STUDIES ON OPTIMIZATION OF LIGHTING DESIGN FOR MOTORIZED ROADS IN INDIA

A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR DEGREE OF
MASTER OF TECHNOLOGY
IN
ILLUMINATION TECHNOLOGY & DESIGN
SCHOOL OF ILLUMINATION SCIENCE, ENGINEERING & DESIGN, JADAVPUR UNIVERSITY

SUBMITTED BY
SUJAN GAIN
University Roll Number- 001931101002
Exam Roll Number- M6ILT22002

UNDER THE SUPERVISION OF

Dr. Suddhasatwa Chakraborty

ELECTRICAL ENGINEERING DEPARTMENT
FACULTY OF ENGINEERING AND TECHNOLOGY
JADAVPUR UNIVERSITY
KOLKATA – 700032

JUNE 2022

JADAVPUR UNIVERSITY
FACULTY OF ENGG. AND TECHNOLOGY
ELECTRICAL ENGINEERING DEPARTMENT

RECOMMENDATION CERTIFICATE

This is to certify that the thesis entitled **"STUDIES ON OPTIMIZATION OF LIGHTING DESIGN FOR MOTORIZED ROADS IN INDIA"** submitted by SUJAN **GAIN**, (Exam. Roll No. **M6ILT22002** , Registration No.**150169** of **2019-2020**) of this university in partial fulfillment of requirements for the award of degree of **Master Of Technology in Illumination technology & design, Department of School of Illumination Science, Engineering & Design**, is a Bonafide record of the work carried out by him under my guidance and supervision.

____
Dr. Suddhasatwa Chakraborty
Thesis Advisor
Assistant Professor
Faculty of Engineering & Technology
Electrical department, Jadavpur Universitty
Kolkata- 700032

____
Dr. Parthasarathi Satvaya
Director
School of Illumination Science, Engineering and Design,
Jadavpur University, Kolkata-700 032

____
Prof. (Dr.) Subenoy Chakraborty
DEAN-FISLM
Jadavpur University Kolkata-700032

CERTIFICATE OF APPROVAL

This foregoing thesis is hereby approved as a creditable study in Illumination Technology & design, carried out and presented by **SUJAN GAIN**, in a manner of satisfactory warrant its acceptance as a pre-requisite to the degree for which it has been submitted. It is notified to be understood that by this approval, the undersigned do not necessarily endorse or approved the thesis only for the purpose for which it has been submitted.

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(Signature of Examiners)

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I hereby declare that this thesis contains literature survey and original research work by the undersigned candidate, as part of my M.Tech. in Illumination technology & design studies during academic session 2019-2022.

All information in this document have been obtained and presented in accordance with academic rules and ethical conduct.

I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

NAME : **SUJAN GAIN**

CLASS ROLL NO. : **001931101002**

EXAM ROLL NO. : **M6ILT22002**

THESIS TITLE**: STUDIES ON OPTIMIZATION OF LIGHTING DESIGN FOR MOTORIZED ROADS IN INDIA.**

SIGNATURE & DATE:

ACKNOWLEDGEMENT

I take this opportunity to express my deep sense of gratitude and indebtedness to my Project Guide & advisor **(Dr). Suddhasatwa Chakraborty, Assistant professor, Electrical Engineering Department, Jadavpur University, Kolkata** for showing me the right path towards successful completion of this project with his constant guidance, supervision, valuable time, and helpful suggestions.

Again, I would like to acknowledge my sincere thanks to **Mr. Parthasarathi Satvaya**, Director of School of Illumination Science, Engineering and Design Department, Jadavpur University for providing me the opportunity to carry out my project work in Illumination Engineering Laboratory, Jadavpur University.

I am also thankful to **Aiswarya Dev Goswami** Scholars of Illumination Engineering, Electrical Engineering Department, Kolkata for their co-operation during my project work.

My sincere thanks also go to my teachers **Prof. (Dr.) Kamalika Ghosh, Prof (Dr.) Saswati Majumder, Prof (Dr.) Biswanath Roy, Mrs. Sangita Sahana** , jadavpur university for the encouragement they provided me in carrying out this work.

I am also thankful to Mr. **Pradip Paul** and Mr. **Samir Mandi**, staff and laboratory instructor of SISED Laboratory for their co-operation during my project work.

Finally, this thesis would not have been possible without the confidence, endurance, and support of my friends with whom I share tons of fond memories. They have always been a source of inspiration and encouragement.

Finally, I wish would convey my gratitude to my parents, whose love, teachings, and support have brought me this far.

Date:

Sujan Gain

Place:

ABSTRACT

A major purpose of road lighting is to increase the visibility for drivers and other roadway users. The visibility of a target depends on observer age and visual characteristics, observer duration, size of target, luminance of the target, luminance of the background, contrast polarity, exposure time, magnitude of the disability glare, and adaptation. A visibility formula was described by Adrian in 1989 and applied with Visibility Levels in North America as a quality criterion. According to procedures described in ANSI/IESNA RP-8-00: American National Standard Practice for Roadway Lighting the visibility of the target can be calculated when the target luminance, background luminance and veiling luminance in calculation methods are given. In European countries this criterion is still investigated as a new concept.

