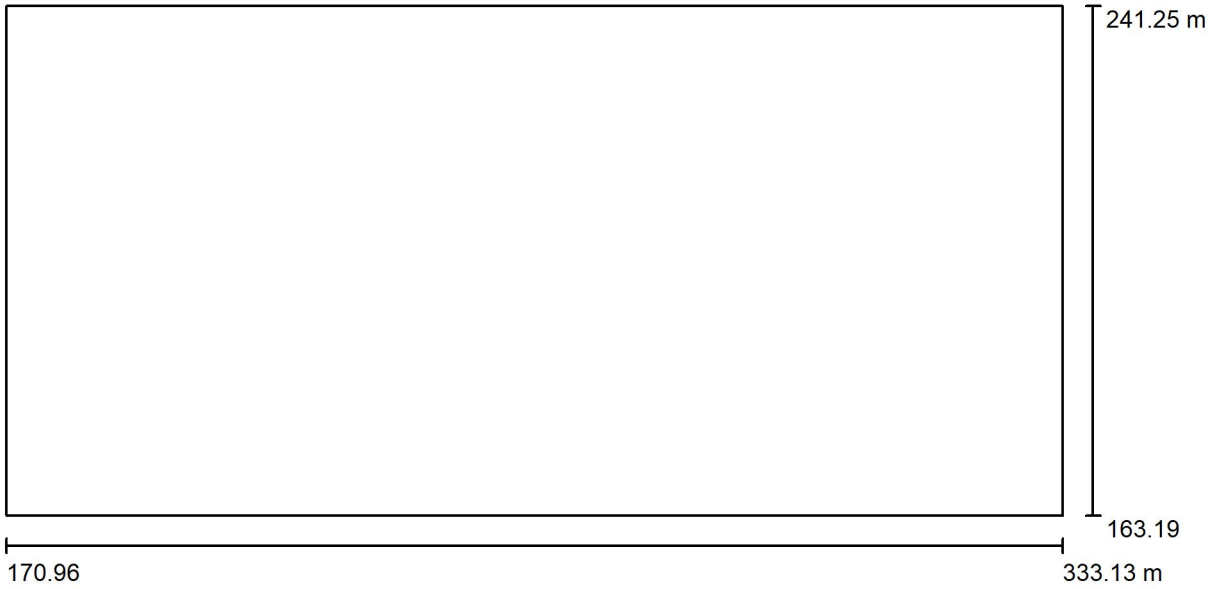
Short Stay Car Park 4000 Spaces / Planning data



Maintenance factor: 0.57, ULR (Upward Light Ratio): 0.0%

Scale 1:1160

Exterior Parking Areas
Average Illuminance: 10lux
Uniformity: 0.25
Interior Parking Areas
Average Illuminance: 75lux
Uniformity: 0.4
Entrance (In/Out) Daytime: 300 lux
Entrance (In/Out) Nightime: 75 lux
(...)

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	27	WE-EF 108-0975 VFL540 [R65] IP66:LED-36/36W/4K (1.000)	4324	4842	42.0
2	33	Zumtobel 42183262 CRAFT S LED7500-840 PM WB LDO WH [STD] (1.000)	7500	7500	58.0
			Total: 364254	Total: 378234	3048.0

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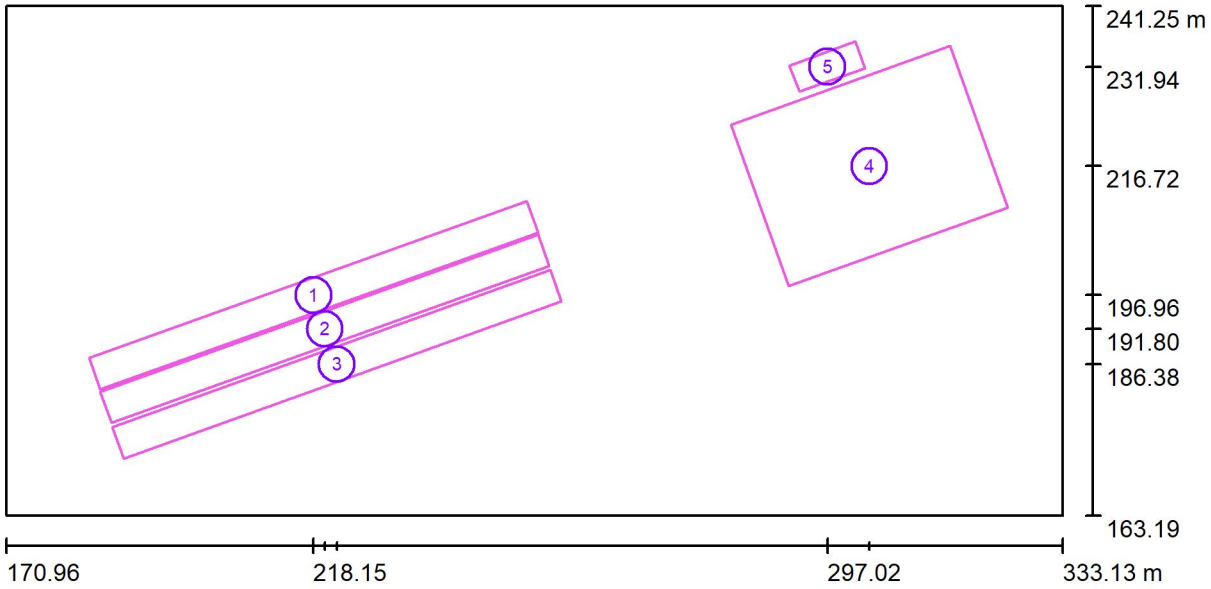
Short Stay Car Park 4000 Spaces / Calculation surfaces (results overview)



Scale 1 : 1160

Calculation Surface List

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1	Typical Calculation - Parking Single Row Area 01	perpendicular	128 x 32	16	7.08	27	0.431	0.263
2	Typical Calculation - Traffic Lane	perpendicular	128 x 32	12	6.74	14	0.564	0.484
3	Typical Calculation - Parking Single Row Area 02	perpendicular	128 x 32	14	6.88	19	0.493	0.369
4	Typical Calculation - Parking Coaches	perpendicular	128 x 32	79	38	219	0.482	0.174
5	Typical Calculation - Parking Coaches - Entrance	perpendicular	32 x 128	323	182	413	0.564	0.440

Summary of Results

Type	Quantity	Average [lx]	Min [lx]	Max [lx]	u0	E_{min} / E_{max}
perpendicular	5	50	6.74	413	0.13	0.02

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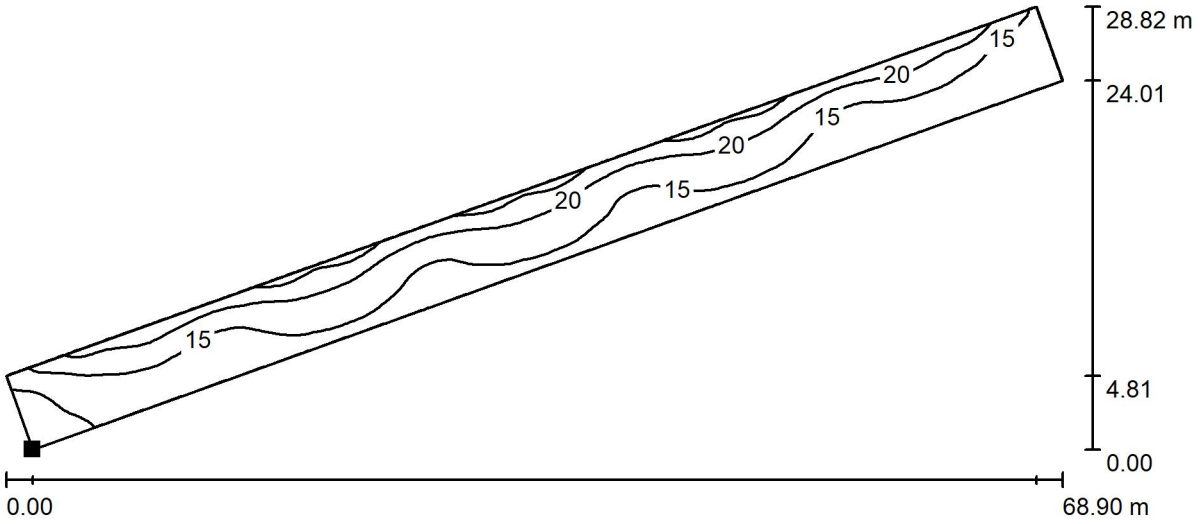
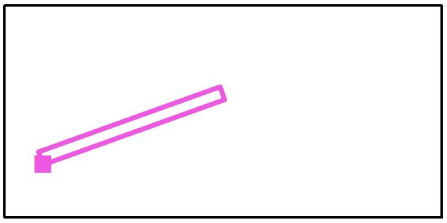
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 01 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 493

Position of surface in external scene:
Marked point:
(185.421 m, 182.550 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
16	7.08	27	0.431	0.263

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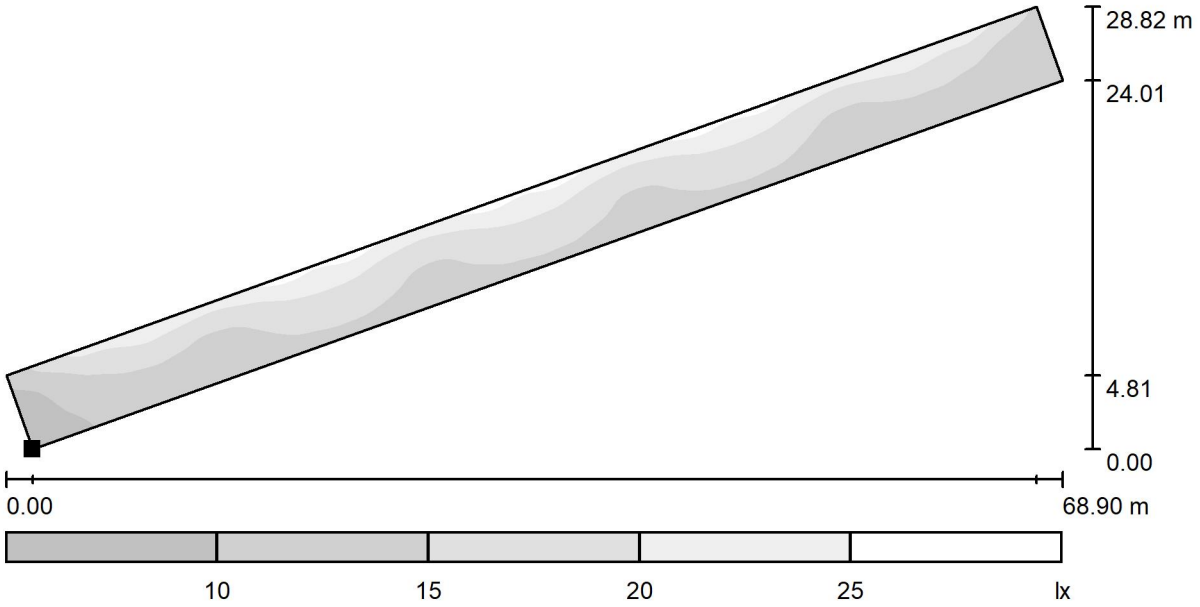
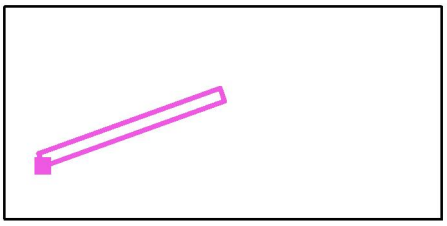
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 01 / Greyscale (E, Perpendicular)



Scale 1 : 493

Position of surface in external scene:
Marked point:
(185.421 m, 182.550 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
16	7.08	27	0.431	0.263

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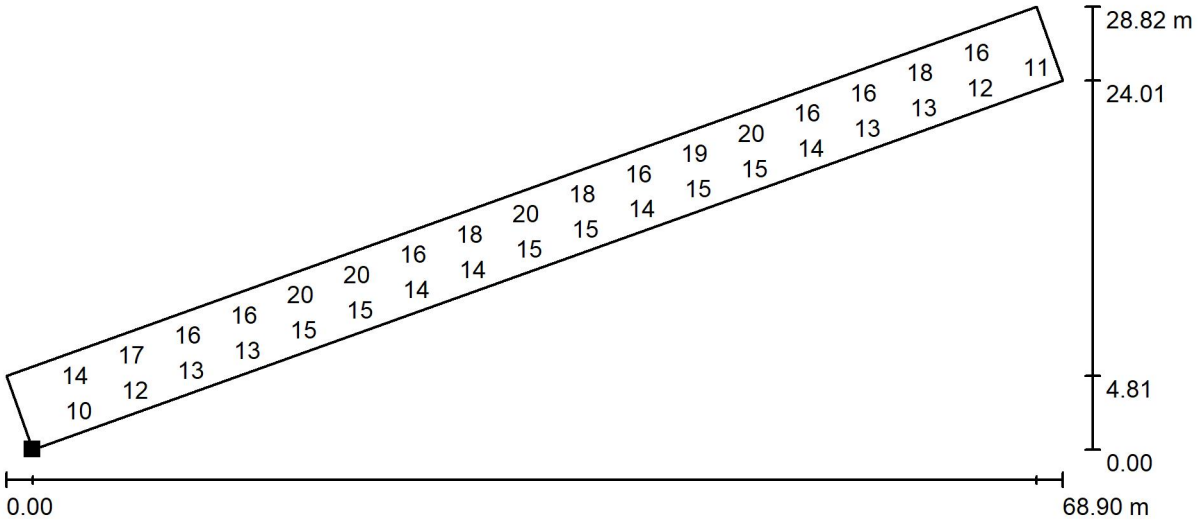
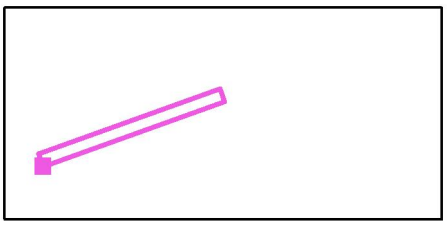
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 01 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 493

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(185.421 m, 182.550 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
16	7.08	27	0.431	0.263

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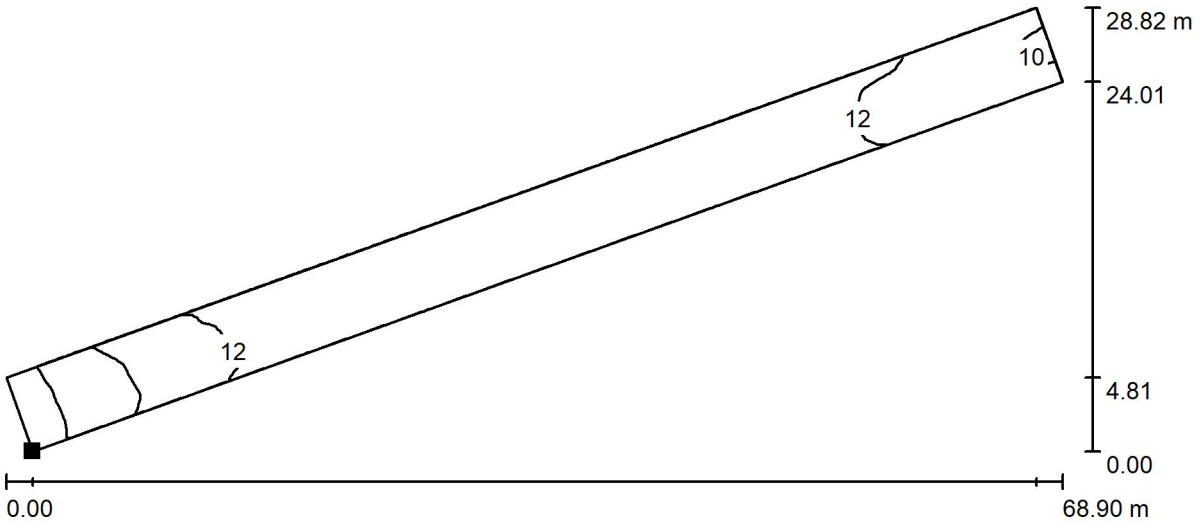
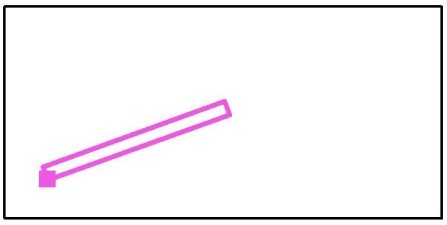
Short Stay Car Park 4000 Spaces / Typical Calculation - Traffic Lane / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 493

Position of surface in external scene:
Marked point:
(187.128 m, 177.388 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
12	6.74	14	0.564	0.484

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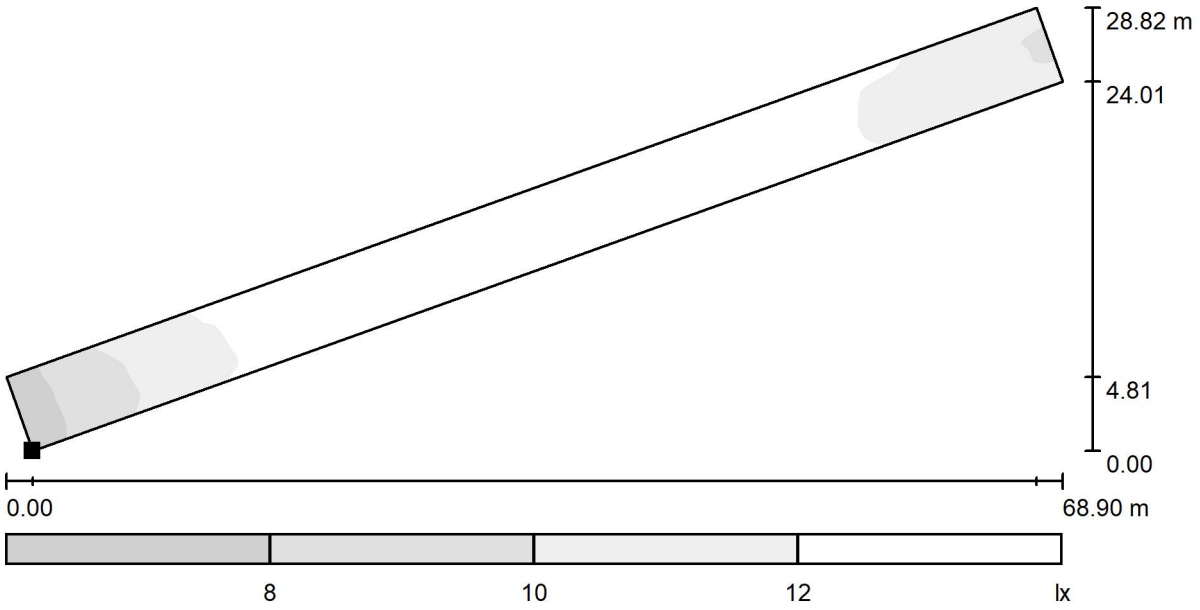
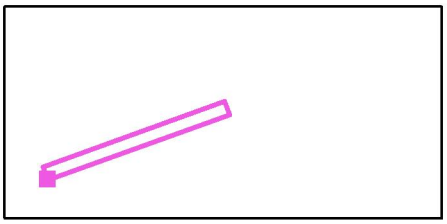
Short Stay Car Park 4000 Spaces / Typical Calculation - Traffic Lane / Greyscale (E, Perpendicular)



Scale 1 : 493

Position of surface in external scene:
Marked point:
(187.128 m, 177.388 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
12	6.74	14	0.564	0.484

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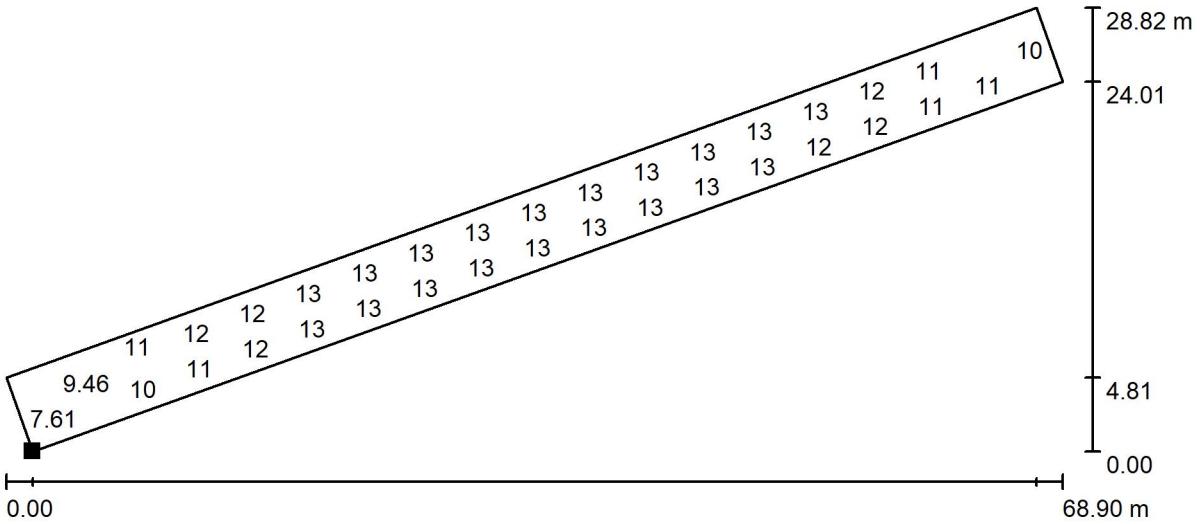
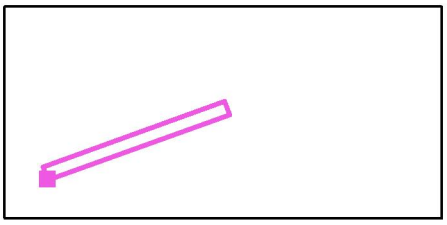
Short Stay Car Park 4000 Spaces / Typical Calculation - Traffic Lane / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 493