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CHAPTER 1
INTRODUCTION

1.1. INTRODUCTION OF PROJECT:

The purpose of this project is to understand efficient lighting design solution for different Road lighting facilities. Lighting plays a critical role in helping people navigate outdoor spaces safely at night. With the increased concern in energy conservation much attention has been found on lighting energy consumption. Inefficient light sources waste energy, as do luminaires that operate for long hours at full power, even when outdoor areas are vacant. Along with the concern of reducing energy consumption it's been realized that lighting has profound effect on visual comfort, cost, and aesthetics. The light requirements will be different for different applications, and it depends on different constraints. So, there is a need of efficient and effective lighting design which depends on lighting designers' knowledge of lighting practices for different applications.

Road lighting has consistently been a significant apparatus for advancing a city. It gives wellbeing and security to drivers, occupants, and people on foot. It is not only used as a functional requirement but also helps in creating an identity and image.

Fixed lighting of open ways for the two vehicles and walkers can make an evening situation where individuals can see easily and can rapidly and precisely recognize objects on the street being voyaged. Street lighting can improve traffic wellbeing, accomplish productive traffic development, and advance the overall utilization of the office during haziness and under a wide assortment of climate conditions.

As an enhancement to vehicular front lamp enlightenment, fixed lighting can empower the driver to see details even more unmistakably, find them with more prominent conviction, and respond securely to street and traffic conditions present on or close to the street office. People on foot must have the option to see with adequate detail to promptly arrange the passer by office and perceive the nearness of different walkers, vehicles, and articles in their region. Street lighting will not be exclusively founded on giving a prescribed measure of light to a street. Vitality compelling road lighting configuration incorporates effective light advancements, ideal shaft dividing, proficient luminaire dissemination and satisfying feel.

Electrical road lighting started with the incandescent lamp and was developed in steps with each invention and improvement of more efficient light sources in the sequence of low-pressure sodium lamps, mercury lamps, fluorescent tubes, high pressure sodium lamps, compact fluorescent lamps and metal halide lamps.

The development of reflector optics has been linked to these steps. It started with parabolic optics for the mercury lamp, allowed by its relatively small and compact shape, and continued with pot optics for the tubular high pressure sodium lamps and metal halide lamps allowed by their even smaller luminous shapes.

The driving force behind these steps of development has been the economy of road lighting. This is clearly demonstrated by the widespread use of high-pressure sodium lamp despite its poor quality of light in terms of colour of light and colour rendition.

The latest step is the LED module that integrates the LED light sources with optics and electrical supply and control gear. The LED module can match the lighting economy of the high-pressure sodium lamp and may pass it soon, and simultaneous provide light of a higher quality.

Studies in many countries and by many different institutions have shown that road lighting can help to reduce the number of night-time accidents by more than 30 percent. There is thus good evidence to suggest that road lighting can reduce the number of accidents occurring at night and that this lighting can be largely paid for out of the savings to the community that it brings with it. It would seem worthwhile, therefore, to look for a possible relationship between accident reduction figures and the standard or quality of the lighting installation producing them. Such a relationship could then be used as a sound basis for the design and specification of truly effective road lighting.

1.1.2. MOTIVATION

A good lighting design should be to save money, environment, and energy. For a lighting engineer, it's a challenge to design an effective lighting solution for Outdoor Street lighting by considering money saving, energy saving and environmentally friendly. A defined lighting design includes proper selection of luminaires and lamps which is eco-friendly with low pollution such as LEDs and electronics conforming to RoHS norms.

The quality of lighting, nowadays, is mainly determined by the choice and disposition of the Luminaires and Lamps, and by nature of surfaces being illuminated. However, there are many situations where artificial light is used in variable circumstances. At this stage, importance of a professional lighting designer comes into existence. A lighting designer should have creativity, innovation, and good knowledge in choosing type of luminaires, light sources, electronics etc.

Lighting automation is now becoming the rule rather than the exception, and it can be found that lighting automation is being used in most of the new construction and renovation projects in outdoor premises like Roads, Highways, Sports ground etc.

1.2 DESIGN CONSIDERATION

1.2.1 Visibility and Visual Comfort

Light level, uniformity, distribution, contrast, visual size, and glare all affect visibility. In terms of light level, uniformity, and distribution, the visual effects of moving from a bright area to a dark area can temporarily reduce visual function. Therefore, outdoor lighting should provide luminance and uniformity levels that are appropriate for the application and provide sufficient visual adaptation when moving between brighter and darker areas In terms of contrast, the relative luminance between adjacent objects and the background should be appropriate for the application. Additionally, glare from light sources or reflected off surfaces can be particularly uncomfortable and reduces visibility. Uniform surface illuminances help cut glare reflected off objects, while shielded luminaires placed carefully can help minimize direct glare from light sources, as well as glare reflected from windows and wet pavement.

1.2.2 Visual Efficacy

Luminous efficacy, a calculation of photopic lumens per watt, is perhaps the most common measure of the benefit-cost ratio for any lighting system. Yet, a better measure for outdoor lighting applications is a photometry system that considers how the human eye sees under typical night-time, or mesopic, lighting applications. The human visual system uses two classes of photoreceptors, rods, and cones. Cones are used under daytime ("photopic") light levels found outdoors during the day and in nearly all indoor applications illuminated by electric lighting systems. Under starlight ("scotopic" light levels), only rods provide visual information. However, many night-time applications, such as outdoor lighting of parking lots, provide light levels in the "mesopic" range, where both rods and cones work together to provide vision. Rods and cones are tuned to different parts of the electromagnetic spectrum. Thus, depending upon the light level, rods and cones provide a different overall spectral sensitivity to light.

1.2.3 Security

Security lighting facilitates the detection and identification of people, animals, and objects. People tend to feel safer when they can see far ahead and identify escape paths, if necessary. The visibility provided by lighting makes people more likely to enter an area and stay awhile, encouraging others to do the same, which can be a deterrent to crime. Property protection, such as cars in a parking lot, is an important objective of security lighting. The most common technique is to brightly illuminate the whole area to be secured, providing at least twice the illuminance of adjoining areas. This allows people in the area to be easily seen. Another strategy may be to keep the secure area dark, such as a guarded storage unit, but brightly illuminate the entrances, aiming luminaires outward. This technique creates glare and gives the sense that trespassers are being watched (Leslie and Rodgers 1996). These measures, however, need to be evaluated on a case-by-case basis and weighted against potential light trespass or light pollution. Additionally, evidence that lighting increases security is conflicting, but lighting does seem to unambiguously increase one's sense of security

1.2.4 Aesthetics and Economic

Development a well-designed outdoor lighting installation can attract shoppers and patrons to places such as outdoor shopping centres, event and concert halls, museums, plazas, and parks, promoting the economic vitality of a community. The lighting in the outdoor areas of these spaces should be attractive, and the appearance of people and architectural features is important. Higher illuminances should be saved to highlight paths, signs, building facades, and landscape features. Designers should consider the colour of the light source and its ability to render colours, including skin tones; the appearance of luminaires and matching luminaires to the site; and issues of glare.

1.3 ENERGY AND ENVIRONMENTAL CONCERNS

1.3.1 Energy Usage:

The energy used by a lighting system depends on the lamp type, the ballast, the luminaire type, the number of luminaires required, and the control strategy. Because average illuminance and illuminance uniformity are important performance criteria for many outdoor lighting applications, energy usage is affected by the luminaire's efficiency and light distribution. Because not all outdoor lighting needs to be on full light output all night, reducing the number of hours of outdoor lighting can reduce energy usage. Methods include timers, motion sensors, photo sensors, curfew dimming, and step switching. Energy usage also can be maximized by considering the unified luminance of a given light source.

1.3.2 Light Pollution:

Light pollution is a consequence of light at night, and can be evaluated in terms of sky glow, light trespass, and glare. With appropriate lighting design, luminaire selection, and controls, light pollution can be minimized. Sky glow is a brightening of the sky, which impedes a view of the stars. Luminaires aimed upward or light reflected off the ground contribute to sky glow. The amount of sky glow depends on immediate weather conditions, the amount of dust, pollution, water vapor, and gas in the atmosphere, the amount of light directed skyward, and the direction from which it is viewed. Sky glow is a very visible effect of light at night and gives an indication of wasted energy. Light trespass occurs when light spills into an area where it is not wanted or needed. What accounts for light trespass is somewhat subjective, but generally light should not be directed on the facades of adjoining buildings or properties, causing light to enter interior areas. Proper aiming and shielding of light sources can significantly reduce light trespass, as can reposition lights away from property boundaries. Glare is a visual sensation caused by excessive and uncontrolled brightness, and it can range from uncomfortable to visually disabling. IESNA's Luminaire Classification System for Outdoor Luminaires provides one means of evaluating glare. The luminous flux exiting a luminaire at a certain angle (the glare zone), the luminaire mounting height, and visually adjacent luminance are other means of evaluating glare.

1.3.3 Economic Feasibility

The economics of an outdoor lighting installation include the first cost to purchase and install, annual maintenance costs (e.g., lamp, ballast, or driver replacements, regular cleaning), and annual energy costs, all which amount to the total cost of ownership. Also, to be considered in the economics of outdoor lighting are less predictable costs and benefits. For example, good security lighting may reduce vandalism and help control liability and accident expenses. Good lighting may attract people to a shopping area or outdoor venue, enhancing the community's vitality and economic development. It may improve the attractiveness of multi-family housing, leading more people to rent or buy into that community. While the costs and benefits of improved security and appearance are less tangible, they can be estimated.