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(187.128 m, 177.388 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
12	6.74	14	0.564	0.484

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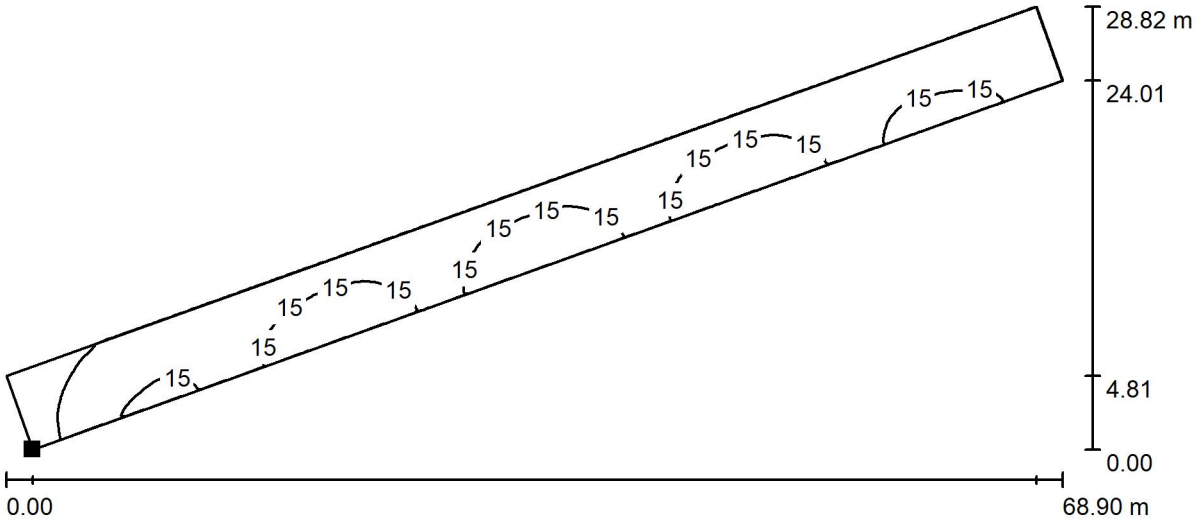
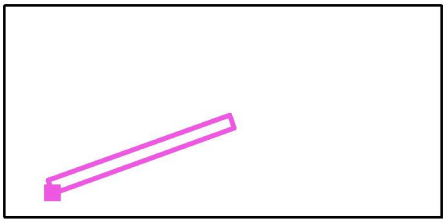
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 02 / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 493

Position of surface in external scene:
Marked point:
(189.000 m, 171.970 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
14	6.88	19	0.493	0.369

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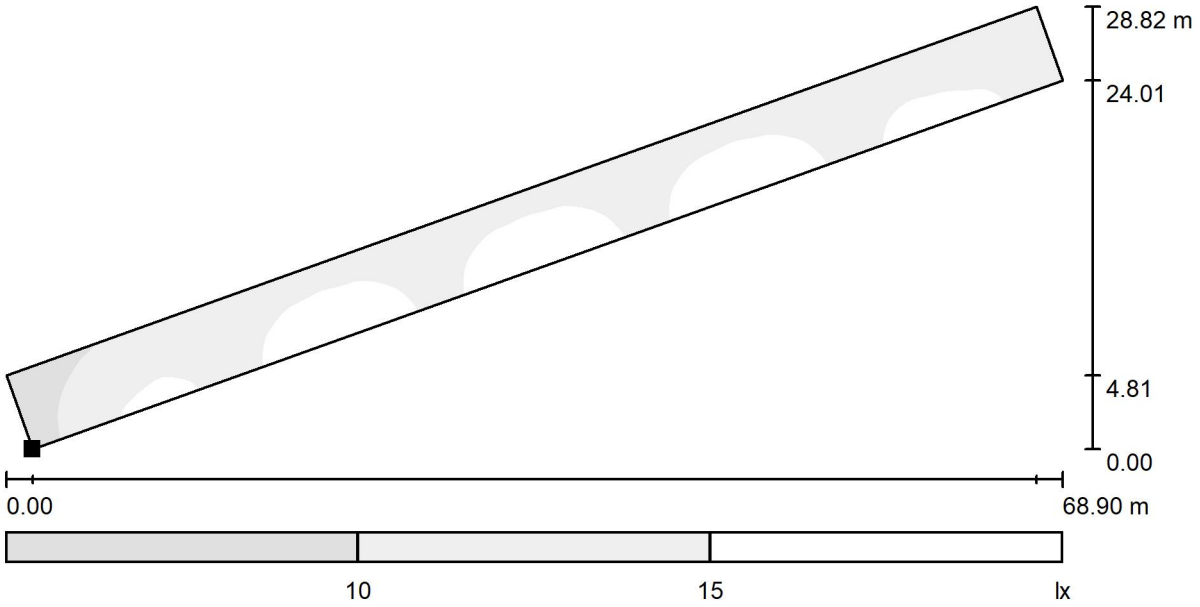
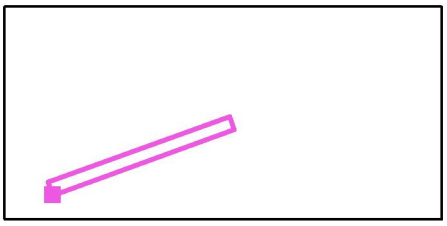
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 02 / Greyscale (E, Perpendicular)



Scale 1 : 493

Position of surface in external scene:
Marked point:
(189.000 m, 171.970 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
14	6.88	19	0.493	0.369

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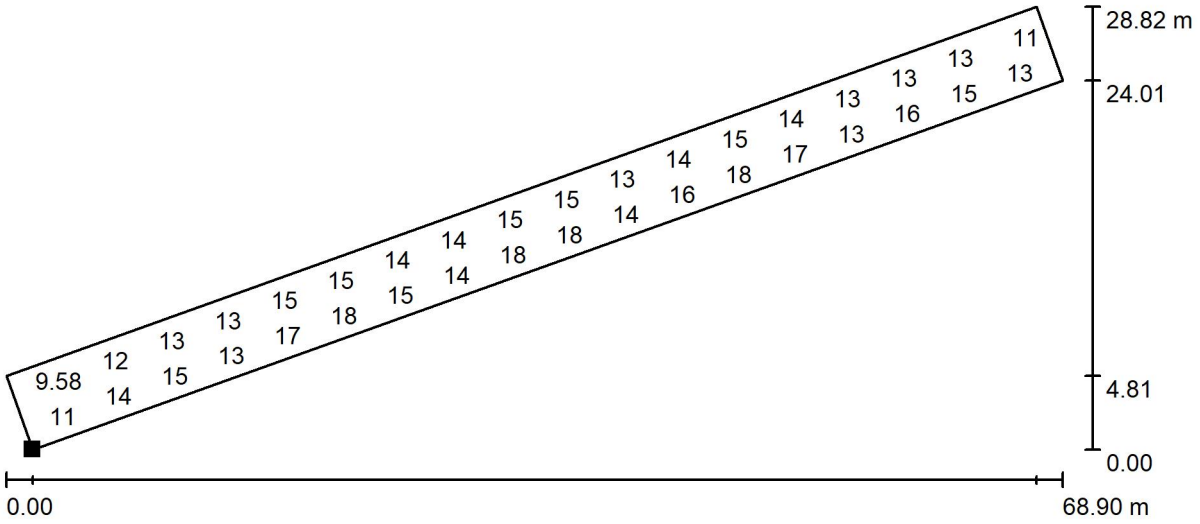
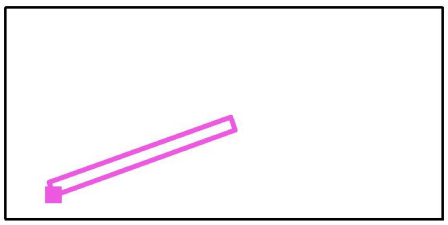
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Single Row Area 02 / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 493

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(189.000 m, 171.970 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
14	6.88	19	0.493	0.369

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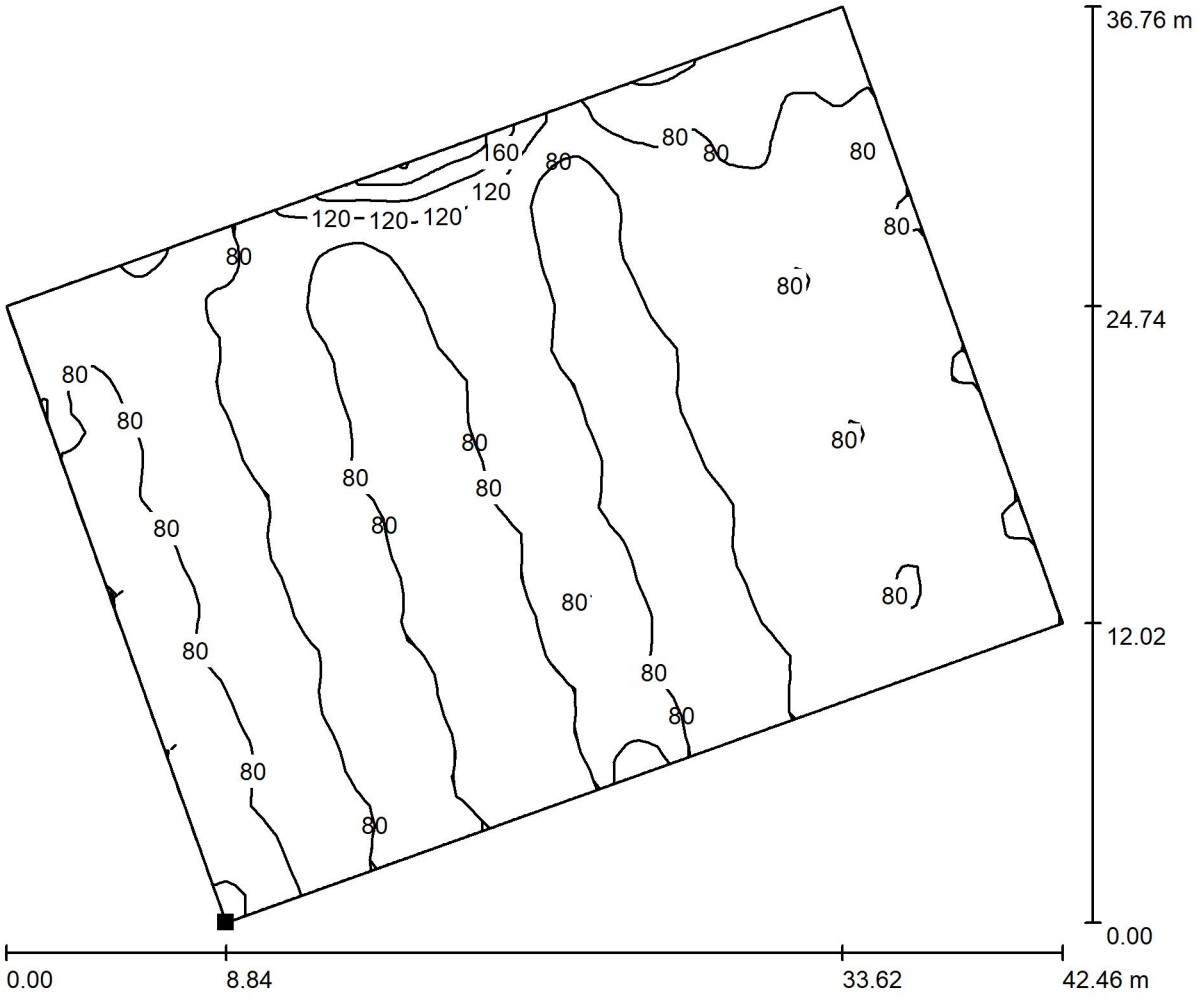
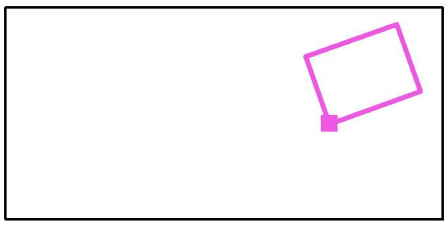
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 304

Position of surface in external scene:
Marked point:
(291.083 m, 198.337 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
79	38	219	0.482	0.174

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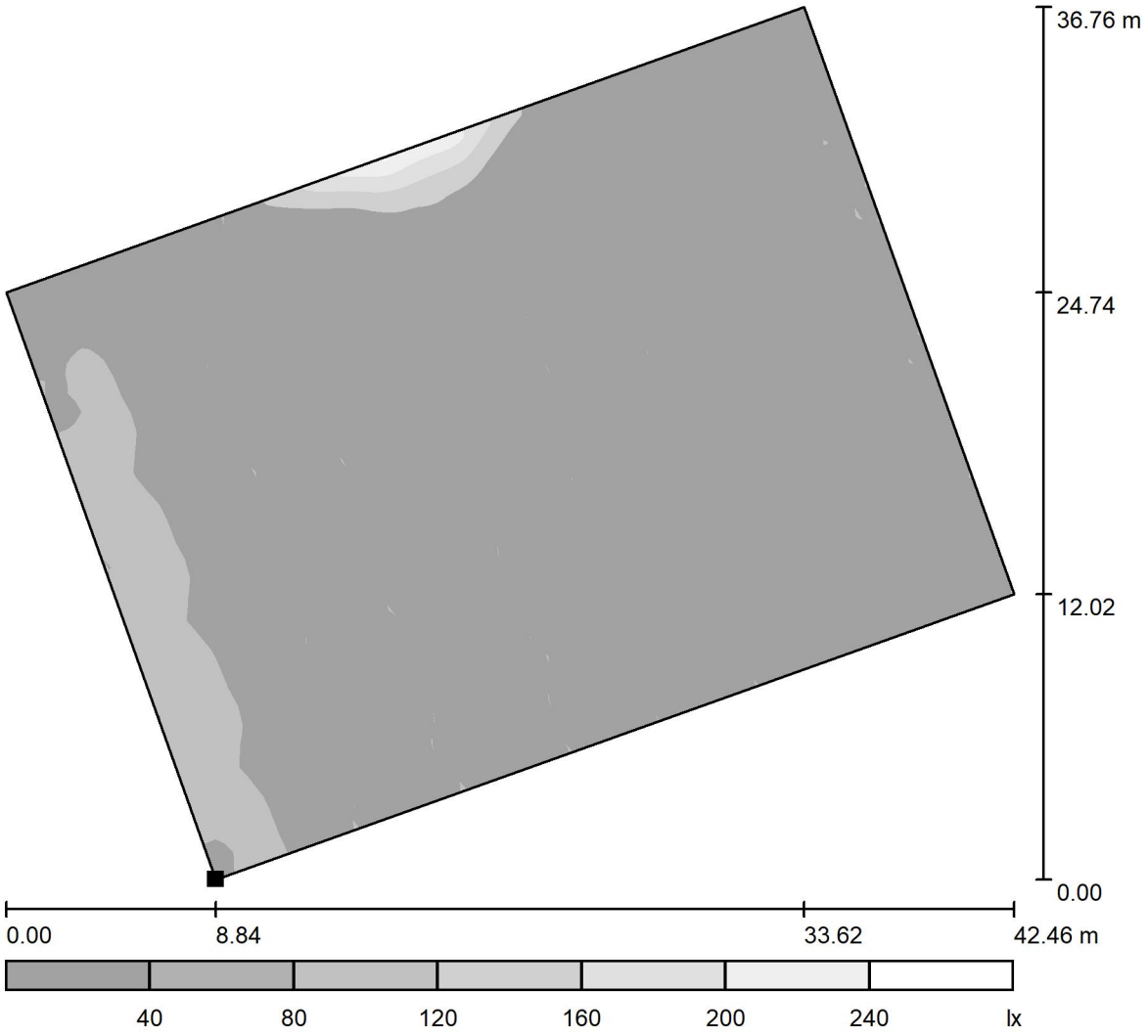
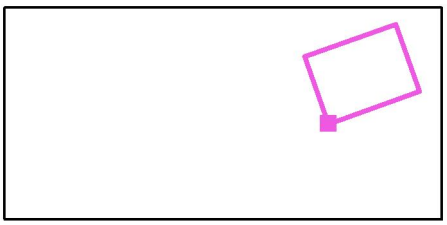
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches / Greyscale (E, Perpendicular)



Scale 1 : 312

Position of surface in external scene:
Marked point:
(291.083 m, 198.337 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
79	38	219	0.482	0.174

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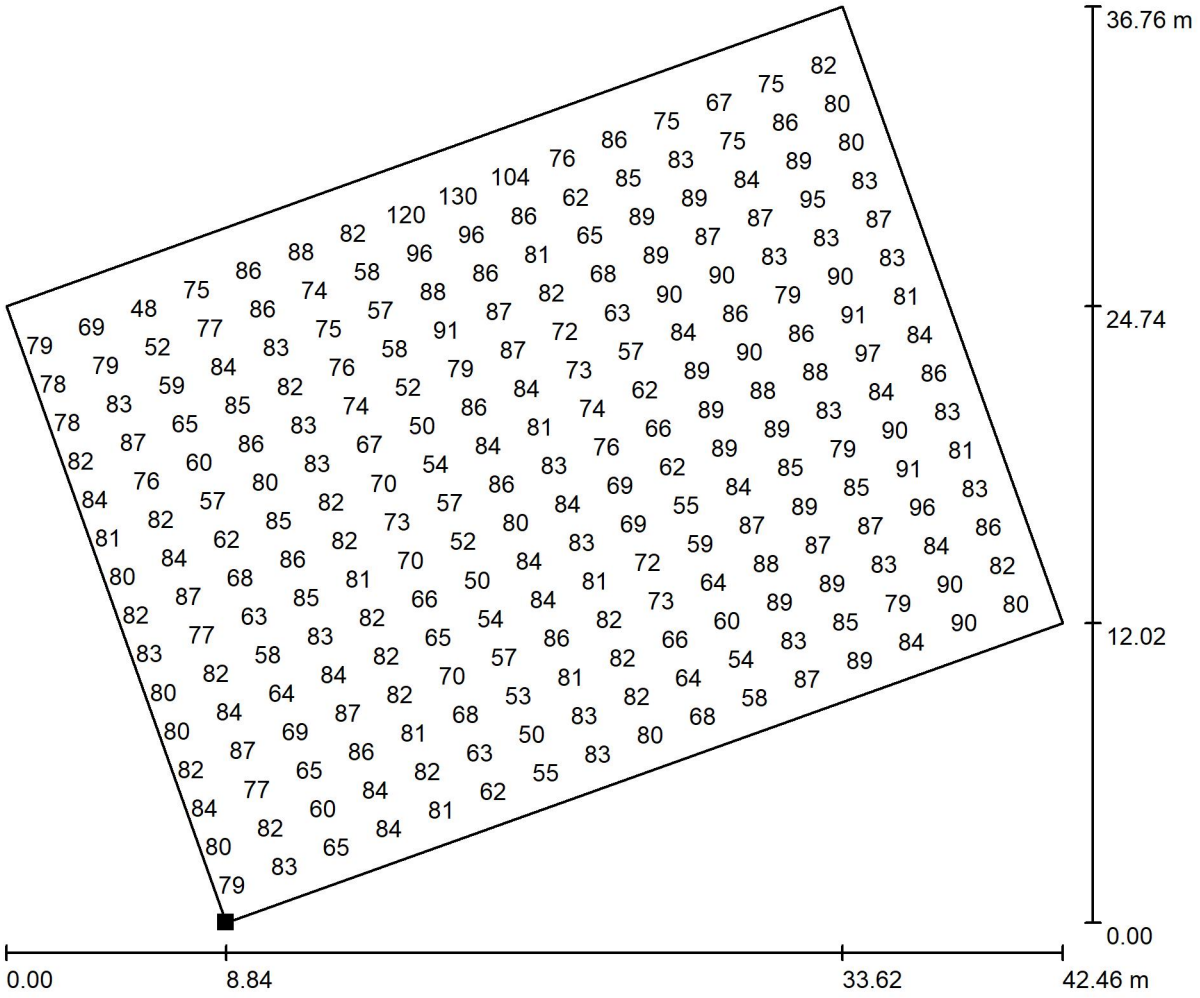
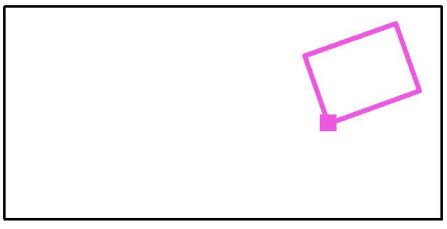
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 304

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(291.083 m, 198.337 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
79	38	219	0.482	0.174