1.4. OBJECTIVES

- Energy saving through selection of efficient lamp technologies and design practices.
- Capital cost saving using proper spacing and placement.
- Maintenance cost 'saving using lamps with longer life and optimum spacing.
- Reduced glare and improved visibility by careful selection of luminaires and lamps.
- Improved sense of security by selection of efficient systems and incorporating proper design. This can make an area appear safer and more secure.
- Improved sense of economic development of communities; and
- Improved safety of motorists, cyclists and pedestrians, improved traffic guidance and a pleasant environment.

1.5. AIM OF THE WORK:

The general aim of the work is to explore the existing lighting of street and is to investigate the required lighting of road and highway in Indian condition.

The objectives of this project are as follows:

1. The primary goal is to structure and compute the amount of light available and its quality and wattage of existing luminaire. And LED luminaire required to light up a specific piece of a roadway according to standard.
2. By adopting new and energy-efficient technologies and introducing procurement practices that promote the purchase of these technologies, large energy and cost savings can be achieved.
3. And What's more, the subsequent goal is comparative studies between existing luminaire & simulated or designed (LED)luminaires.
4. The efficiency of street lighting can also be significantly improved by selecting appropriate optics for the luminaires as well as ensuring proper mounting height, overhang, and angle of tilt in a street lighting installation.
5. Selection of lamps that operate over a wide range of power parameters would significantly reduce the replacement costs of the lamps by reducing the failure rate, although it may entail a high initial investment cost.

Following these can enhance visibility and safety, and help reduce electricity consumption and costs, to free up resources for other pressing needs, thereby contributing to the improvement of the overall quality of life.

CHAPTER 2

STREET LIGHTING

2. STREET WAYLIGHTING:

A streetway may require lighting to facilitate the safety movements of vehicles from one area to another. Streetway lighting is especially important where mixed modes of movement converge, such as vehicular/pedestrian and automobile/service vehicle. These streetway systems should use low-glare luminaires that produce very little intensity between 700and 900from nadir and no intensity at 900or above. A reduction in intensity at these high angles will reduce light pollution, minimize spill light, and optimize the use of energy by placing the light where it is needed. High angle intensity does little or nothing to produce illumination on a horizontal streetway surface.

The current streetway lighting standard uses horizontal illuminance and uniformity of illumination as the primary design criteria for streetway lighting. Both factors are deficient in terms of what the visual system sees. A design based on horizontal illuminance is less than desirable, but it is currently the design procedure most used. The lighting professional should be aware of the deficiencies but may be required to use this procedure to arrive at a solution.

2.1 HIGHWAY RELATED TERMS HIGHWAY:

Highways:

Highway is any public road or other public way on land. It is used for major roads, but also includes other public roads and public tracks.

Carriageway:

A carriageway consists of a width of road on which a vehicle is not restricted by any physical barriers or separation to move laterally. A carriageway generally consists of several traffic lanes together with any associated shoulder but may be a sole lane in width.

A single carriageway road has one carriageway with 1, 2 or more lanes together with any associated footways /sidewalk and road verges/ green belt). A dual carriageway road has two roadways separated by a central reservation or median. A local-express lane system has more than two roadways, typically two sets of 'local lanes' and two sets of 'express lanes'. "Cars only" lanes may be physically separated from those open to mixed traffic including trucks and buses.

Median or Central Reserve:

The median strip or central reservation is the reserved area that separates opposing lanes of traffic on divided roadways, such as divided highways, dual carriageways, freeways, and motorways.

Service Road:

A service road is a local road running parallel to a higher-speed, limited-access road and connected only at selected points with the principal road. A service road is often used to provide access to private driveways, shops, houses, industries, or farms.

Cycle Track:

Cycle Track is a way or part of a highway for use by pedal cycles only.

Footway:

Footway is that portion of a road reserved exclusively for pedestrians.

Verge:

The unpaved area flanking a carriageway, forming part of the highway and substantially at the same level as the carriageway.

Shoulder:

A strip of highway adjacent to and level with the main carriageway to provide an opportunity for vehicles to leave the carriageway in an emergency.

Refuge:

A raised platform or a guarded area so sited in the carriageway as to divide the streams of traffic and to provide a safety area for pedestrians.

Kerb:

A border of stone, concrete or other rigid material formed at the edge of a carriageway.