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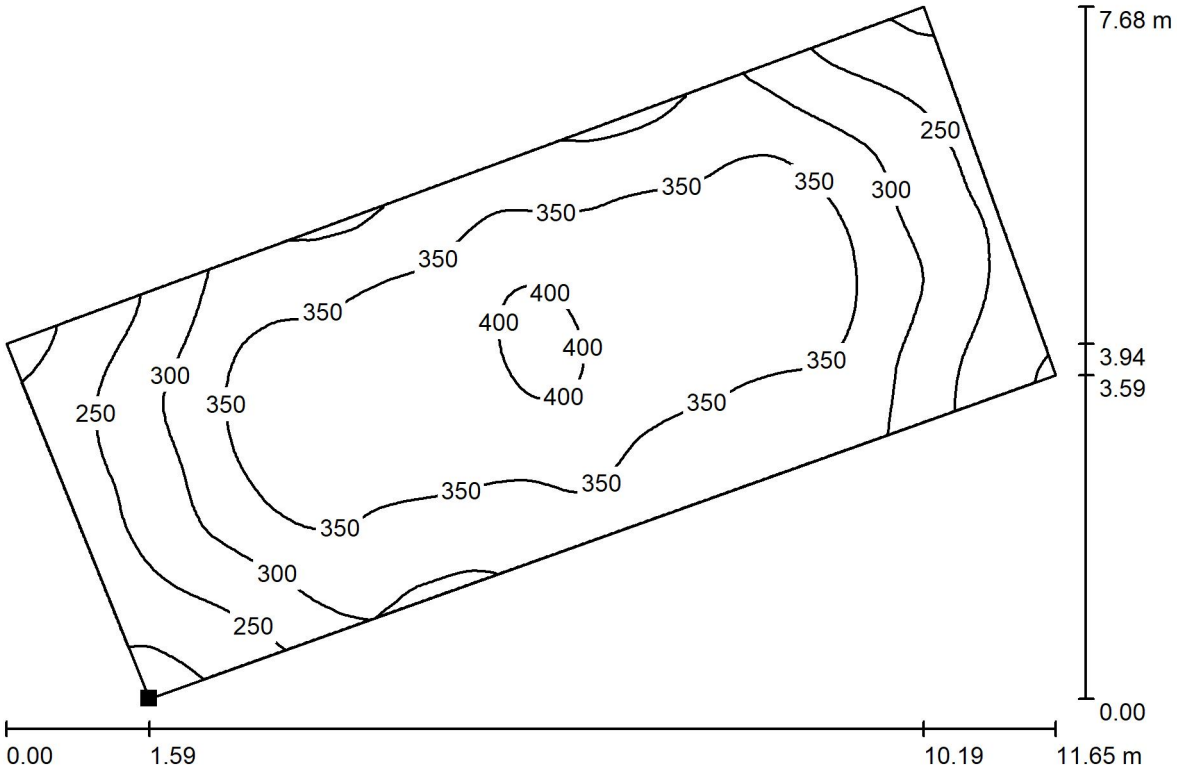
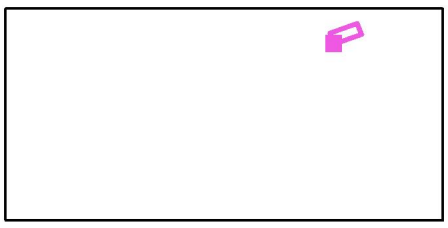
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches - Entrance / Isolines (E, Perpendicular)



Values in Lux, Scale 1 : 84

Position of surface in external scene:
Marked point:
(292.733 m, 228.126 m, 0.750 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
323	182	413	0.564	0.440

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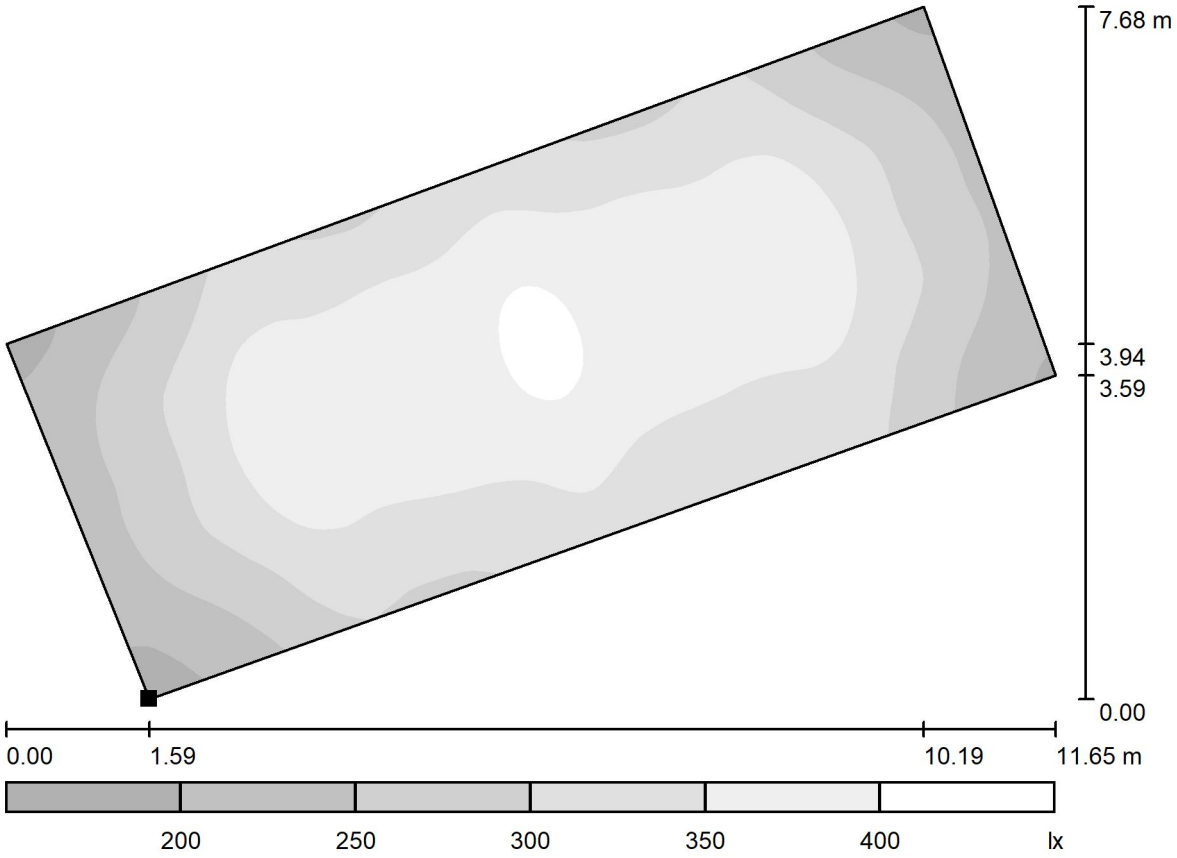
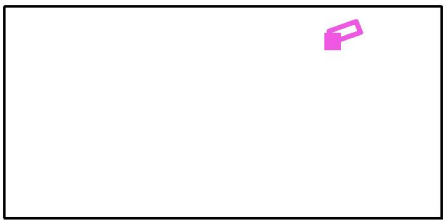
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches - Entrance / Greyscale (E, Perpendicular)



Scale 1 : 84

Position of surface in external scene:
Marked point:
(292.733 m, 228.126 m, 0.750 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
323	182	413	0.564	0.440

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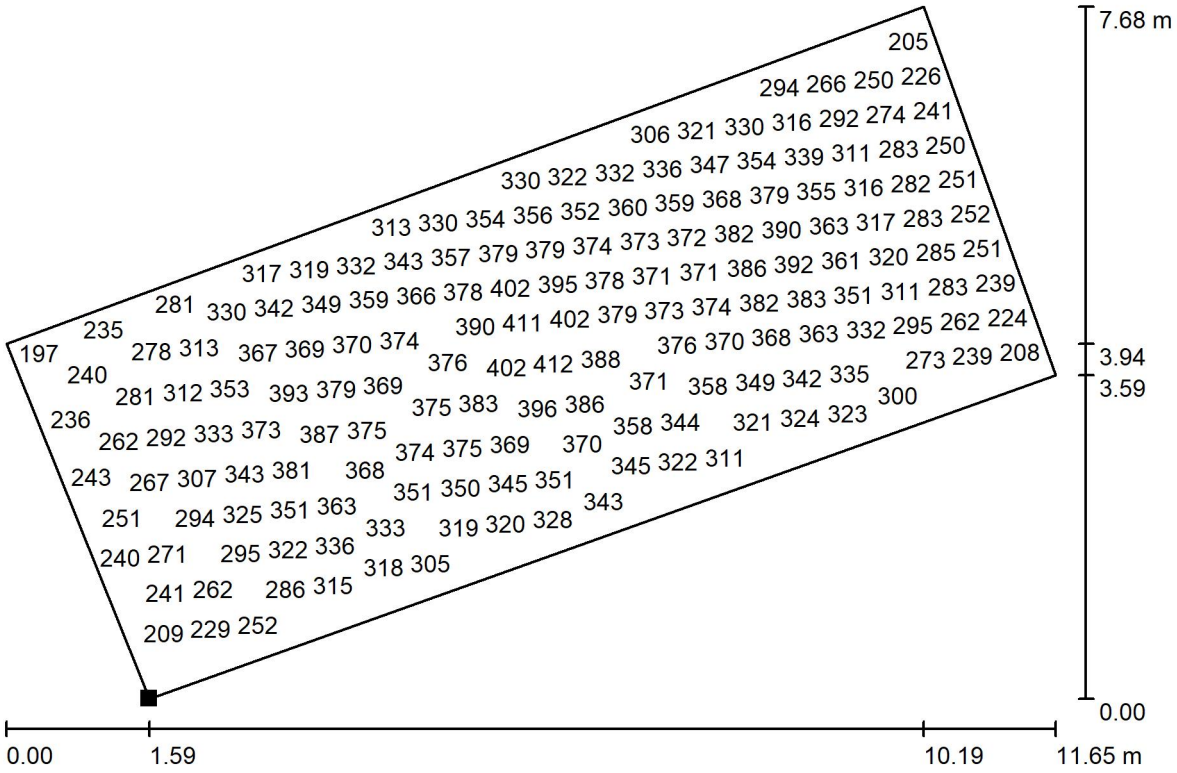
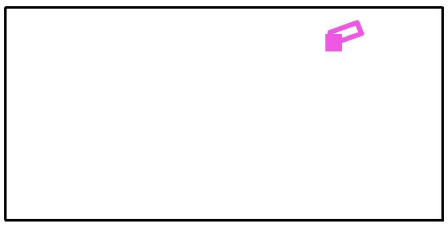
Short Stay Car Park 4000 Spaces / Typical Calculation - Parking Coaches - Entrance / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 84

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(292.733 m, 228.126 m, 0.750 m)



Grid: 32 x 128 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
323	182	413	0.564	0.440

Luton Airport Expansion

Street Lighting

Date: 28.06.2019
Operator: Katerina Konsta

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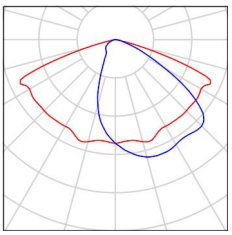
Luton Airport Expansion / Luminaire parts list

37 Pieces WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K
Article No.: 108-0907
Luminous flux (Luminaire): 7973 lm
Luminous flux (Lamps): 8854 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90
Fitting: 36 x LED-36/72W/840 - 4000K
(Correction Factor 1.000).



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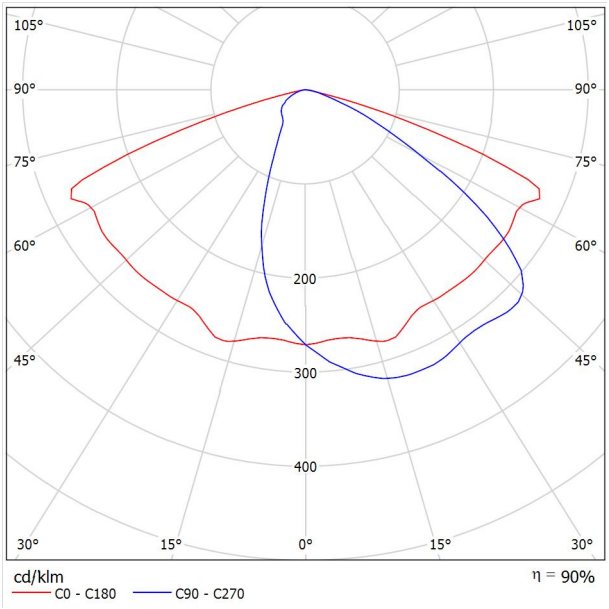
WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K / Luminaire Data Sheet

Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90

Due to missing symmetry properties, no UGR table can be displayed for this luminaire.

IP66, Class I or Class II. IK08. Marine-grade die-cast aluminium alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. UV stabilised acrylic panel in RFC® technology. Integrated heat sinks. Easy removal and replacement of LED board. CAD optimised OLC® PMMA lens for superior illumination and glare control. The luminaire is factory- sealed and does not need to be opened during the installation.
Spigot D = 60 x 80 mm or D = 76 x 80 mm (to be specified at order placement).
Recommended mounting height 2.5-8.0 m, depending on lamp type selected.

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Class M3 - (two lanes) / Planning data

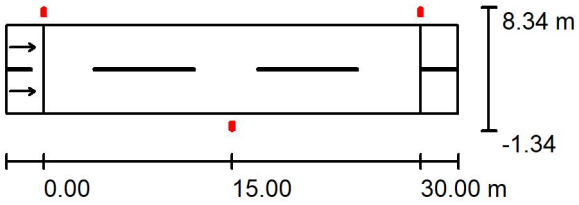
Road width: 7 meters
Lanes: 2
Column height: 8 meters
Arrangement: Double row with offset
Column spacing: 30 meters

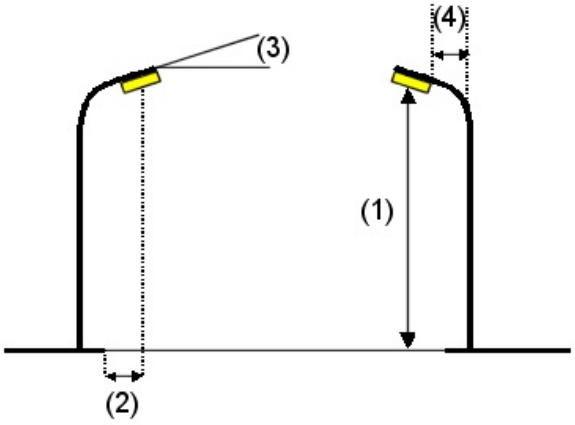
Street Profile

Roadway 1 (Width: 7.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Maintenance factor: 0.60

Luminaire Arrangements





Luminaire:	WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K	
Luminous flux (Luminaire):	7973 lm	Maximum luminous intensities
Luminous flux (Lamps):	8854 lm	at 70°: 413 cd/klm
Luminaire Wattage:	81.0 W	at 80°: 66 cd/klm
Arrangement:	Double row, with offset	at 90°: 0.00 cd/klm
Pole Distance:	30.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.
Mounting Height (1):	8.000 m	
Height:	8.000 m	No luminous intensities above 90°.
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.
Boom Angle (3):	0.0 °	
Boom Length (4):	0.000 m	Arrangement complies with glare index class D.5.

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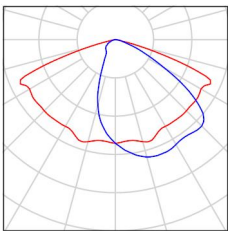
Class M3 - (two lanes) / Luminaire parts list

WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K
Article No.: 108-0907
Luminous flux (Luminaire): 7973 lm
Luminous flux (Lamps): 8854 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90
Fitting: 36 x LED-36/72W/840 - 4000K (Correction Factor 1.000).



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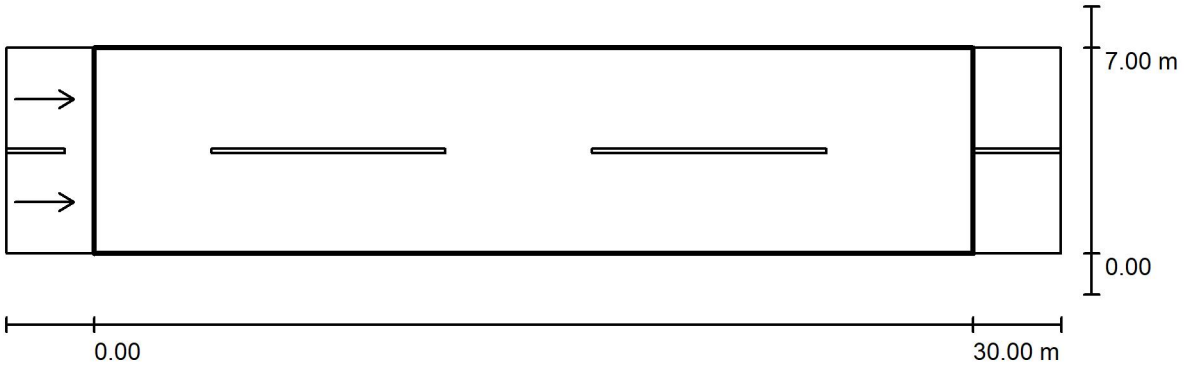
Class M3 - (two lanes) / Valuation Field Roadway 1 / Results overview



Maintenance factor: 0.60

Scale 1:258

Grid: 10 x 6 Points
Accompanying Street Elements: Roadway 1.
tarmac: R3, q0: 0.070
Selected Lighting Class: ME3a

(All lighting performance requirements are met.)

	L_{av} [cd/m²]	U0	Ul	TI [%]	SR
Calculated values:	1.12	0.90	0.86	5	0.72
Required values according to class:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15	≥ 0.50
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Assigned Observer (2 Pieces):

No.	Observer	Position [m]	L_{av} [cd/m²]	U0	Ul	TI [%]
1	Observer 1	(-60.000, 1.750, 1.500)	1.12	0.90	0.86	5
2	Observer 2	(-60.000, 5.250, 1.500)	1.12	0.90	0.86	5

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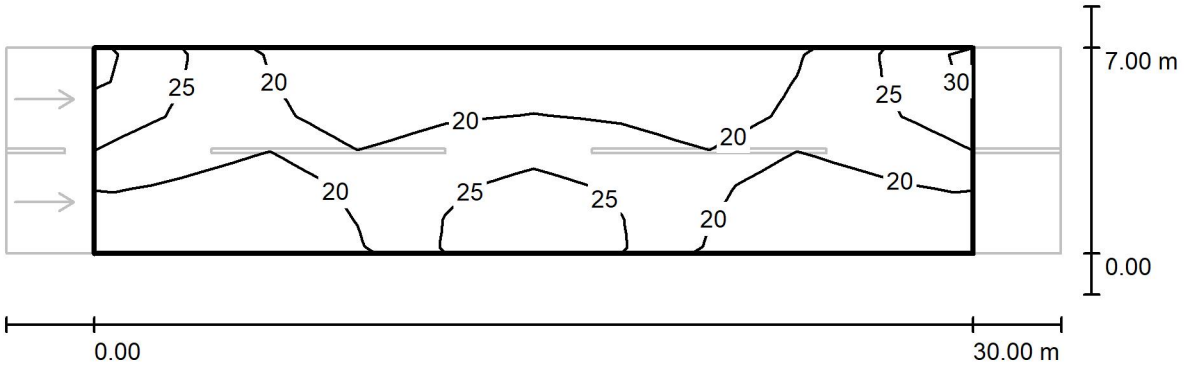
Class M3 - (two lanes) / Valuation Field Roadway 1 / Isolines (E)



Values in Lux, Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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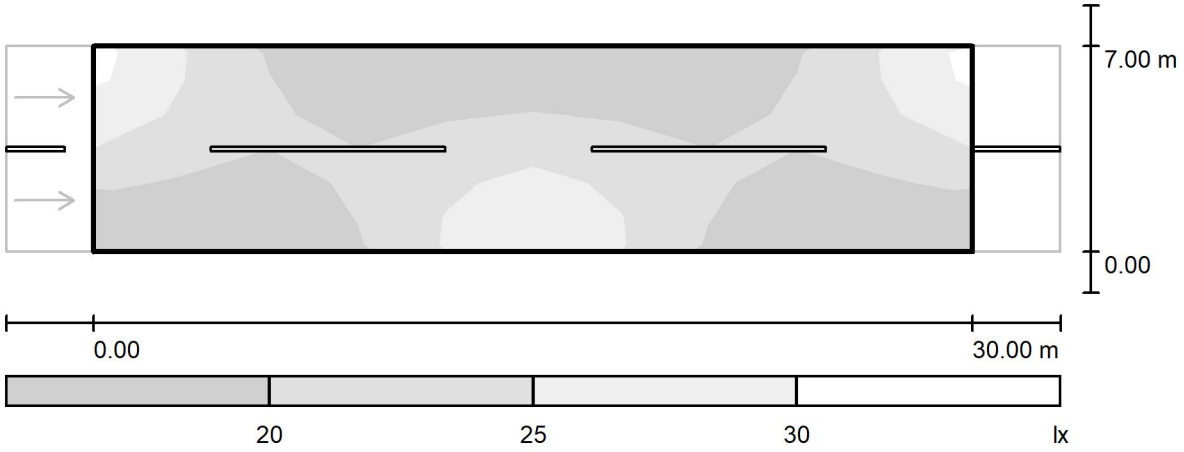
Class M3 - (two lanes) / Valuation Field Roadway 1 / Greyscale (E)



Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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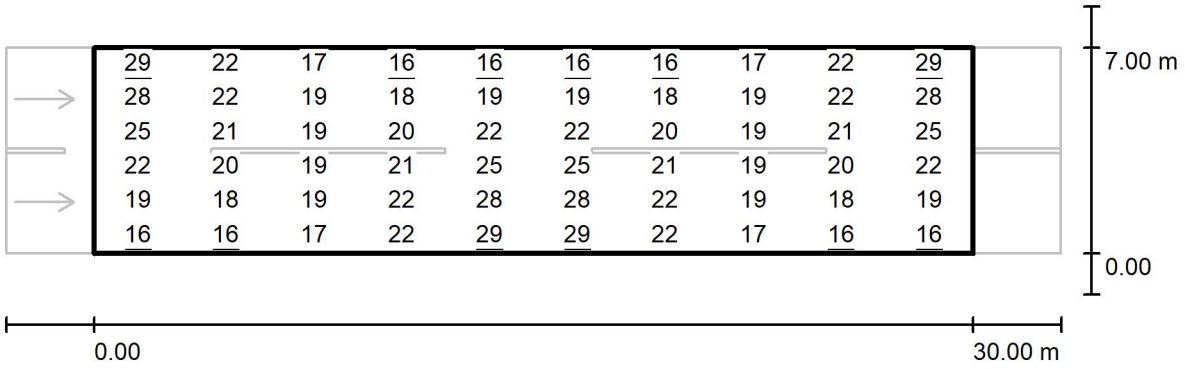
Class M3 - (two lanes) / Valuation Field Roadway 1 / Value Chart (E)