2.2 SCHEMATIC DIAGRAM OF STREET LIGHTING

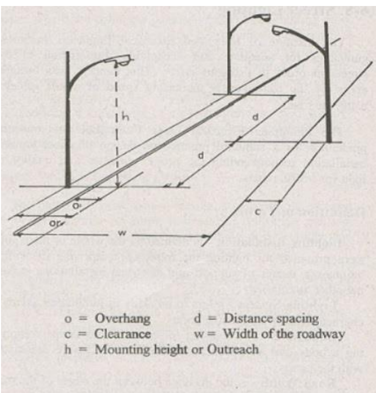


Figure 1 street lighting

h = Mounting height (pole height ≠ mounting height)

d = spacing

or = outreach c =clearance

w = width of roadway o =overhang

And or ≠ c + o

2.3 GEOMETRY AND TERMINOLOGY

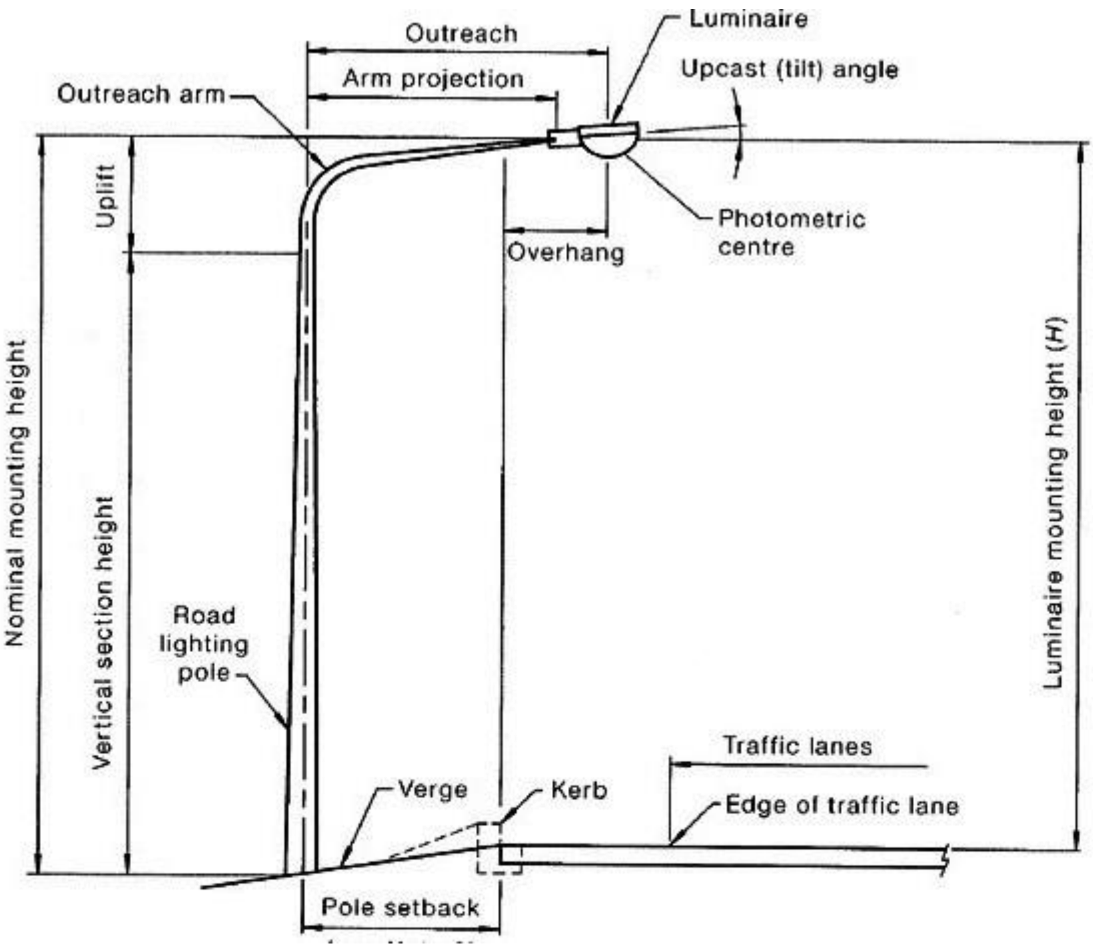


Figure 2 Geometry of typical Road Lighting installation

Mounting Height: The vertical distance from the roadway surface to the photometric center of the luminaire.

Carriageway width (Wk.): The portion (width) of the roadway that is devoted to the use of vehicles.

Overhang: Overhang is measured horizontally from the edge of the kerb to the photometric centre of the luminaire. This is a basic measurement utilized in structure programming applications in deciding carriageway luminance and illuminance.

Outreach: Outreach is measured horizontally from the centre line of the pole to the photometric centre of the luminaire.

Pole setback: The horizontal distance between the edge of the kerb (or edge of the traffic lane if no kerb) and the centreline of the lighting pole, measured normal to the direction of traffic.

Spacing: The distance, measured along the centre line of the carriageway, between successive luminaires in an installation

Span: That part of the highway lying between successive luminaires in an installation. It is required for the calculation of number of poles required in a stretch.

Upcast (tilt angle): The angle between the axis of the fixing spigot entry is tilted above the horizontal when the luminaire is installed.