Values in Lux, Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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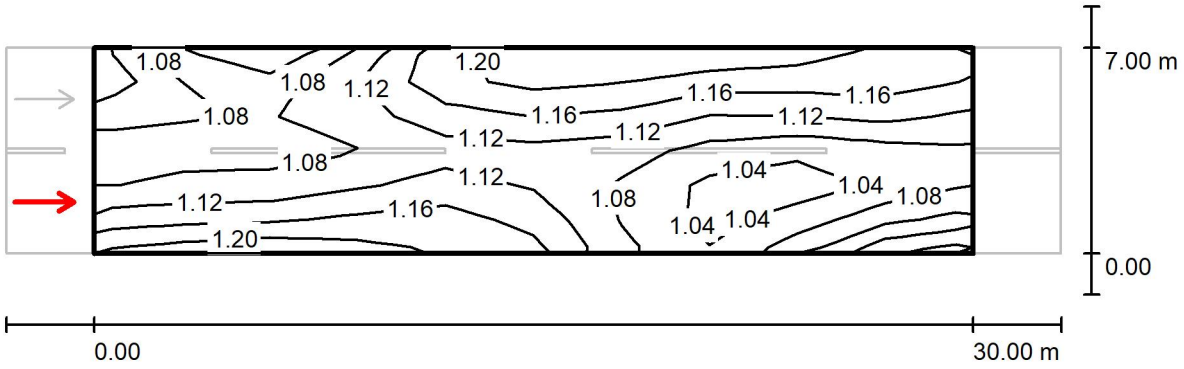
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 1 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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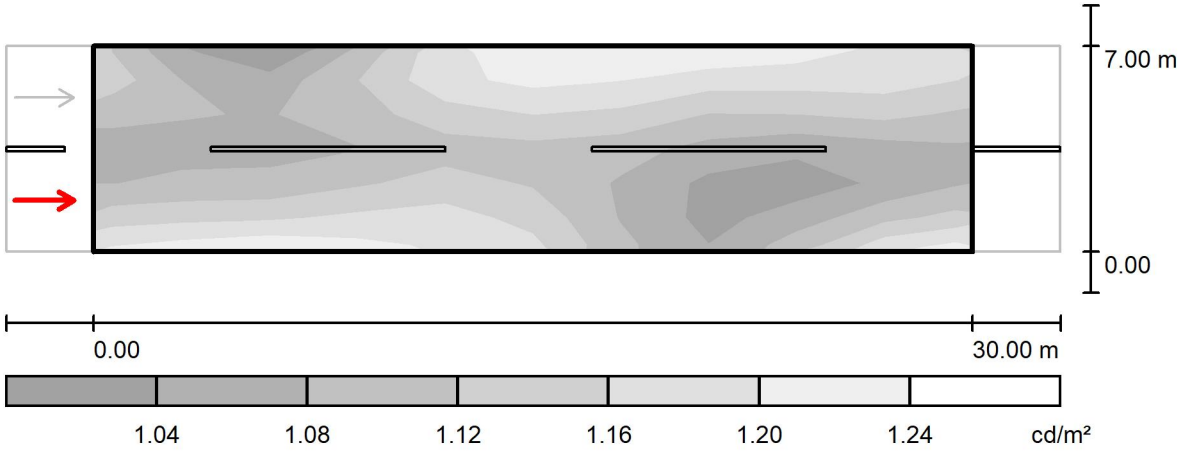
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 1 / Greyscale (L)



Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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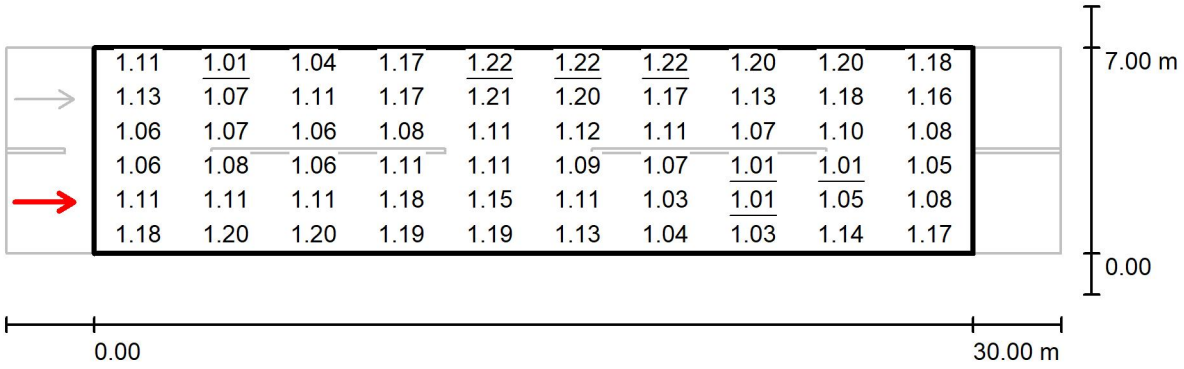
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 1 / Value Chart (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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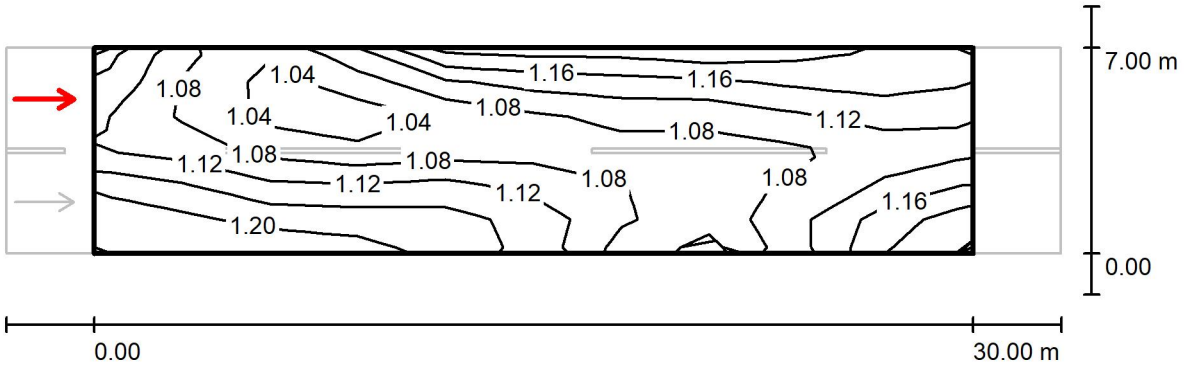
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 2 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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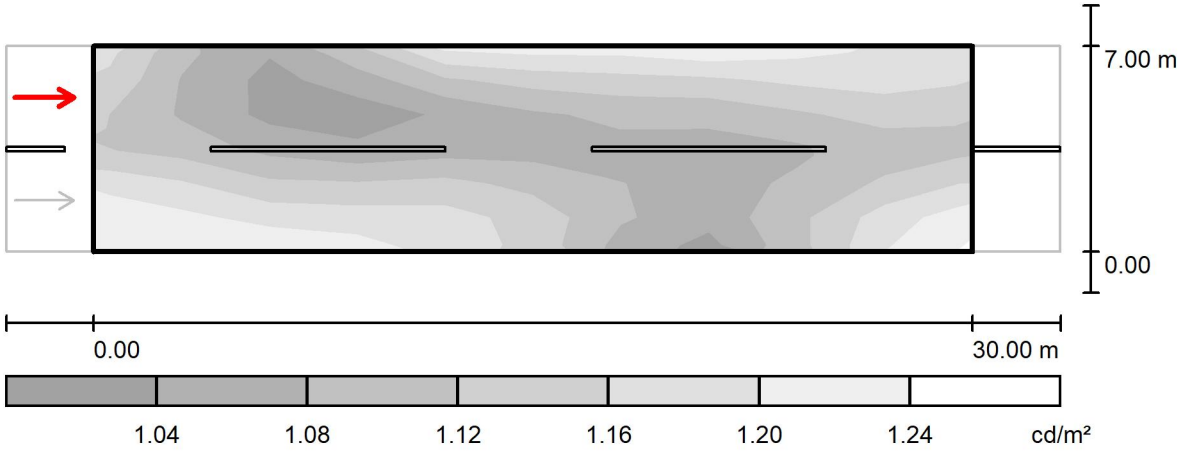
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 2 / Greyscale (L)



Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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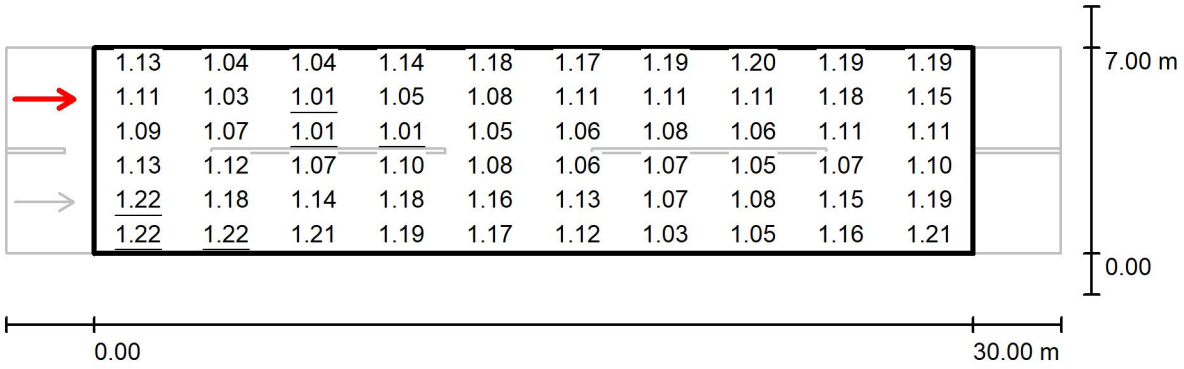
Class M3 - (two lanes) / Valuation Field Roadway 1 / Observer 2 / Value Chart (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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Class M4 / Planning data

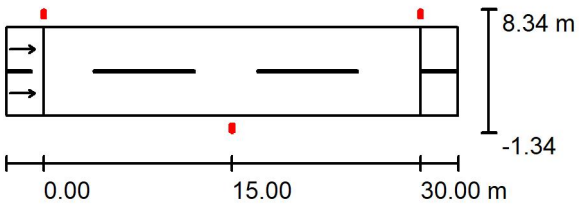
Road width: 7 meters
Lanes: 2
Column height: 8 meters
Arrangement: Double row with offset
Column spacing: 30 meters

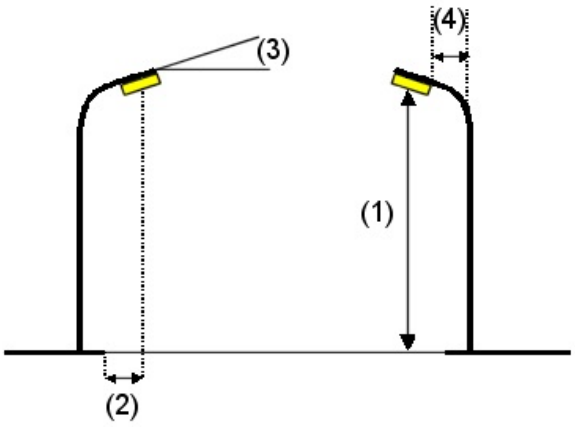
Street Profile

Roadway 1 (Width: 7.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Maintenance factor: 0.60

Luminaire Arrangements





Luminaire:	WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K	
Luminous flux (Luminaire):	7973 lm	Maximum luminous intensities
Luminous flux (Lamps):	8854 lm	at 70°: 413 cd/klm
Luminaire Wattage:	81.0 W	at 80°: 66 cd/klm
Arrangement:	Double row, with offset	at 90°: 0.00 cd/klm
Pole Distance:	30.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.
Mounting Height (1):	8.000 m	
Height:	8.000 m	No luminous intensities above 90°.
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.
Boom Angle (3):	0.0 °	
Boom Length (4):	0.000 m	Arrangement complies with glare index class D.5.

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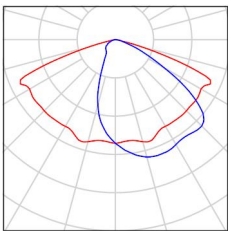
Class M4 / Luminaire parts list

WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K
Article No.: 108-0907
Luminous flux (Luminaire): 7973 lm
Luminous flux (Lamps): 8854 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90
Fitting: 36 x LED-36/72W/840 - 4000K (Correction Factor 1.000).



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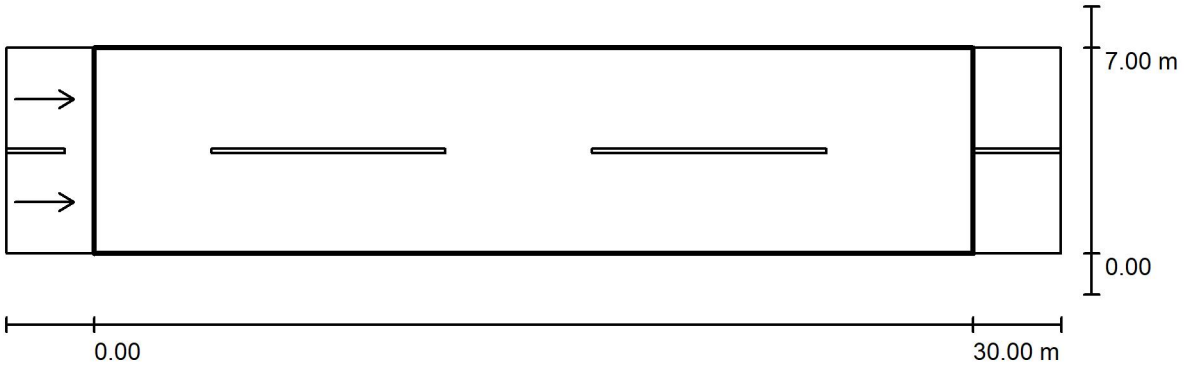
Class M4 / Valuation Field Roadway 1 / Results overview



Maintenance factor: 0.60

Scale 1:258

Grid: 10 x 6 Points
Accompanying Street Elements: Roadway 1.
tarmac: R3, q0: 0.070
Selected Lighting Class: ME4a (All lighting performance requirements are met.)

	L_{av} [cd/m²]	U0	Ul	TI [%]	SR
Calculated values:	1.12	0.90	0.86	5	0.72
Required values according to class:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15	≥ 0.50
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Assigned Observer (2 Pieces):

No.	Observer	Position [m]	L_{av} [cd/m²]	U0	Ul	TI [%]
1	Observer 1	(-60.000, 1.750, 1.500)	1.12	0.90	0.86	5
2	Observer 2	(-60.000, 5.250, 1.500)	1.12	0.90	0.86	5

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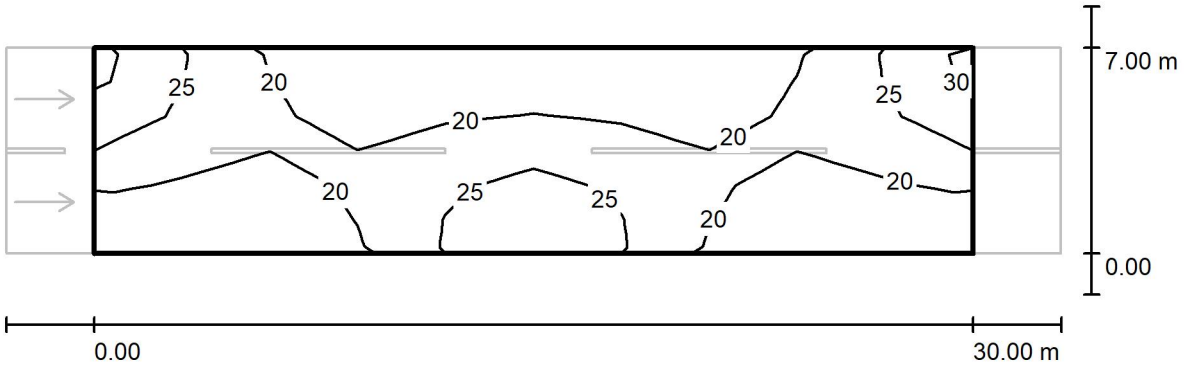
Class M4 / Valuation Field Roadway 1 / Isolines (E)



Values in Lux, Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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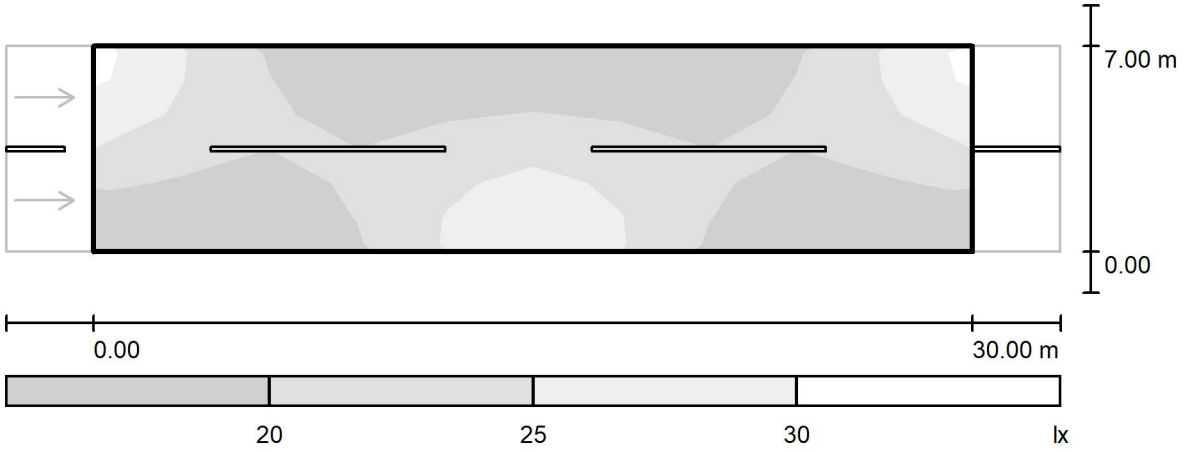
Class M4 / Valuation Field Roadway 1 / Greyscale (E)



Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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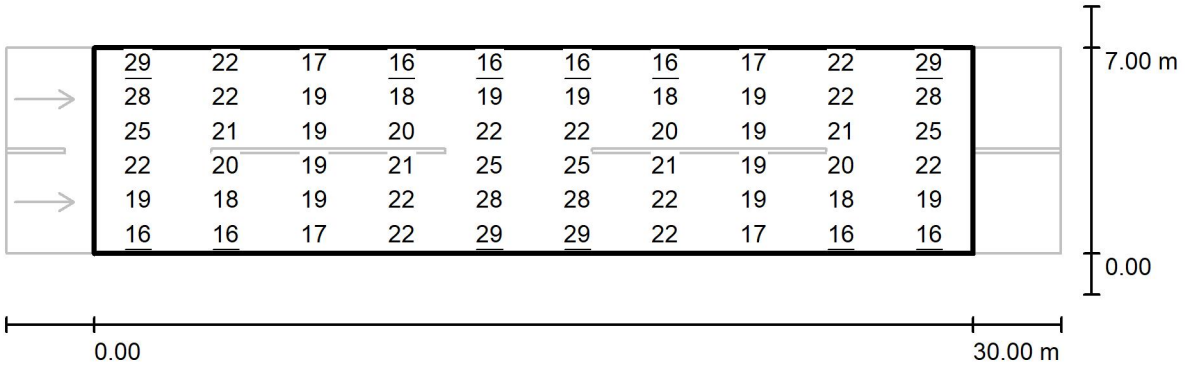
Class M4 / Valuation Field Roadway 1 / Value Chart (E)



Values in Lux, Scale 1 : 258

Grid: 10 x 6 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
21	16	29	0.750	0.547