CHAPTER 3

CALCULATIONS OF ROAD LIGHTING DESIGN

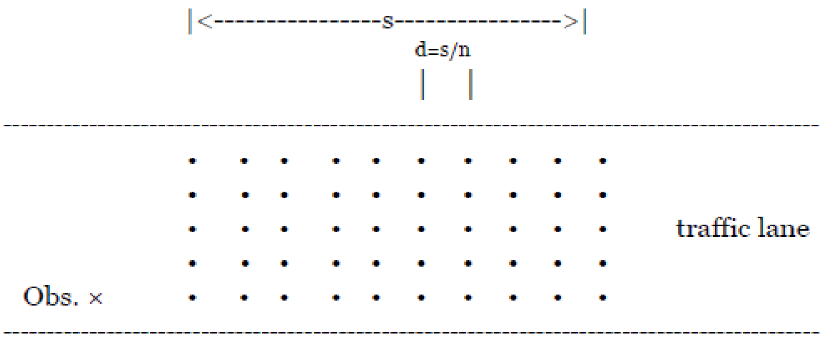
3.CALCULATIONS OF ROAD LIGHTING DESIGN

During the actual lighting design phase of a lighting project, a lighting engineer must perform lighting calculations to arrive at solutions that will satisfy the relevant lighting requirements.
Since the performance of lighting calculations involving luminance is relatively time consuming, extensive use is now being made of computers. Universally applicable computer programs are available for this purpose.
But for routine design work on the computer is often not needed; provided that is, that suitable information concerning the performance of the luminaires under various standard conditions of use is available in an acceptable form. An example of how performance information can be presented and used in manual design work will be given in this chapter.
Where lighting calculations must be carried out for non-standard situations (e.g., exceptional road width, mounting height, or road curvature) and a computer is not available, use can be made of the photometric data (in graph form) of the relevant luminaires. The method of using these graphs for the purpose of calculating the average illuminances and luminance as well as the uniformities and glare values will also be outlined in this chapter.

3.1 CONVENTIONS

3.1.1 Calculation Points

The values obtained for calculated averages and uniformities, whether they be illuminances or luminance, are only of course meaningful if both the number and the position of the calculation points employed are specified.
It is generally accepted that the area on the road for which the calculations are performed-the calculation grid- should be representative of the road between 60 and 160 meters in front of the road user, which is the area of the greatest interest to him. Test calculations have, in fact, shown that this requirement will be fully satisfied if the calculation grid covers at least one span (this being the area between successive luminaries on the same side of the road) and if this is placed roughly in the middle of the 1oo meter stretch of road specified above.
The CIE (1976a) recommends that where the luminaire spacing does not exceed 50 meters there should be ten evenly spaced transverse rows of calculation points over these lengths, while for luminaire spacings greater than 50 meters the number of transverse rows should be such that the distance between two successive rows does not exceed 5 meters.



Calculation grid as proposed by the CIE
s=spacing.
d=longitudinal distance between calculation points.
n=number of transverse rows.
For s≤50m, n=10; s>50m, n=smallest integer giving d≤5m.

Finally, the CIE also recommends that there should be five points across each traffic lane, with one point positioned on the center line of each lane. It is stated that where the uniformity is good-$U_\circ \geq 0.4$- subsequent calculations may be based on three points instead of five.

3.1.2 Observer Position

The luminance and glare calculations made in road lighting must consider the most probable position of the road user relative to the area of the road surface for which the calculations are made. This position, the so-called observer position, can be fixed by specifying the eye height of the observer above the road surface and his distances from the beginning of the calculation grid (longitudinal position) and the side of the road (lateral position).

3.1.3 Eye height

In the CIE publication referred to above it is recommended that eye height be taken as 1.5 meters, this being close to the average height of driver 's eyes above the road.

3.1.4 Longitudinal position

From what has been said above; the observer is assumed to occupy a position some 60 metres plus (depending on the width of the span involved) in front of the calculation grid.

There is, however, one exception to this rule, and this is in the case of the glare parameter TI (the threshold increment). This should be calculated for the longitudinal observer position giving the highest TI value. Since the screening angle formed by a car's roof is standardized at 20° (CIE, 1976b), TI will generally be at a maximum for that longitudinal position of the observer at which a luminaire appears just within this screening angle; the longitudinal observer position at which this situation arises is therefore the one assumed to be most appropriate when calculating TI.

3.1.5. Lateral position

The CIE defines the lateral position of the observer according to the type of calculation being performed. For the calculation or measurement of all quality parameters other than longitudinal uniformity, the observer is considered as occupying a position one quarter of the carriageway width from the nearside kerb-the so-called Standard Lateral Observer Position. (For a single-sided, or asymmetrical, lighting arrangement there will in fact be two such observer positions, one for each direction of traffic flow.) Longitudinal uniformity, on the other hand,is calculated for the line passing through an observer positioned in the middle of each traffic lane and facing the direction of traffic flow.

To gain an insight into the influence that lateral observer position has on the values obtained for the various quality parameters. The calculations were performed for single-sided, staggered and twin-central lighting arrangements and for several dry and wet road surfaces. The results obtained are summarized in figure which shows the maximum deviation of the various parameters with change in the lateral position of the observer from the Standard Lateral Position defines above, as a function of the specular factor S1.

For dry road surfaces (shaded area in figure) the level and uniformity parameters (Lav, U_0andUl) show a deviation of no more than about 10 per cent for any departure from the standard observer position defines above. In other words, the error in calculating Lav,U_0andUl for the Standard Lateral Observer Position alone rather than employing a separate position, as is done by the CIE for the calculation of Ul, would appear to be unwarranted, at least for dry-weather conditions. For the glare parameter (TI), however, the change in value with departure from the Standard Lateral Observer Position is quite considerable-as much as 60 per cent. Where glare can be critical, therefore, a check on TI at observer positions other than the Standard Lateral Position defines above, would seem advisable, even though not actually recommended by the CIE.

For wet road surface, it is apparent from this figure that observer position has a much greater influence on all four quality parameters. However, before any definite conclusions can be drawn from this concerning which is the best observer position to take for the purposes of establishing a convention-or whether indeed more than one position should be considered-further investigative work on wet-weather lighting would have to be carried out.

3.1.6Average and Perspective Average

A road user sees the road ahead of him in perspective and gives weight to a luminance according to the apparent size of the area concerned: the closer the area is to him, the larger it will appear and the more influence it will have in comparison with other areas of equal real size farther away. In the average road surface luminance as normally calculated, the individual luminance values are not weighted according to the apparent size of the areas concerned, too little weight is given to the areas close to the observer position and too much to those farther away. By distributing the individual calculation points uniformly over the perspective picture of the road surface and calculating from these points, the perspective average road surface luminance is obtained.
As the road user travels along the road, his area of interest naturally moves along in front of him. Ideally, therefore, the average perspective luminance should be averaged for many observer positions between one span and the next. It has been shown, however, that the average of the perspective averages so obtained (termed the dynamic perspective average) is very close to the normal, unweighted (static) average calculated for a calculation grid that starts at the beginning of a span. It follows, therefore, that in practice the calculation of this unweighted static average will suffice.

3.2 GRAPHICAL PHOTOMETRIC LUMINAIRE DATA

Using the appropriate graphical presentations of the photometric luminaire data, the point and average values of both illuminance and road surface luminance can be calculated in a straightforward way for any combination of lighting arrangement and road cross-section. The techniques employed are given below.

3.2.1 Illuminance

Illuminance at a point

The horizontal illuminance at a point on the road can be determined from the isolux diagram belonging to the particular luminaire type in use. A typical isolux diagram is shown in the figure. As can be seen, the grid of the diagram is specified in terms of the mounting height *(h)* of the luminaire, so making it valid for all mounting heights. The values of the illuminance contours are expressed as a percentage of the maximum illuminance given by the luminaire.
The relative illuminance produced by a single luminaire at a point can thus be read direct from the diagram; provided, of course, that the position of the point on the grid is defined in terms of *h*. The total relative illuminance at the point is then found by adding to this value the contributions made to the illuminance by the other luminaires. In practice it is usually sufficient to sum the contributions made by only three luminaires, viz. that nearest the point considered and one on either side of it to ensure a reasonably accurate result.
In performing this summation, the isolux diagram is used as follows. A copy of the isolux diagram made on a transparent sheet is layed over a plan of the road drawn to the same scale as that of the diagram itself, the origin of the diagram coinciding with the position of the first luminaire. The contribution made by this luminaire to the relative illuminance at the point is then read off. This produce is repeated for the other two luminaire positions of interest, and the contribution made by all three luminaires summed.
It is important to ensure that the correct kerbside/road-side orientation of the isolux diagram is maintained; for example, had the luminaires in the example illustrated been on the other side of the road, it would have been necessary to turn the isolux diagram through 180 degrees.

Average illuminance

The average illuminance for a defined area of calculation may be found using
$E_{av} = \Sigma E_p / n$

Where Ep is the illuminance at each point considered and n is the total number of points regularly distributed over this area.
But of course, this approach is very time consuming. For a straight road, however, the average illuminance can be quickly and easily calculated from the utilization factor diagram for the particular luminaire in use.

3.2.2 Luminance

Luminance at a point

The luminance at a point on a road can be determined using the isoluminance diagram appropriate to the luminaire and road surface class considered. The grid of the diagram is specified in terms of the luminaire mounting height(h) to make the diagram valid for all heights. The isoluminance contours are specified as percentages of the maximum luminance.
Each diagram is calculated for an observer stationed in the vertical plane parallel to the road axis and passing through the luminaire (the C=0° plane) and a distance 10h from it. The way in which the diagram is used will thus depend on the actual position of the observer. There are basically two cases to consider: observer in-line with the row of luminaires, and observer outside the row.