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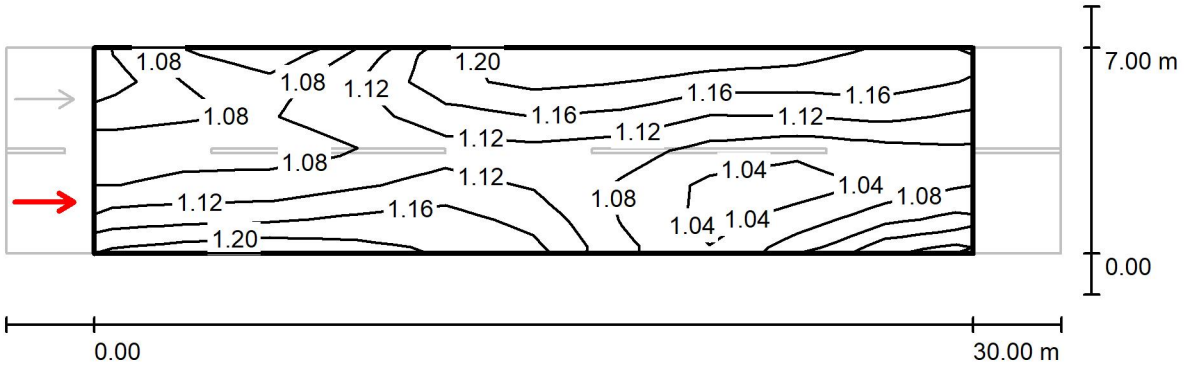
Class M4 / Valuation Field Roadway 1 / Observer 1 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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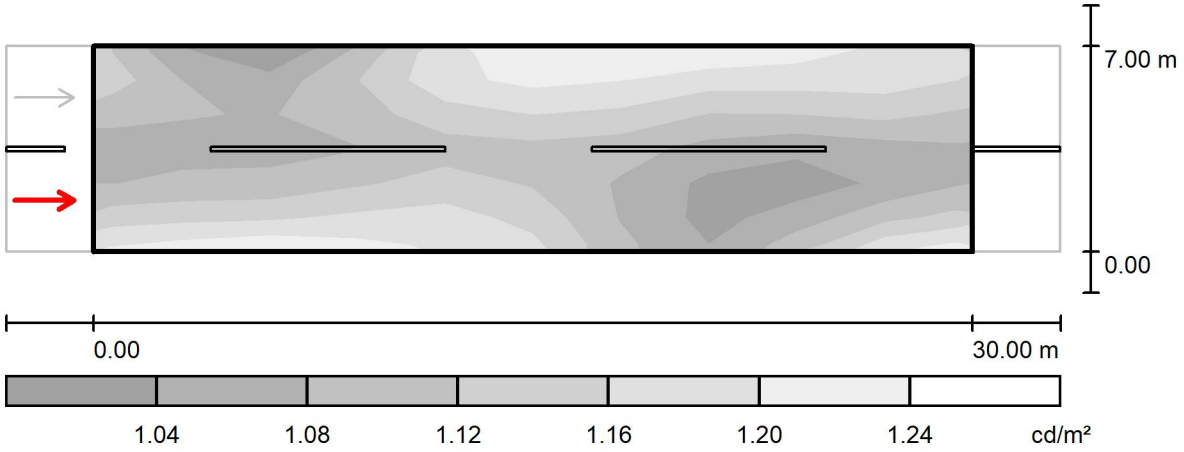
Class M4 / Valuation Field Roadway 1 / Observer 1 / Greyscale (L)



Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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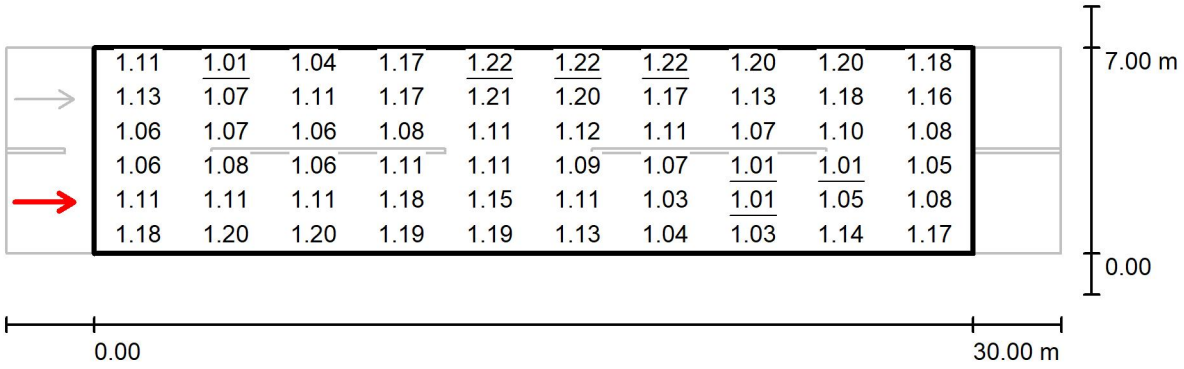
Class M4 / Valuation Field Roadway 1 / Observer 1 / Value Chart (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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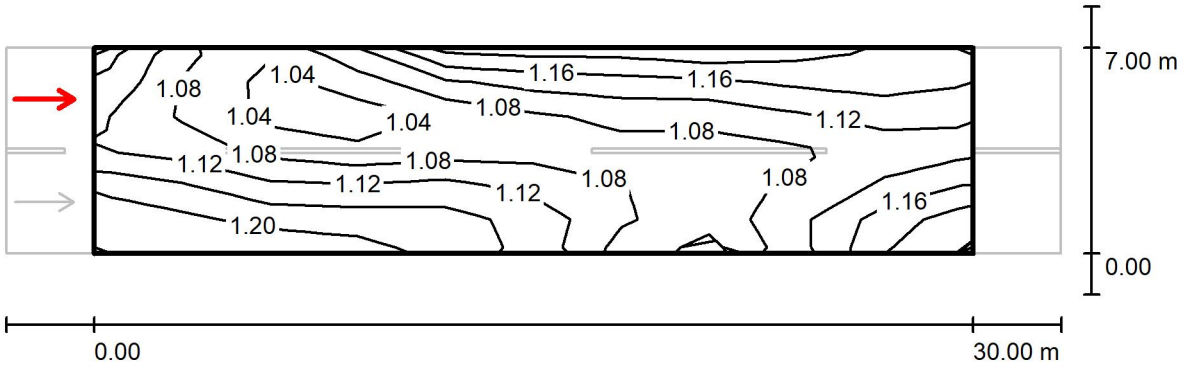
Class M4 / Valuation Field Roadway 1 / Observer 2 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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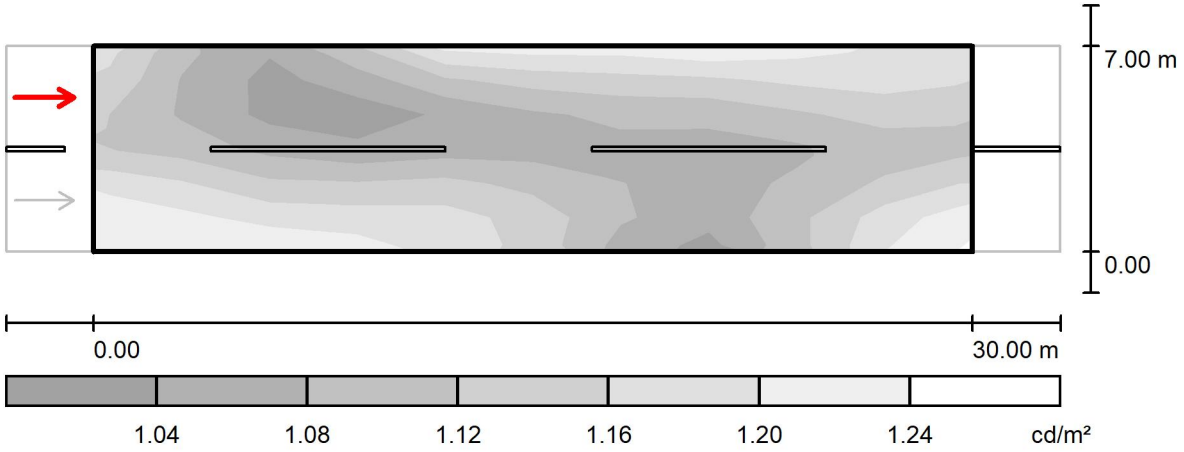
Class M4 / Valuation Field Roadway 1 / Observer 2 / Greyscale (L)



Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	Tl [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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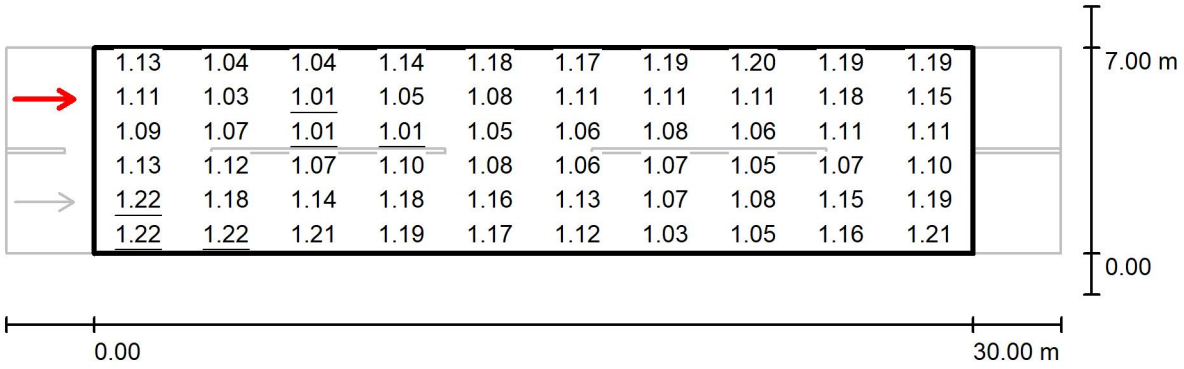
Class M4 / Valuation Field Roadway 1 / Observer 2 / Value Chart (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.12	0.90	0.86	5
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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Class M3 (four lanes) / Planning data

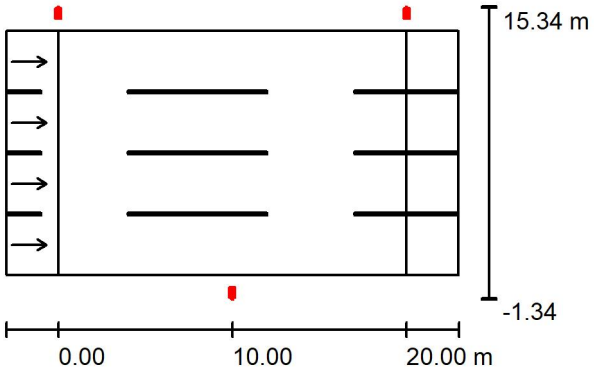
Road width: 14 meters
Lanes: 4
Column height: 8 meters
Arrangement: Double row with offset
Column spacing: 20 meters

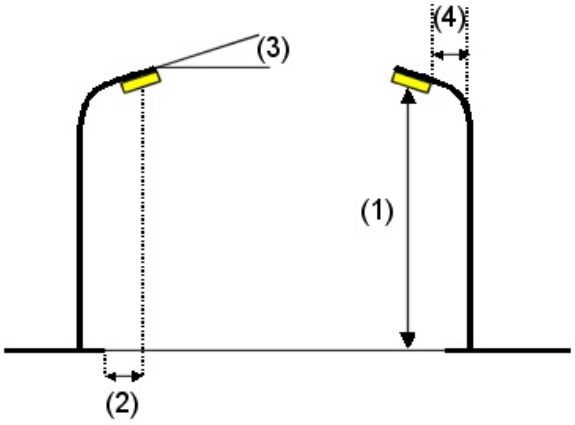
Street Profile

Roadway 1 (Width: 14.000 m, Number of lanes: 4, tarmac: R3, q0: 0.070)

Maintenance factor: 0.60

Luminaire Arrangements





Luminaire:	WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K		
Luminous flux (Luminaire):	7973 lm	Maximum luminous intensities	
Luminous flux (Lamps):	8854 lm	at 70°:	413 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	66 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	20.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	8.000 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °		
Boom Length (4):	0.000 m	Arrangement complies with glare index class D.5.	

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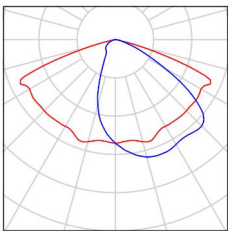
Class M3 (four lanes) / Luminaire parts list

WE-EF 108-0907 VFL540 [S60] IP66:LED-36/72W/4K
Article No.: 108-0907
Luminous flux (Luminaire): 7973 lm
Luminous flux (Lamps): 8854 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 40 74 97 100 90
Fitting: 36 x LED-36/72W/840 - 4000K (Correction Factor 1.000).



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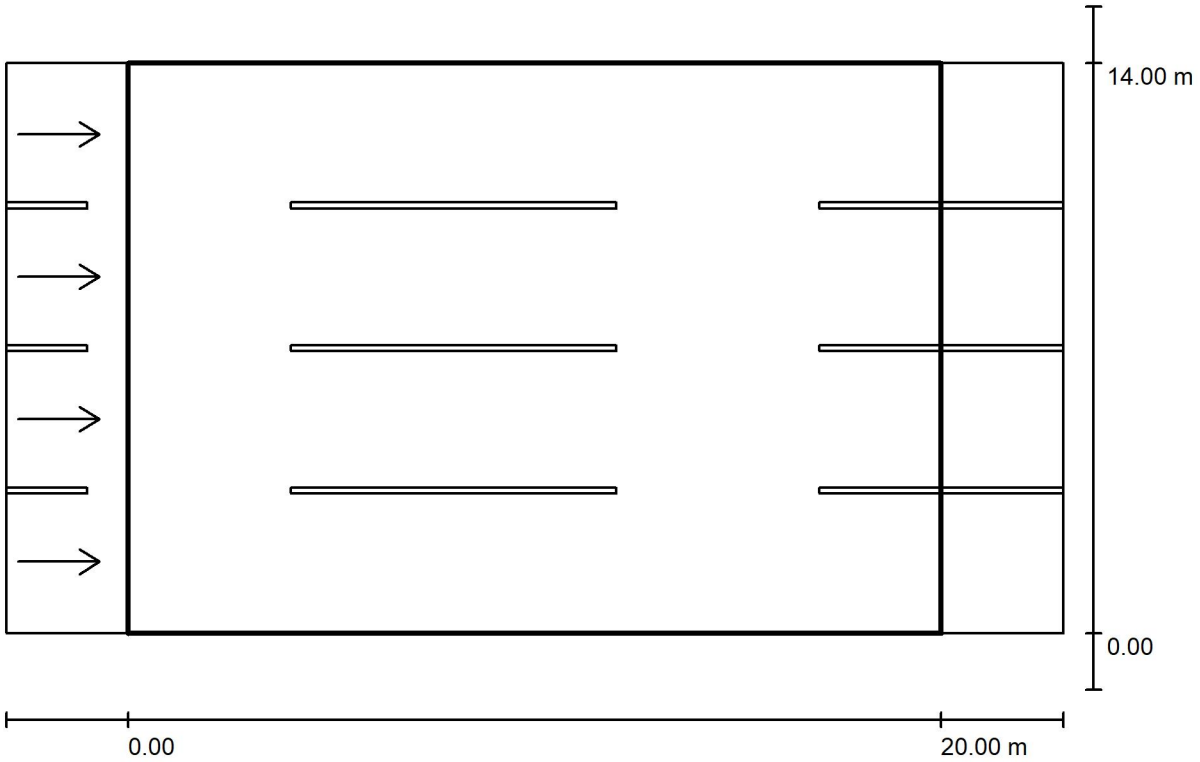
Class M3 (four lanes) / Valuation Field Roadway 1 / Results overview



Maintenance factor: 0.60

Scale 1:186

Grid: 10 x 12 Points
Accompanying Street Elements: Roadway 1.
tarmac: R3, q0: 0.070
Selected Lighting Class: ME3a (All lighting performance requirements are met.)

	L_{av} [cd/m²]	U0	Ul	TI [%]	SR
Calculated values:	1.18	0.78	0.83	5	0.59
Required values according to class:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15	≥ 0.50
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Assigned Observer (4 Pieces):

No.	Observer	Position [m]	L_{av} [cd/m²]	U0	Ul	TI [%]
1	Observer 1	(-60.000, 1.750, 1.500)	1.18	0.79	0.83	5
2	Observer 2	(-60.000, 5.250, 1.500)	1.19	0.78	0.91	4
3	Observer 3	(-60.000, 8.750, 1.500)	1.19	0.78	0.91	4
4	Observer 4	(-60.000, 12.250, 1.500)	1.18	0.79	0.83	5

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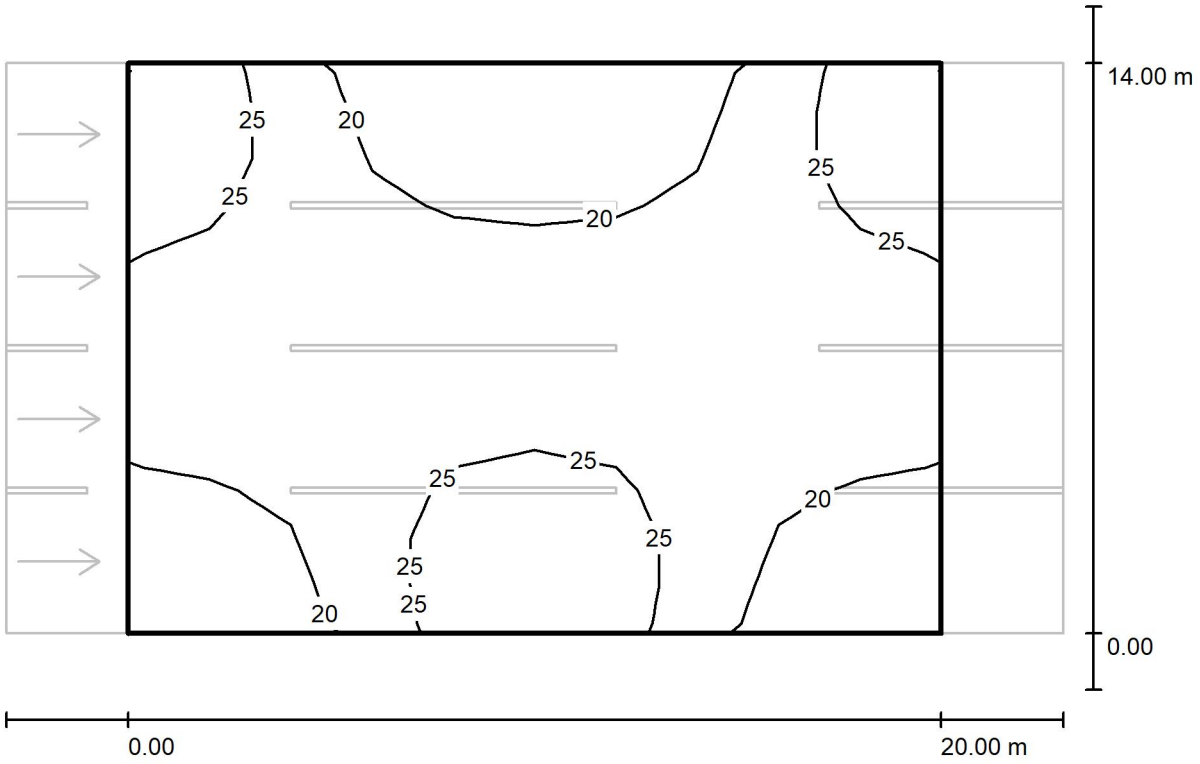
Class M3 (four lanes) / Valuation Field Roadway 1 / Isolines (E)



Values in Lux, Scale 1 : 186

Grid: 10 x 12 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
22	15	29	0.678	0.521

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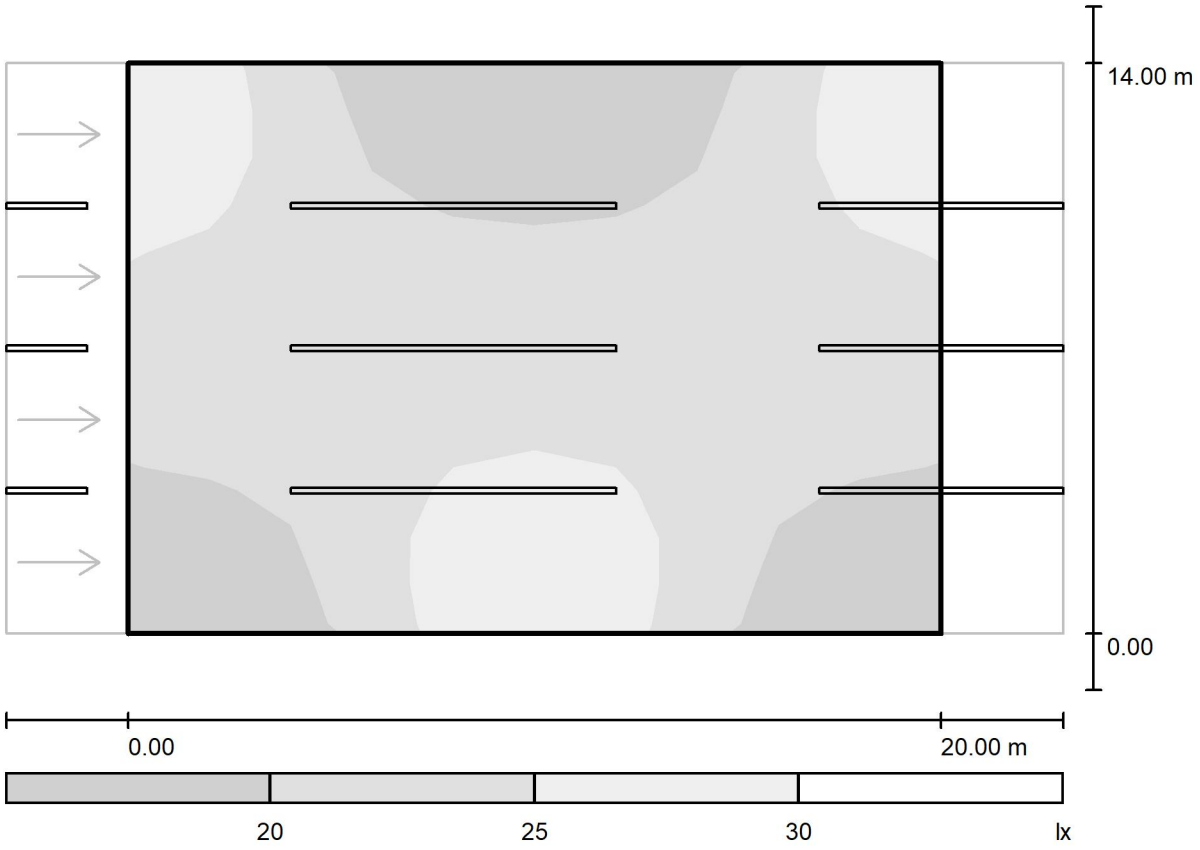
Class M3 (four lanes) / Valuation Field Roadway 1 / Greyscale (E)



Scale 1 : 186

Grid: 10 x 12 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
22	15	29	0.678	0.521

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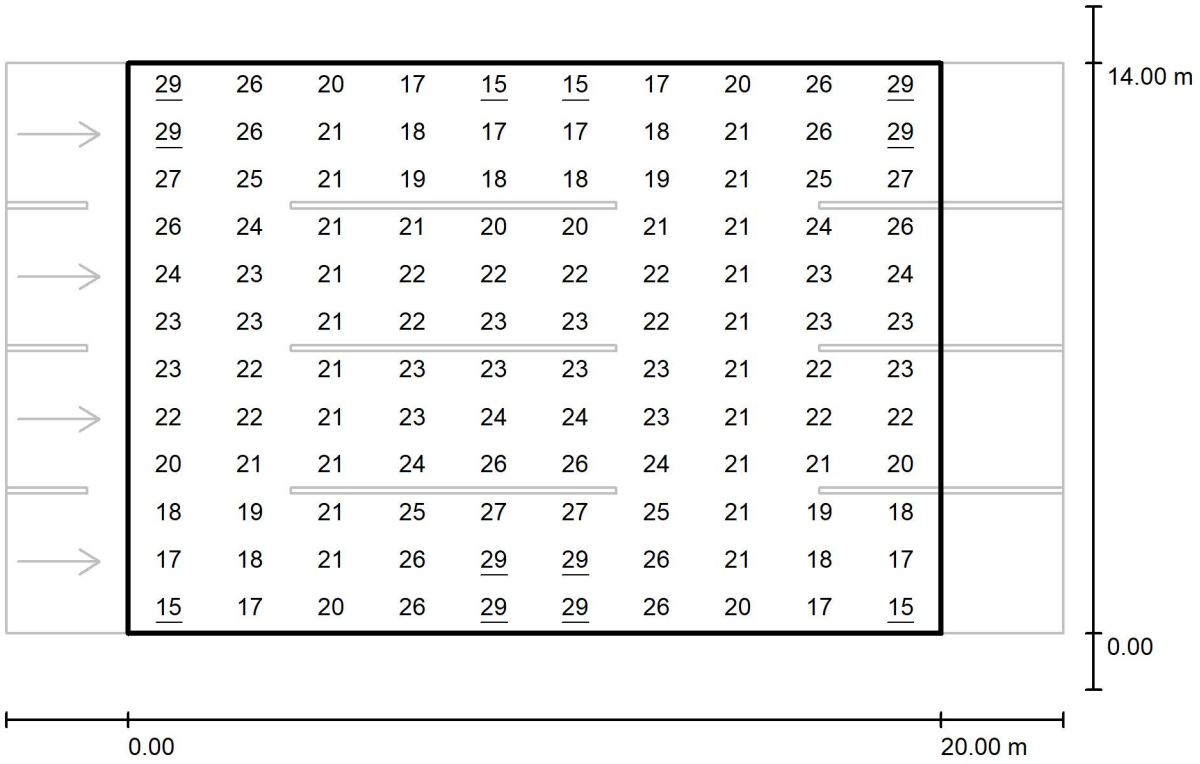
Class M3 (four lanes) / Valuation Field Roadway 1 / Value Chart (E)



Values in Lux, Scale 1 : 186

Grid: 10 x 12 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
22	15	29	0.678	0.521

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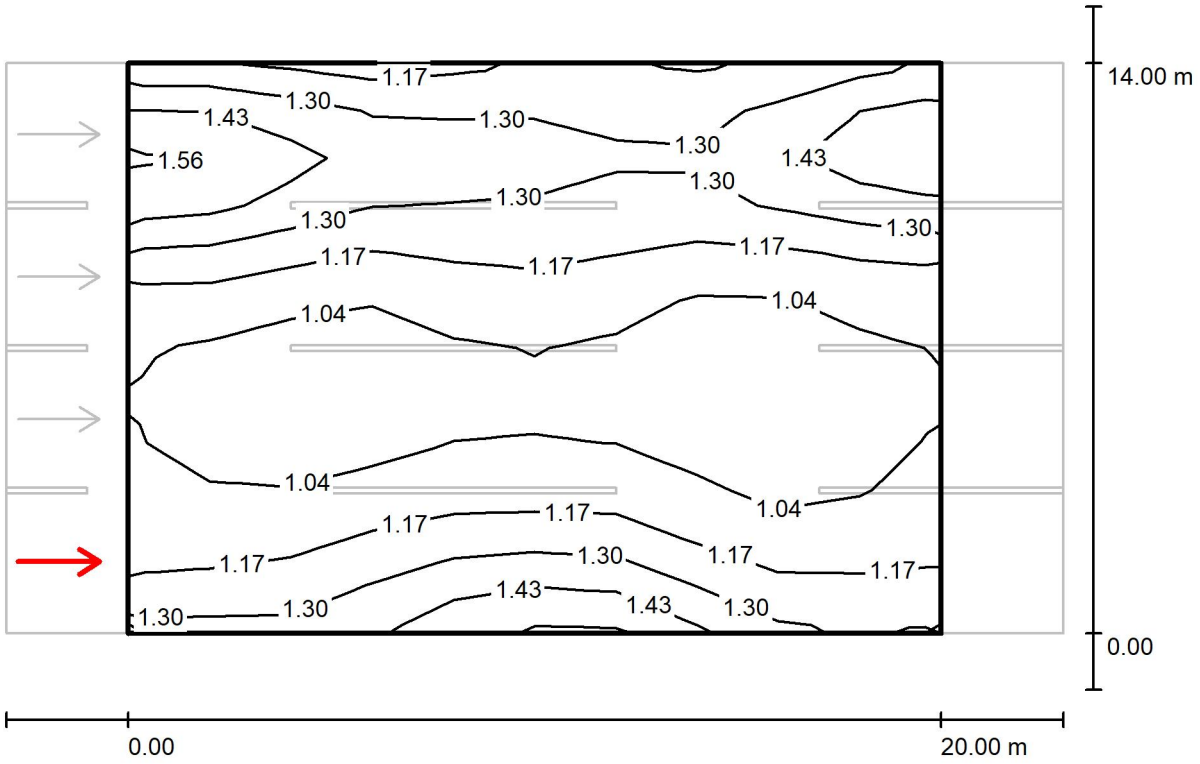
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 1 / Isolines (L)



Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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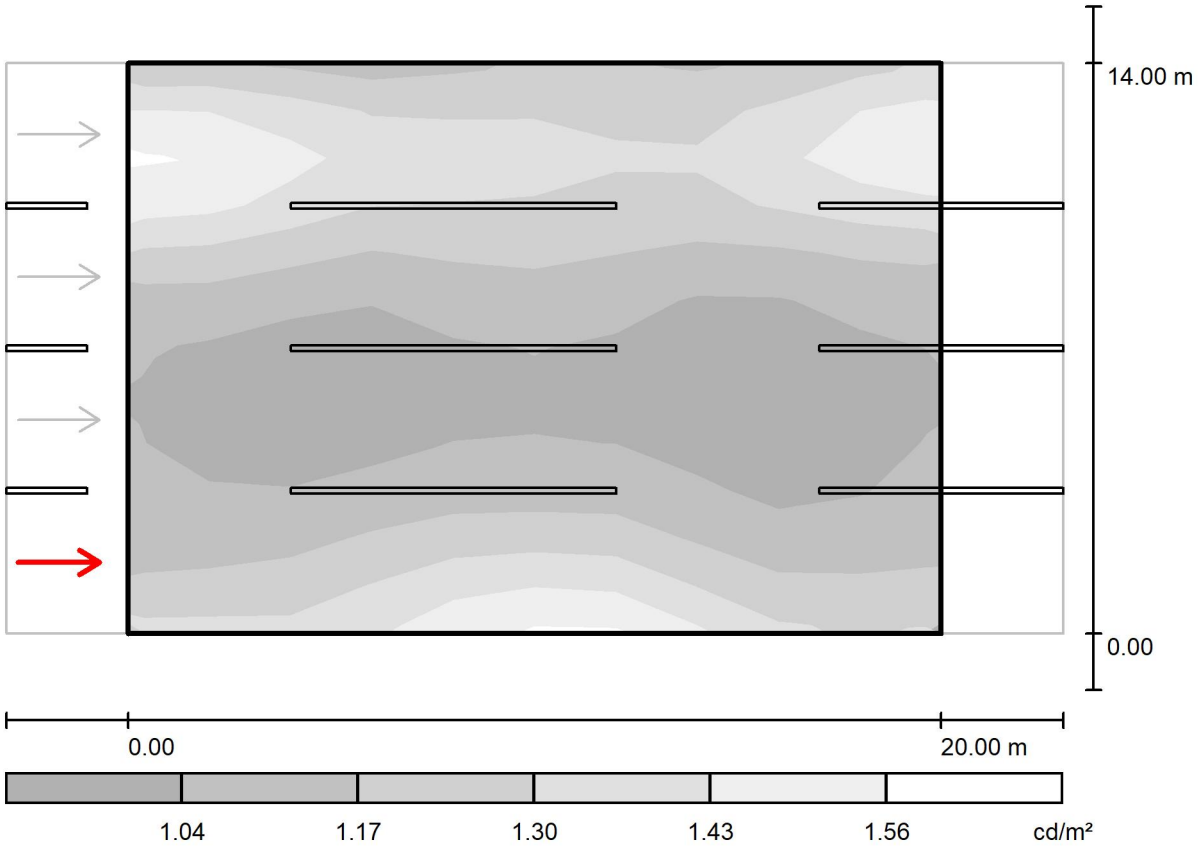
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 1 / Greyscale (L)



Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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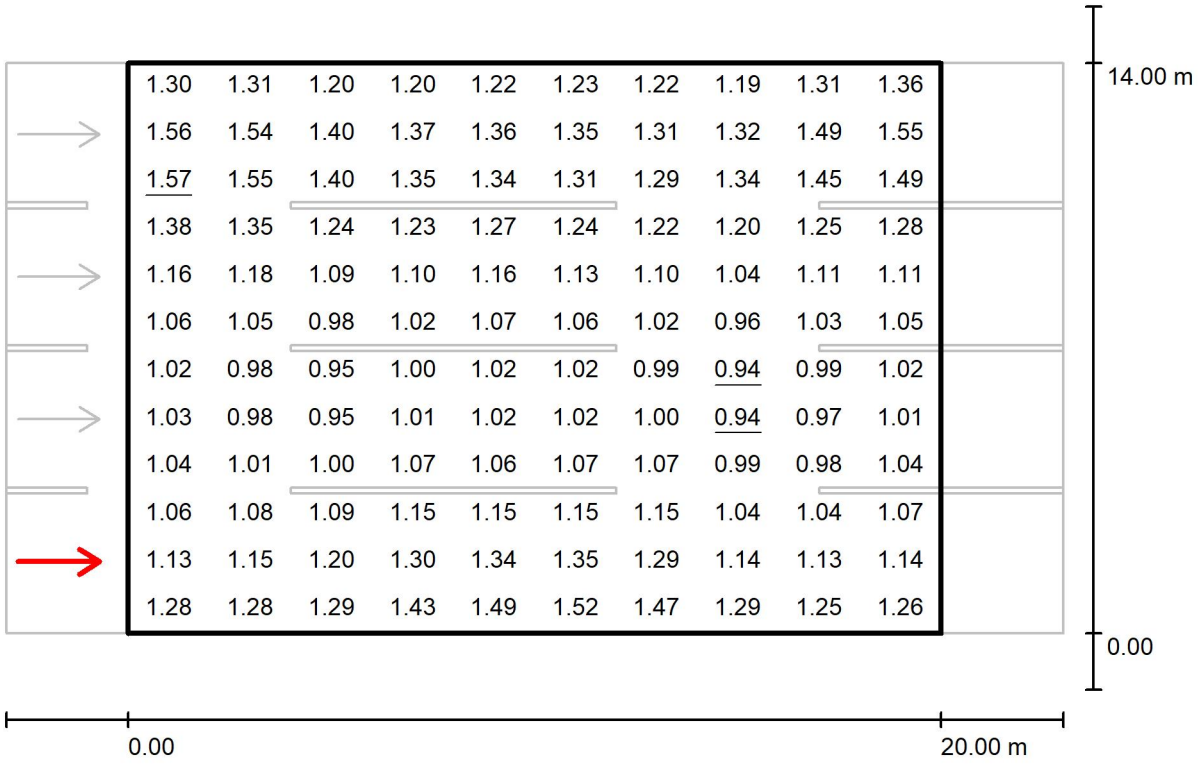
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 1 / Value Chart (L)



Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 1.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Arup

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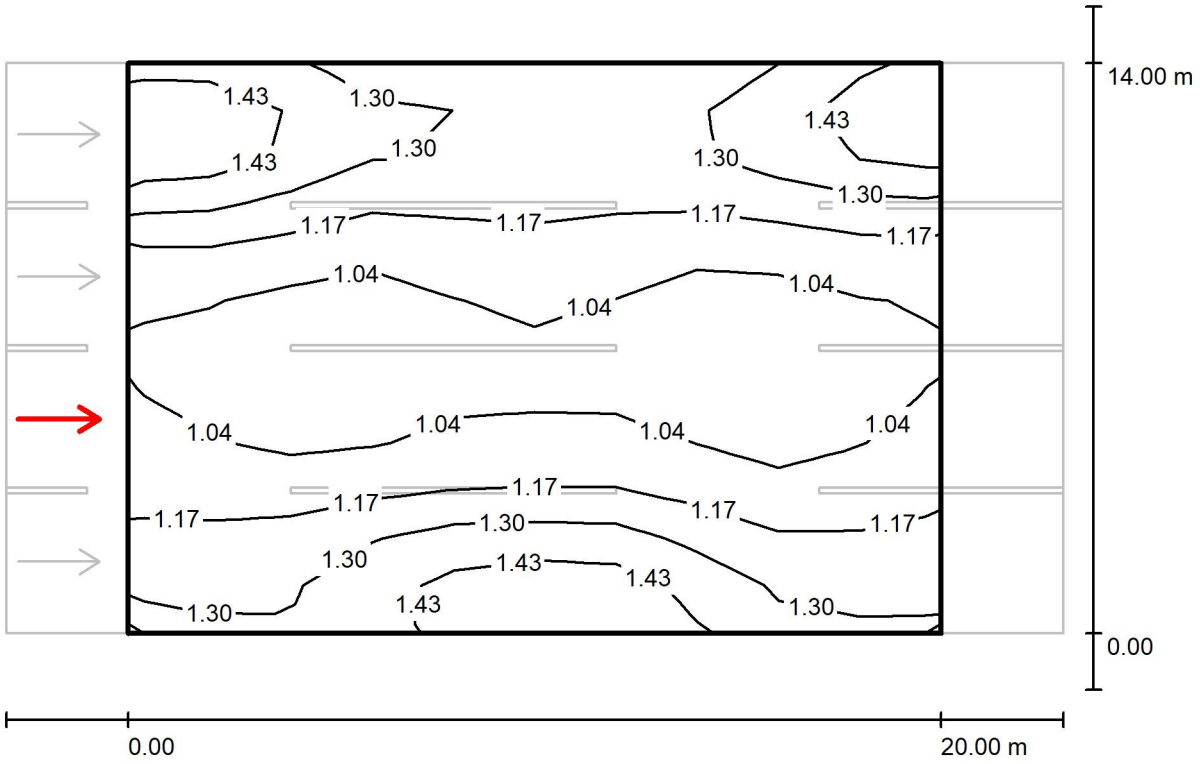
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 2 / Isolines (L)



Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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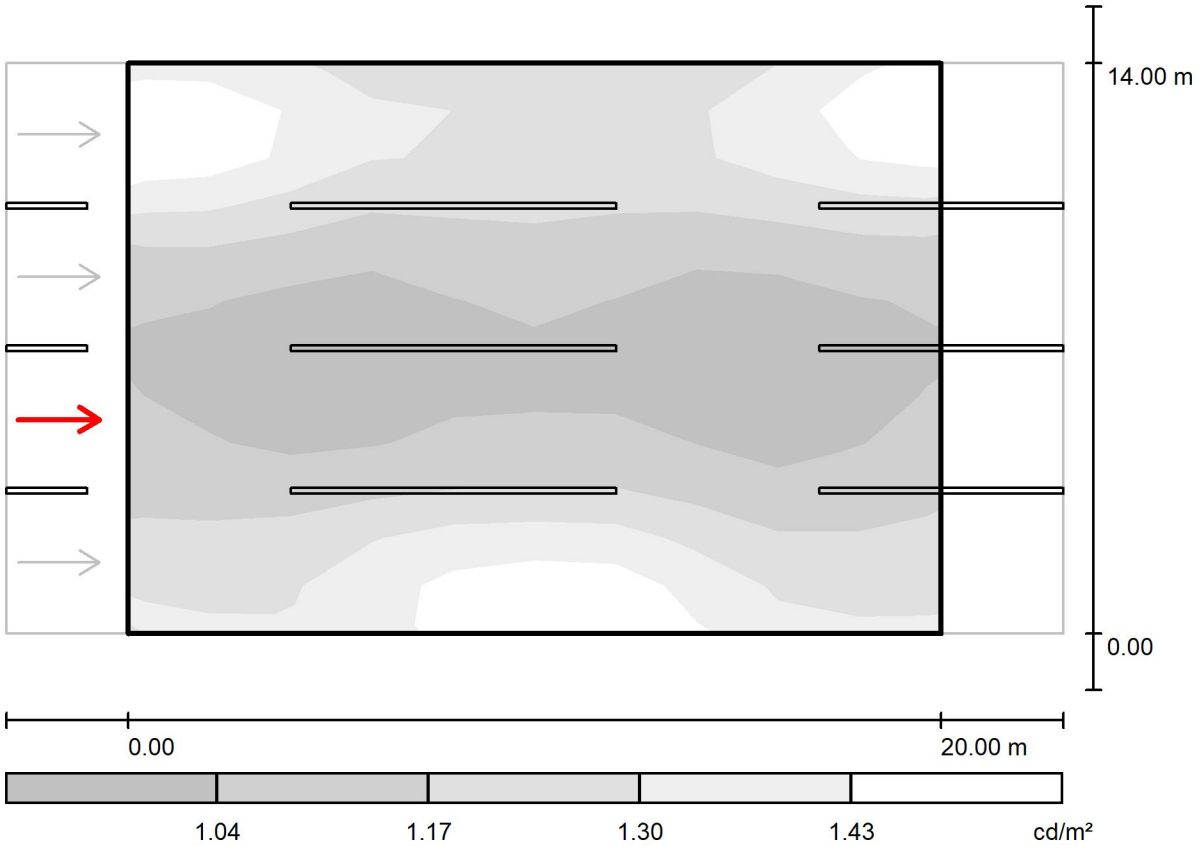
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 2 / Greyscale (L)



Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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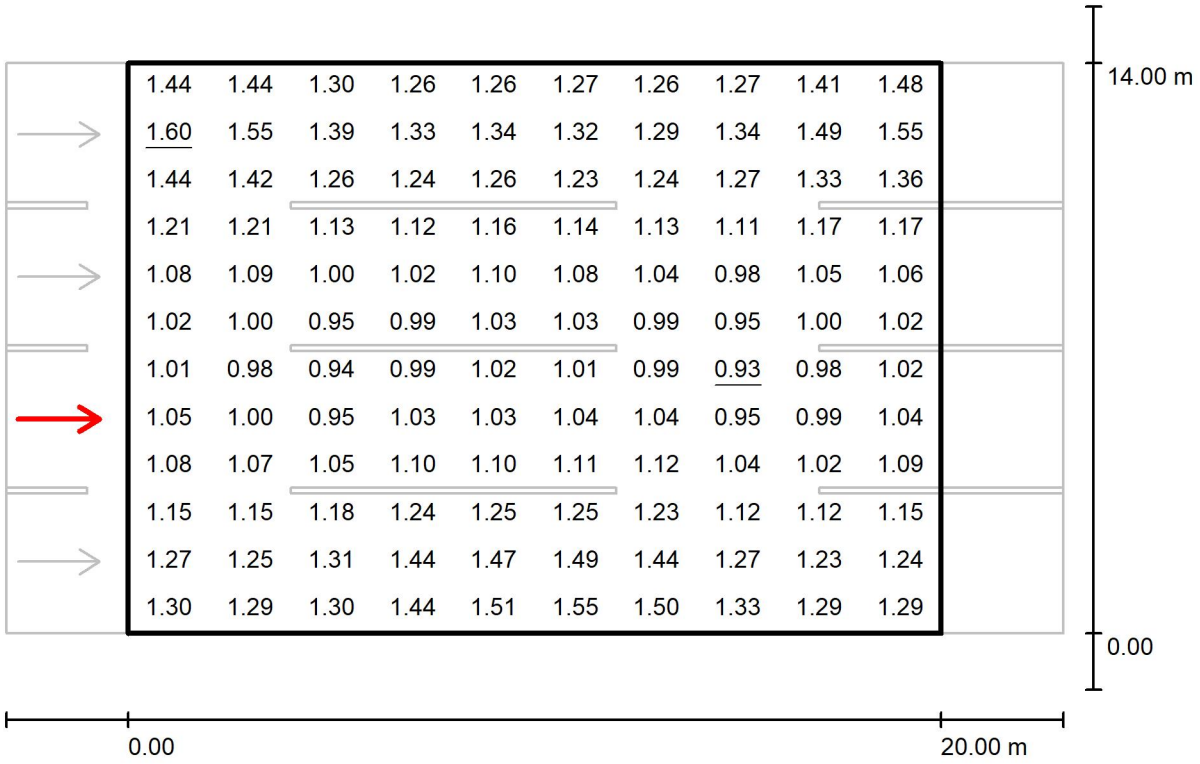

Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 5.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
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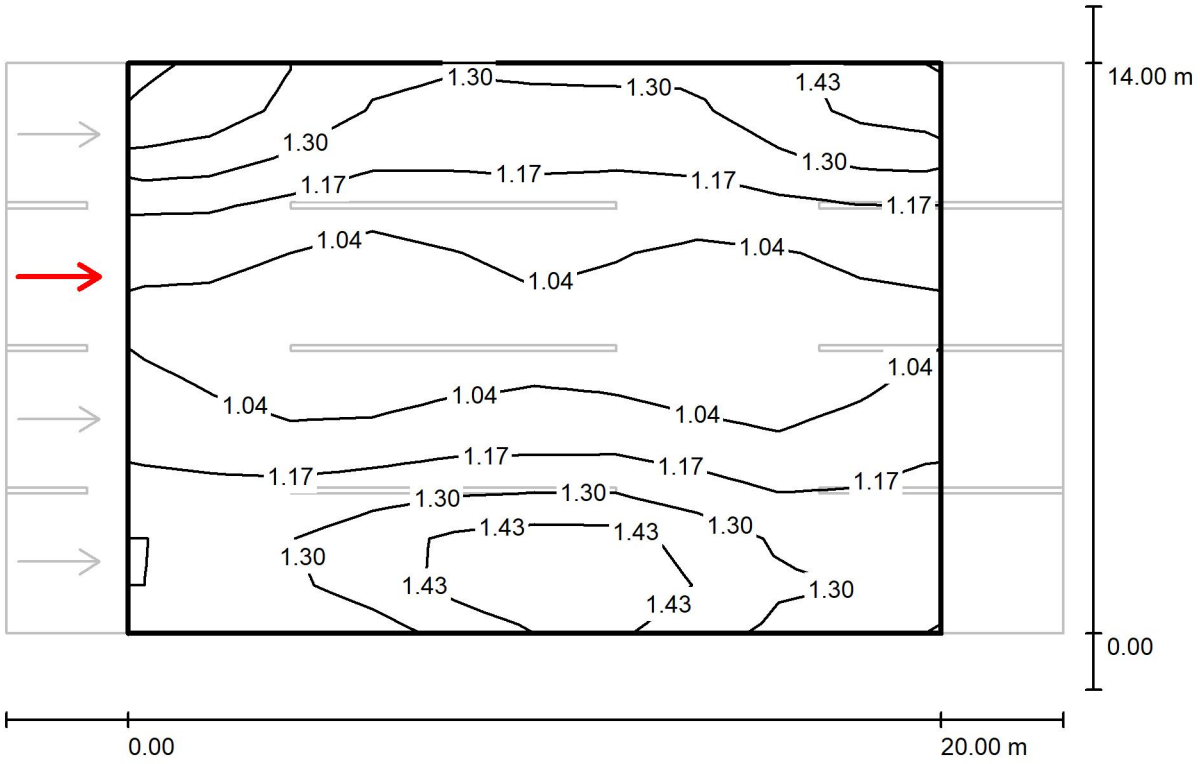
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 3 / Isolines (L)



Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 8.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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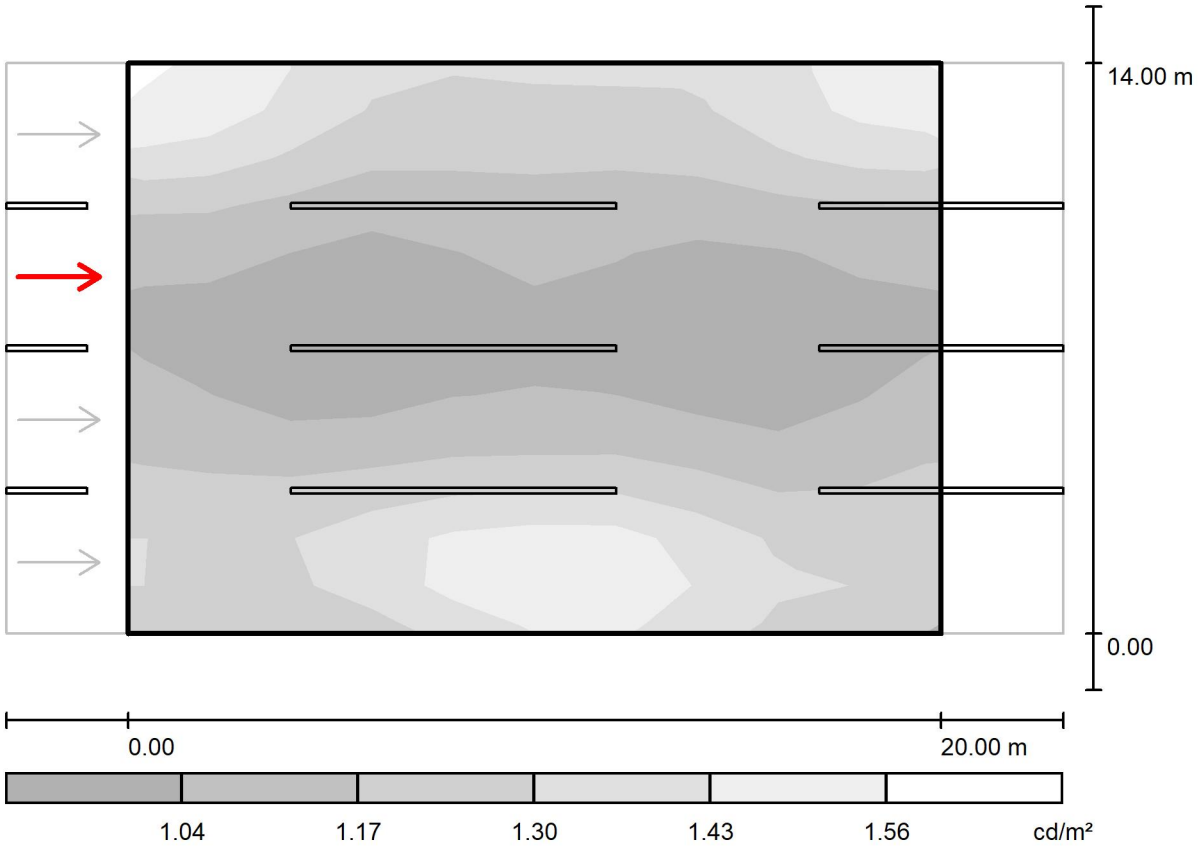
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 3 / Greyscale (L)



Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 8.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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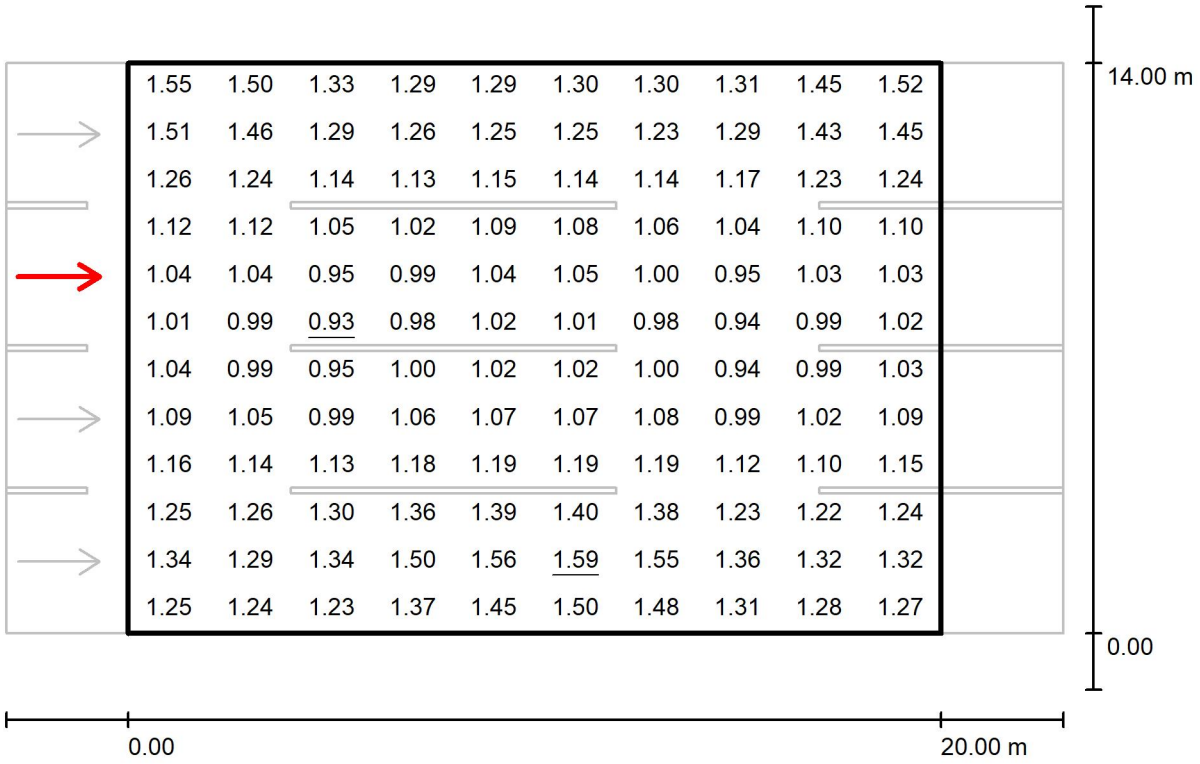

Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 8.750 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	Tl [%]
Calculated values:	1.19	0.78	0.91	4
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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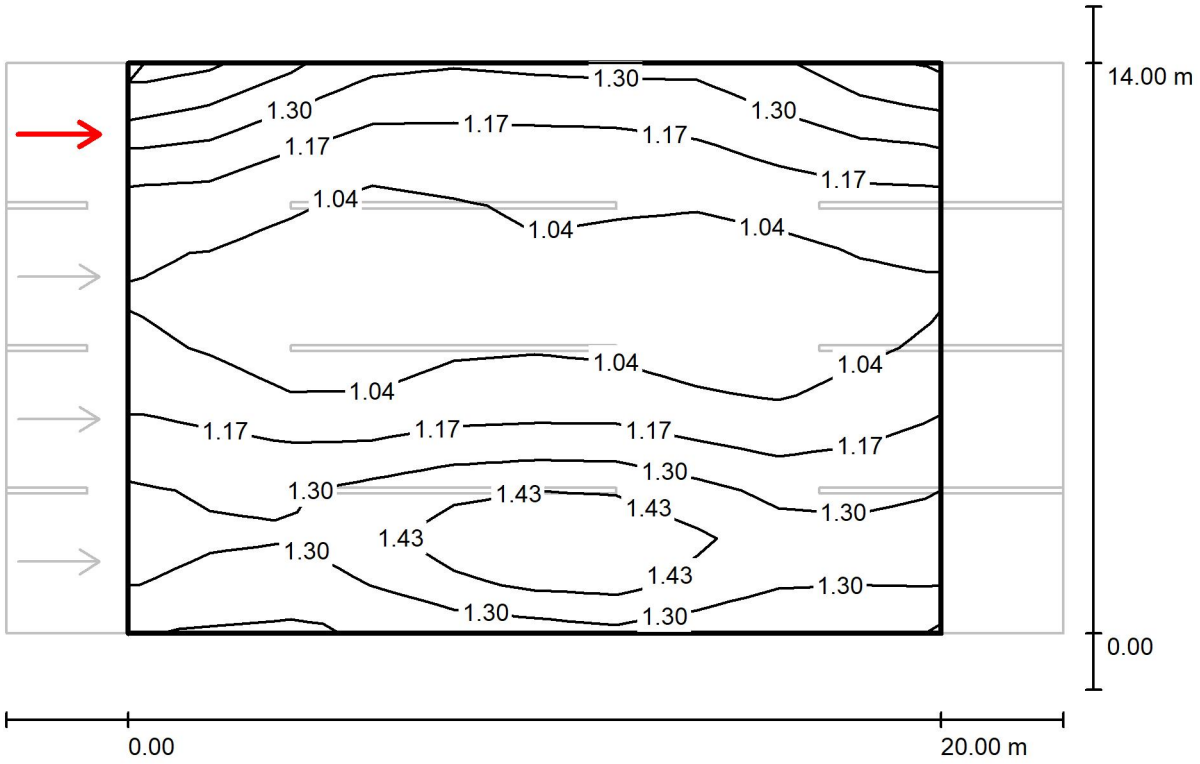
Class M3 (four lanes) / Valuation Field Roadway 1 / Observer 4 / Isolines (L)



Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 12.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	Tl [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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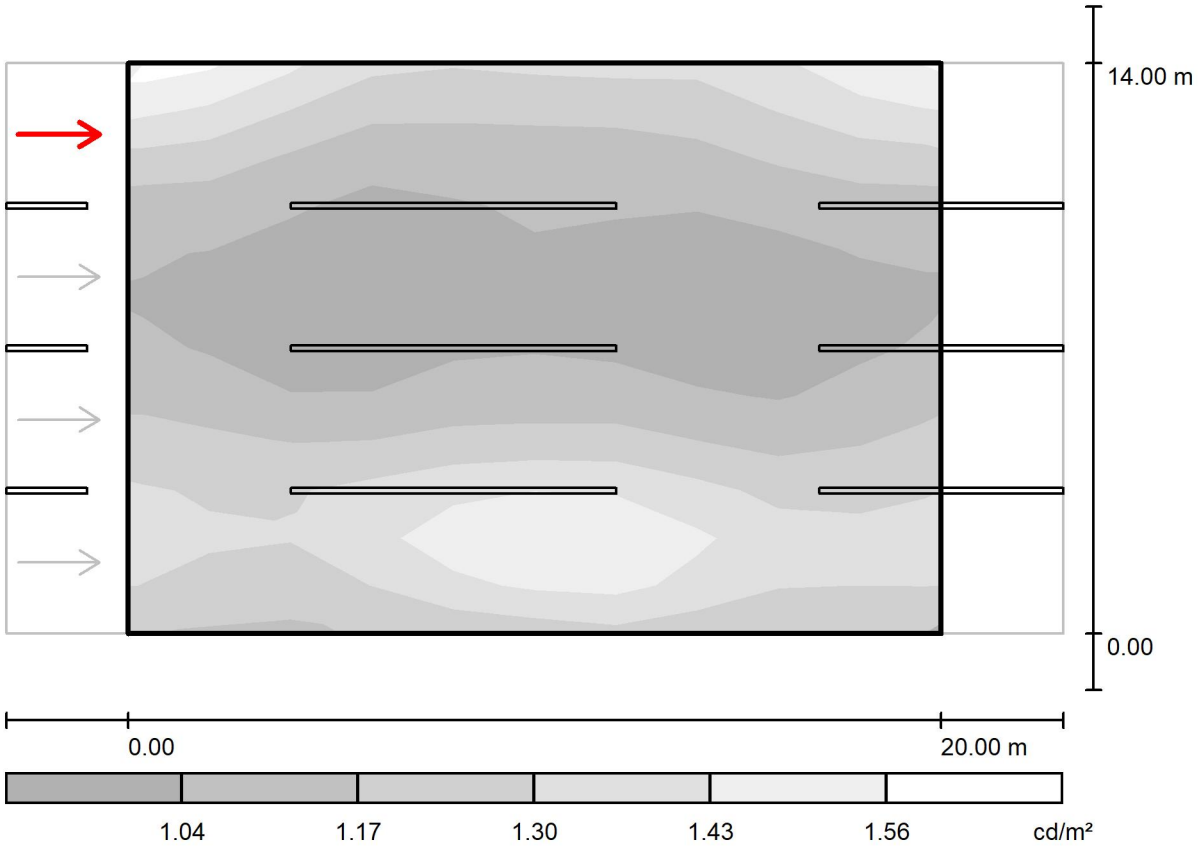

Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 12.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

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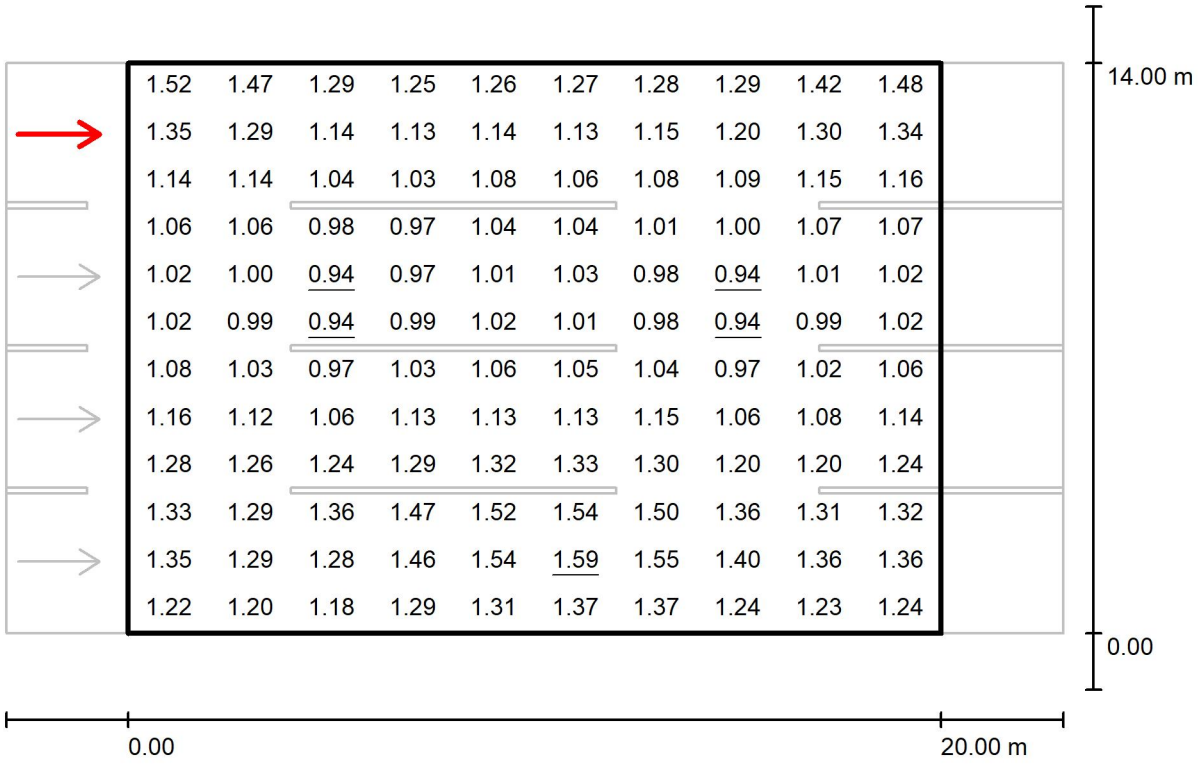


Values in Candela/m², Scale 1 : 186

Grid: 10 x 12 Points
Observer Position: (-60.000 m, 12.250 m, 1.500 m)
tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	UI	TI [%]
Calculated values:	1.18	0.79	0.83	5
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Appendix G

G1 Apron Lighting Design

The lighting drawings below define the strategy for the apron lighting and have been incorporated in the light obtrusion assessment.

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Referenced Models:

LLADCO-3C-ACM-AIR-FLG-M2-CE-0001
LLADCO-3C-ACM-WHS-GEN-IM-IM-0002
LLADCO-3C-CAP-WHS-GEN-M2-IN-0001

NOTES

1. The information within this drawing has been provided by CU-Phosco Lighting and must not be reproduced without the permission of CU Phosco Lighting.
2. Flood light design by CU Phosco Lighting, drawing number LS14770-3-4, titled "LONDON LUTON AIRPORT T2 WEST PROPOSED LIGHTING PHASE 3", dated 07-OCT-2020.
3. This drawing is a photometric design on a horizontal plane unless stated otherwise.
4. Lighting levels may deviate from those shown due to tolerances in lit area geometry, surface reflectance, luminaire installation position, luminaire and light source performance, and electrical supply and any obstructions within the area.
5. Illuminance, glare and floodlights schedules are shown on LLADCO-3C-ACM-AIR-FLG-DR-CE-0002.
6. For airfield layout drawing refer to LLADCO-3C-ACM-AIR-PRA-DR-CE-0001.
7. This is a preliminary design until a site survey is completed to fully assess the hazards and risks, e.g. from overhead and underground services, equipment positions or mounting heights, and any necessary revisions included to eliminate these.
8. Lighting of the airside roads is not included in this design and shall be developed in conjunction with the pier design.
9. Illumination requirements in accordance with EASA CS-ADR-DSN.
10. Minimum luminance level demonstrated to be always above 5 lux.
11. Minimum average luminance level demonstrated to be always above 20 lux.
12. Height of high masts (25m) are below obstacle limitation surface.
13. For fire training ground lighting design refer to drawing LLADCO-3C-ACM-AIR-FLG-0004.

KEY

Obs 15 — Glare observation point and reference

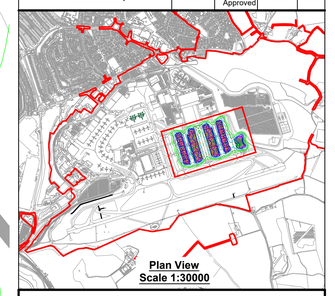
Lux Levels (Contour)

- Lux level = 1
- Lux level = 2
- Lux level = 5
- Lux level = 10
- Lux level = 20

Luminaire type and reference

- FL800R-2-B7-CW-F800-328W
- FL800R-2-B8-CW-F800-328W
- FL800R-2-F8-CW-F800-328W
- FL800R-3-F8-CW-F800-492W

Revision History	Drawn	Checked / Approved	Date	Rev.
Second Issue	CZ	SR	25/03/20	P01
For information	CZ	AE	09/10/20	P02



Plan View
Scale 1:30000

London Luton Airport Ltd
A Luton Council company
London Luton Airport Ltd.
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.llal.org.uk

London Luton Airport Development Consent Order

Drawing Title

PROPOSED FLOOD LIGHTING
FINAL PHASE - 32 MPPA

Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
C.Ziogas	S.Robinson	A.Evans	09/10/20	1:1000	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number: LLADCO-3C-ACM-AIR-FLG-DR-CE-0001 — Revision: P02

Project – Phase – Originator – AssetZone – Sub Asset – Type – Discp. – Number

0 25 50 m
1:1000 SCALE @A1

Luminaire Schedule						
No	Luminaire	X	Y	Height	Orient	Tilt
1	FL810-1-KS6-740-FGF-L0350	417.162	583.463	25	215	0
2	FL810-1-LS8-740-FGF-L0350	417.162	538.463	25	135	0
3	FL810-1-KS6-740-FGF-L0350	417.162	538.463	25	190	0
4	FL810-1-LS8-740-FGF-L0350	417.162	538.463	25	240	0
5	FL810-1-LS8-740-FGF-L0350	417.162	448.463	25	100	0
6	FL810-1-LS8-740-FGF-L0350	417.162	448.463	25	135	0
7	FL810-1-KS6-740-FGF-L0350	417.162	448.463	25	190	0
8	FL810-1-LS8-740-FGF-L0350	417.162	448.463	25	240	0
9	FL810-1-LS8-740-FGF-L0350	417.161	358.463	25	100	0
10	FL810-1-LS8-740-FGF-L0350	417.161	358.463	25	135	0
11	FL810-1-KS6-740-FGF-L0350	417.161	358.463	25	190	0
12	FL810-1-LS8-740-FGF-L0350	417.161	358.463	25	235	0
13	FL810-1-LS8-740-FGF-L0350	418.038	263.763	25	100	0
14	FL810-1-LS8-740-FGF-L0350	418.038	263.763	25	140	0
15	FL810-1-LS8-740-FGF-L0350	480.451	263.763	25	15	0
16	FL810-1-LS8-740-FGF-L0350	480.451	263.763	25	35	0
17	FL810-1-LS8-740-FGF-L0350	480.451	263.763	25	70	0
18	FL810-1-LS8-740-FGF-L0350	481.33	358.464	25	290	0
19	FL810-1-LS8-740-FGF-L0350	481.33	358.464	25	330	0
20	FL810-1-LS8-740-FGF-L0350	481.33	358.464	25	0	0
21	FL810-1-LS8-740-FGF-L0350	481.33	358.464	25	30	0
22	FL810-1-LS8-740-FGF-L0350	481.33	358.464	25	70	0
23	FL810-1-LS8-740-FGF-L0350	481.331	448.465	25	290	0
24	FL810-1-LS8-740-FGF-L0350	481.331	448.465	25	330	0
25	FL810-1-LS8-740-FGF-L0350	481.331	448.465	25	0	0
26	FL810-1-LS8-740-FGF-L0350	481.331	448.465	25	30	0
27	FL810-1-LS8-740-FGF-L0350	481.331	448.465	25	70	0
28	FL810-1-LS8-740-FGF-L0350	481.333	538.464	25	290	0
29	FL810-1-LS8-740-FGF-L0350	481.333	538.464	25	330	0
30	FL810-1-LS8-740-FGF-L0350	481.333	538.464	25	25	0
31	FL810-1-LS8-740-FGF-L0350	504.334	583.465	25	305	0
32	FL810-1-KS6-740-FGF-L0350	504.334	583.465	25	345	0
33	FL810-1-KS6-740-FGF-L0350	696.515	583.464	25	195	0
34	FL810-1-LS8-740-FGF-L0350	696.515	583.464	25	235	0
35	FL810-1-LS8-740-FGF-L0350	719.513	538.466	25	155	0
36	FL810-1-LS8-740-FGF-L0350	719.513	538.466	25	210	0
37	FL810-1-LS8-740-FGF-L0350	719.513	538.466	25	250	0
38	FL810-1-LS8-740-FGF-L0350	719.512	448.465	25	110	0
39	FL810-1-LS8-740-FGF-L0350	719.512	448.465	25	150	0
40	FL810-1-LS8-740-FGF-L0350	719.512	448.465	25	180	0
41	FL810-1-LS8-740-FGF-L0350	719.512	448.465	25	210	0
42	FL810-1-LS8-740-FGF-L0350	719.512	448.465	25	250	0
43	FL810-1-LS8-740-FGF-L0350	719.51	358.466	25	110	0
44	FL810-1-LS8-740-FGF-L0350	719.51	358.466	25	150	0
45	FL810-1-LS8-740-FGF-L0350	719.51	358.466	25	180	0
46	FL810-1-LS8-740-FGF-L0350	719.51	358.466	25	210	0
47	FL810-1-LS8-740-FGF-L0350	719.51	358.466	25	250	0
48	FL810-1-LS8-740-FGF-L0350	720.389	263.765	25	110	0
49	FL810-1-LS8-740-FGF-L0350	720.389	263.765	25	145	0
50	FL810-1-LS8-740-FGF-L0350	720.389	263.765	25	165	0
51	FL810-1-LS8-740-FGF-L0350	784.941	263.763	25	40	0
52	FL810-1-LS8-740-FGF-L0350	784.941	263.763	25	80	0
53	FL810-1-LS8-740-FGF-L0350	785.818	358.463	25	305	0
54	FL810-1-KS6-740-FGF-L0350	785.818	358.463	25	350	0
55	FL810-1-LS8-740-FGF-L0350	785.818	358.463	25	45	0
56	FL810-1-LS8-740-FGF-L0350	785.818	358.463	25	80	0
57	FL810-1-LS8-740-FGF-L0350	785.818	448.463	25	300	0
58	FL810-1-KS6-740-FGF-L0350	785.818	448.463	25	350	0
59	FL810-1-LS8-740-FGF-L0350	785.818	448.463	25	45	0
60	FL810-1-LS8-740-FGF-L0350	785.818	448.463	25	80	0
61	FL810-1-LS8-740-FGF-L0350	785.818	538.463	25	300	0
62	FL810-1-KS6-740-FGF-L0350	785.818	538.463	25	350	0
63	FL810-1-LS8-740-FGF-L0350	785.818	538.463	25	45	0
64	FL810-1-KS6-740-FGF-L0350	785.818	583.465	25	325	0
65	FL810-1-LS8-740-FGF-L0625	984.538	382.254	25	200	5
66	FL810-1-LS8-740-FGF-L0625	984.538	382.254	25	220	5
67	FL810-1-LS8-740-FGF-L0625	984.538	382.254	25	245	0
68	FL810-1-LS8-740-FGF-L0625	984.538	275.097	25	125	0
69	FL810-1-LS8-740-FGF-L0625	984.538	275.097	25	170	0

Luminaire Summary				
Symbol	Qty	Luminaire	LLF	Lumens
	5	FL810-1-LS8-740-FGF-L0625	0.820	75921
	54	FL810-1-LS8-740-FGF-L0350	0.850	48924
	10	FL810-1-KS6-740-FGF-L0350	0.850	45032

Illuminance Calculation					
Label	Avg	Max	Min	Min/Avg	Min/Max
Stand 11	22.56	57	8	0.35	0.14
Stand 12	22.86	43	10	0.44	0.23
Stand 13	25.63	45	9	0.35	0.20
Stand 14	23.61	43	10	0.42	0.23
Stand 15	25.45	44	9	0.35	0.20
Stand 16	22.66	41	9	0.40	0.22
Stand 17	21.44	35	7	0.33	0.20
Stand 21	23.10	50	7	0.30	0.14
Stand 21L	22.98	50	8	0.35	0.16
Stand 21R	24.01	46	8	0.33	0.17
Stand 22	23.28	48	7	0.30	0.15
Stand 22L	22.20	44	8	0.36	0.18
Stand 22R	24.41	47	8	0.33	0.17
Stand 23	21.68	44	8	0.37	0.18
Stand 23L	22.37	44	8	0.36	0.18
Stand 23R	21.17	38	9	0.43	0.24
Stand 24	26.66	54	9	0.34	0.17
Stand 31	26.67	54	9	0.34	0.17
Stand 32	21.68	44	8	0.37	0.18
Stand 32L	21.17	38	9	0.43	0.24
Stand 32R	22.50	44	8	0.36	0.18
Stand 33	23.29	48	7	0.30	0.15
Stand 33L	24.41	47	8	0.33	0.17
Stand 33R	22.19	44	8	0.36	0.18
Stand 34	23.13	50	7	0.30	0.14
Stand 34L	24.01	47	8	0.33	0.17
Stand 34R	23.07	50	8	0.35	0.16
Stand 41	21.84	35	7	0.32	0.20
Stand 42	23.04	41	10	0.43	0.24
Stand 43	25.67	45	9	0.35	0.20
Stand 44	23.61	43	10	0.42	0.23
Stand 45	25.62	45	9	0.35	0.20
Stand 46	22.86	43	10	0.44	0.23
Stand 47	22.55	57	8	0.35	0.14
Stand 51	24.15	59	7	0.29	0.12

Glare Rating			
Label	Observer	Obs Ht	Max
Stand 12	Obs 12	4	31
Stand 13	Obs 13	4	28
Stand 14	Obs 14	4	31
Stand 15	Obs 15	4	28
Stand 16	Obs 16	4	31
Stand 17	Obs 17	4	31
Stand 21	Obs 21	6	22
Stand 21L	Obs 21L	4	36
Stand 21R	Obs 21R	4	36
Stand 22	Obs 22	6	22
Stand 22L	Obs 22L	4	35
Stand 22R	Obs 22R	4	36
Stand 23	Obs 23	6	22
Stand 23L	Obs 23L	4	35
Stand 23R	Obs 23R	4	31
Stand 24	Obs 24	4	32
Stand 31	Obs 31	4	32
Stand 32	Obs 32	6	22
Stand 32L	Obs 32L	4	31
Stand 32R	Obs 32R	4	35
Stand 33	Obs 33	6	24
Stand 33L	Obs 33L	4	36
Stand 33R	Obs 33R	4	35
Stand 34	Obs 34	6	25
Stand 34L	Obs 34L	4	37
Stand 34R	Obs 34R	4	36
Stand 41	Obs 41	4	25
Stand 42	Obs 42	4	28
Stand 43	Obs 43	4	24
Stand 44	Obs 44	4	30
Stand 45	Obs 45	4	28
Stand 46	Obs 46	4	31
Stand 47	Obs 47	4	30
Stand 51	Obs 51	6	45

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Referenced Models:

LLADCO-3C-ACM-WHS-GEN-IM-IM-0002
LLADCO-3C-ACM-AIR-FLG-M2-CE-0001

NOTES

1. Flood light design by CU-Phosco Lighting, drawing number LS14770-3-4, titled "LONDON LUTON AIRPORT T2 WEST PROPOSED LIGHTING", dated 07-OCT-2020.
2. Lighting levels may deviate from those shown due to tolerances in lit area geometry, surface reflectance, luminaire installation position, luminaire and light source performance, and electrical supply and any obstructions within the area.
3. For airfield layout drawing refer to LLADCO-3C-ACM-AIR-PRA-DR-CE-0001.
4. The information within this drawing has been provided by CU-Phosco Lighting and must not be reproduced without the permission of CU Phosco Lighting.
5. Lighting of the airside roads is not included in this design and shall be developed in conjunction with the pier design.
6. Illumination requirements in accordance with EASA CS-ADR-DSN.
7. Minimum luminance level demonstrated to be always above 5 lux.
8. Minimum average luminance level demonstrated to be always above 20 lux.
9. Height of high masts (25m) below obstacle limitation surface.

Revision History	Drawn	Checked Approved	Date	Rev.
Second Issue	CZ	SR	25/03/20	P01
For information	CZ	AE	09/10/20	P02

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London Luton Airport Development Consent Order

Drawing Title

PROPOSED FLOOD LIGHTING SCHEDULES 32 MPPA

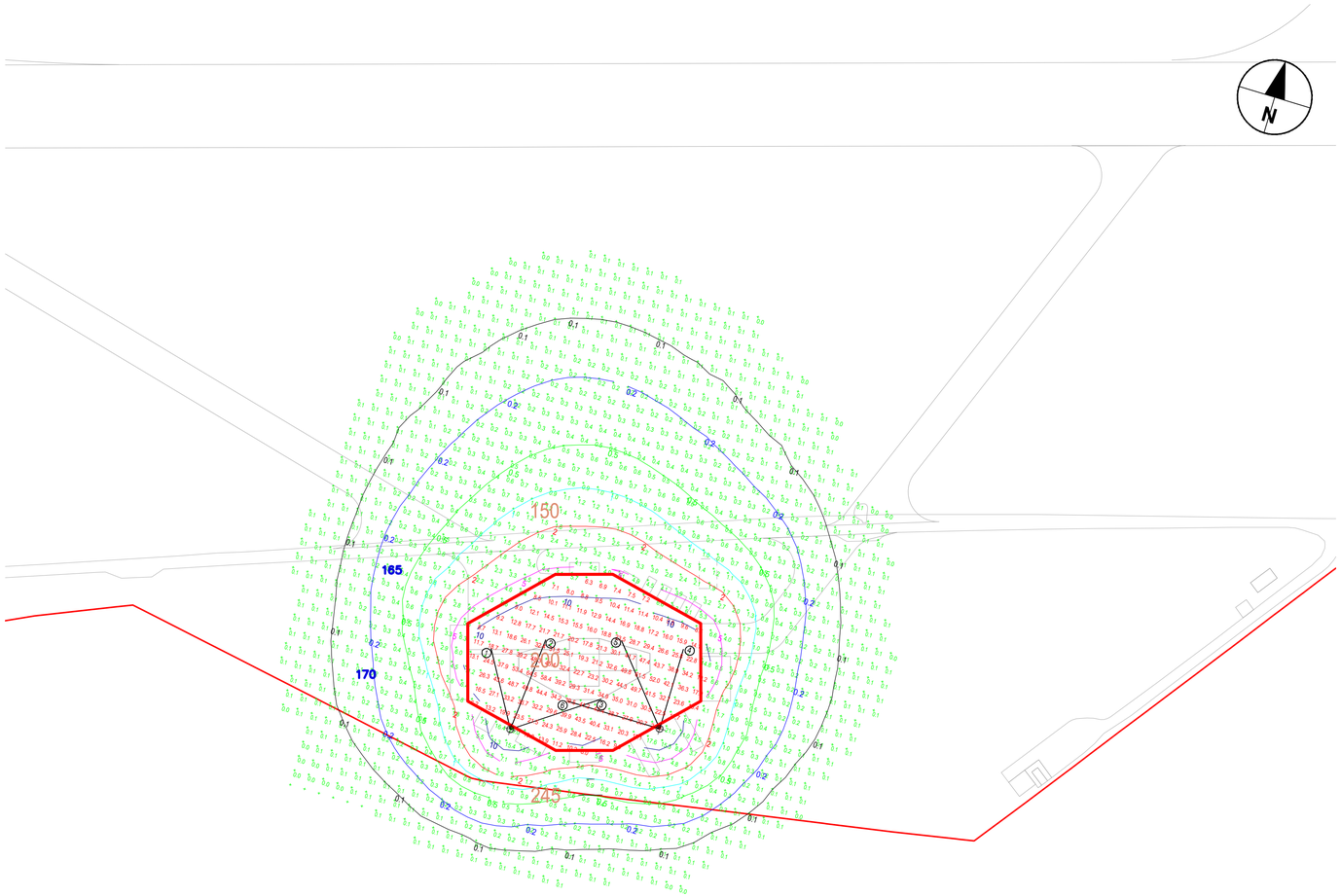
Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
C.Ziogas	S.Robinson	A.Evans	09/10/20	N/A	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ACM-AIR-FLG-DR-CE-0002	P02

Project – Phase – Originator – AssetZone – Sub Asset – Type – Discp. – Number



Fire Training Ground

0 25 50 m

1:1000 SCALE @A1

Luminaire Schedule					
Symbol	Qty	Label	Arrangement	LLF	Lum. Lumens
	4	FL800R-1-B8-CW-F800-164W	SINGLE	0.800	18501
	2	FL800R-2-B8-CW-F800-328W	SINGLE	0.800	36244

Luminaire Location Summary						
LumNo	Label	X	Y	Z	Orient	Tilt
1	FL800R-1-B8-CW-F800-164W	65.233	38.963	10	120	5
2	FL800R-2-B8-CW-F800-328W	65.233	38.963	10	85	7.5
3	FL800R-1-B8-CW-F800-164W	65.233	38.963	10	35	7.5
4	FL800R-1-B8-CW-F800-164W	113.09	53.494	10	90	5
5	FL800R-2-B8-CW-F800-328W	113.09	53.494	10	130	7.5
6	FL800R-1-B8-CW-F800-164W	113.09	53.494	10	180	7.5

Calculation Summary Avg/Min							
Label	CalcType	Units	Avg	Max	Min	Min/Avg	Min/Max
Fire Training Ground	Illuminance	Lux	25.01	64.5	6.2	0.25	0.10
Overspill	Illuminance	Lux	0.29	25	0.0	0.00	0.00

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

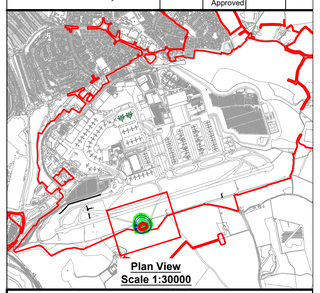
Referenced Models:

LLADCO-3C-ACM-WHS-GEN-IM-IM-0002
LLADCO-3C-ACM-AIR-FLG-M2-CE-0004
LLADCO-3C-ACM-AIR-FLG-M2-CE-0003
LLADCO-3C-CAP-WHS-GEN-M2-IN-0001

NOTES

1. The information within this drawing has been provided by CU-Phosco Lighting and must not be reproduced without the permission of CU Phosco Lighting.
2. Flood light design by CU Phosco Lighting, drawing number LS15018-1-2, titled "PROPOSED LIGHTING NEW FIRE TRAINING GROUND LONDON LUTON AIRPORT FOR AECOM", dated 03 Oct 2019.
3. Flood light design by CU Phosco Lighting, drawing number LS15018-2-1, titled "LONDON LUTON AIRPORT ENGINE GROUND RUN-UP ENCLOSURE PROPOSED LIGHTING", dated 22 Jan 2020.
4. This drawing is a photometric design on a horizontal plane unless stated otherwise.
5. Lighting levels may deviate from those shown due to tolerances in lit area geometry, surface reflectance, luminaire installation position, luminaire and light source performance, and electrical supply and any obstructions within the area.
6. For airfield layout drawing refer to LLADCO-3C-ACM-AIR-PRA-DR-CE-0001.
7. This is a preliminary design until a site survey is completed to fully assess the hazards and risks, e.g. from overhead and underground services, equipment positions or mounting heights, and any necessary revisions included to eliminate these.
8. Lighting of the airside roads is not included in the drawing.

Revision History	Drawn	Checked Approved	Date	Rev.
Second Issue	CZ	SR	25/03/20	P01
For information	CZ	AE	09/10/20	P02



Plan View
Scale 1:30000

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London Luton Airport
Development Consent Order

Drawing Title

PROPOSED FLOODLIGHTING
FIRE TRAINING GROUND
AT 32MPPA

Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
C.Ziogas	S.Robinson	A.Evans	09/10/20	1:1000	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ACM-AIR-FLG-DR-CE-0004	P02

Project -- Phase -- Originator -- Asset/Zone -- Sub Asset -- Type -- Discp. -- Number

REFERENCES

Ref 1 Institute of Lighting Professionals (2021). Guidance Note 01/21 - The Reduction of Obtrusive Light. Rugby: Institute of Lighting Professionals.
Ref 2 Carlson, T (2003). Light Pollution. International Dark Sky Association. London: HMSO.
Ref 3 HMSO (1990). Environmental Protection Act 1990, s.79. London: HMSO.
Ref 4 HMSO (2005). Clean Neighbourhoods and Environment Act 2005, s.102. London: HMSO.
Ref 5 HMSO (2000). Transport Act 2000, s.93-95. London: HMSO.
Ref 6 Institute of Light Professionals (2018). Guidance Note 08/18 Bats and Artifical Lighting in the UK. Rugby: Institute of Light Professionals.
Ref 7 Institute of Lighting Professionals (2013). Professional Lighting Guide 04 - Guidance on Undertaking Environmental Lighting Impact Assessments. Rugby: Institute of Lighting Professionals.
Ref 8 International Commission on Illumination (2017). CIE 150:2017 - Guide on the Limitation of the Effects of Obtrusive Light From Outdoor Lighting Installations. 2nd ed. Vienna: Commission Internationale de l'Eclairage.
Ref 9 International Commission on Illumination (1997). CIE 126 - 1997 - Guidelines for Minimizing Sky-glow; a CIE Technical Report. Vienna: Commission Internationale de l'Eclairage.
Ref 10 International Commission on Illumination (2000). CIE 136-2 - Guide to the Lighting of Urban Areas. Vienna: Commission Internationale de l'Eclairage.
Ref 11 The Society of Light and Lighting (2016). Lighting Guide 6: The Exterior Environment. London: Chartered Institute of Building Services Engineers.
Ref 12 Technical Committee CEN/TC 169 (2014). BS EN 12464-2:2014 - Light and Lighting - Lighting of work places - Part 2: Outdoor work. London: BSI Standards Ltd.
Ref 13 Tulla, A (2019). Factfile No.7 - Design and Assessment of Exterior Lighting Schemes. London: The Society of Light and Lighting.