Average luminance

Knowing the luminance values over a part of a road, the average luminance over the same area may be found from

$L_{av} = \Sigma L_p/n$

Where Lp is the luminance at each point in a regular grid and *n* is the total number of points considered. But of course, this approach is very time consuming.
The quickest way of calculating the average luminance of a straight road of infinite length is by using the luminance yield diagram appropriate to the luminaire and road surface class concerned.
Having determined the luminance yield factor for the road cross-section, observer position and road-surface class being considered,the average luminance Lav can be obtained from

$L_{av} = \eta L.(Ø/w.s).Q_0$

Where ηL= luminance yield factor
Ø= luminous flux of the bare lamp used in the luminaire (lm)
w= width of road (m)
s= luminaire spacing (m)
Q_0= average luminance coefficient of road surface (cd/m²/lux)

3.3 PERFORMANCE SHEETS

For routine design work the relatively time-consuming method of calculation based on the use of graphical photometric luminaire data can be avoided-even when no computer is available-if performance sheets such as those described in this chapter are available for the luminaires considered.
As already mentioned, performance sheets may take many different forms. However, each sheet should at least give the values of thephotometric quality parameters (luminance level, luminance uniformity and glare ratings) for a specified road cross-section, lighting arrangement,luminaire-lamp combination and mounting height for various luminaire spacings and for the four standard road-surface reflection classes.
A library of such performance sheets covering a range of typical road cross-sections and lighting arrangements can be used to facilitate the design of road lighting installations. The first step, of course, is to narrow the number of sheets down to those depicting a road cross-section the same as the one for which the design must be made. It is then simply a matter of going through these sheets one by one and noting for each which of the precalculated lighting schemes (viz. pole arrangement, lamp-luminaire combination, mounting height and spacing), satisfies the quality requirements in force for the road-surface reflection class being considered. Should the road cross-section, the lighting arrangement, or both, differ from those contained in the library, it will then be necessary to interpolate between known values to arrive at the required design figures.

3.4 COMPUTERISED CALCULATIONS

Where a more detailed design analysis is required than can be provided by the precalculated performance sheets described above, the speed and accuracy obtainable with a computer are essential.

Illuminance, luminance, and glare calculations made using photometric luminaire data presented in graphical form are rather tedious and time consuming. Such methods should therefore be seen more as a way of performing a limited number of spot checks on a tentative design proposal rather than as an aid in the design process itself.

The computer can be programmed to perform the basic illuminance and luminance calculations described using just two equations

1. For illuminance at a point, Ep

$Ep=I(C,\gamma)/h^2 \, x\cos^3 \gamma$

2. For luminance at a point, Lp

$Lp=q\ (\beta, \gamma)\ Ep=I(C,\gamma)/h^2 \ x\ r(\beta,\gamma)$

Where $I(C,\gamma)$= luminous intensity in the direction of the point as defined by the angles C and γ

h= luminaire mounting height

$q\ (\beta, \gamma)$ = luminance coefficient of the road surface for the angle (γ) of light incidence concerned and angle (β) between vertical plane of observation and plane of light incidence

$r\ (\beta, \gamma)$ = reduced luminance coefficient ($q\cos^3\gamma$) of the road surface for the angle (γ) of light incidence concerned and for the angle (β) between vertical plane of observation and vertical plane of light incidence.

The CIE recommends that tables giving the necessary intensities (termed I-table) and reduced luminance coefficients (termed r-tables) be drawn up according to standard formats. Intensity and reflectance values for C-γ and β-γ combinations not appearing in the tables must, of course, be arrived at by a process of interpolation.

The computer programs employed for the calculation of the above illuminance, luminance and glare values can be structured to suit various input and output requirements and to give various degree of sophistication. Two programs used for luminance calculations are described in CIE Technical Report No. 30. One of them is a standard program which is simple in use, but which can only be used for straight road sections with relatively simple lighting geometries. The other program is a comprehensive one and can deal with a greater number of situations concerning road and lighting geometry but is, for this reason, also more complicated to use.

CHAPTER 4

DIFFERENT INTERNATIONAL & NATIONAL RECOMMENDATIONS ON ROAD LIGHTING DESIGN

4.DIFFERENTINTERNATIONAL&NATIONAL RECOMMENDATIONS ON ROAD LIGHTING DESIGN:

4.1. IS 1944 (PART I AND PART II)-1970[5]:

Classification of Lighting: -

The classification is one of lighting and not of roads but is linked with traffic density. Lighting for Streets is classified into the following groups: -

Group A - For main roads. This is subdivided in two categories: -

- Group A1 - For very important routes with rapid and dense traffic where the only considerations are the safety and speed of the traffic and the comfort of the drivers.
- Group A2 - For other main roads with considerable mixed traffic

Group B - For secondary roads. This is also subdivided in two categories: -

- Group B1 - For secondary roads with considerable traffic.
- Group B2 - For secondary roads with light traffic.

Group C - Lighting for residential and unclassified roads.

Group D - Lighting for bridges and flyovers.

Group E - Lighting for town and city centres.

Group F - Lighting for roads with special requirements, such as roads near airfields, railways, and docks.

Categories of the Road: -

The level and type of lighting adopted for a road is based mainly on its traffic importance, both vehicular and pedestrian. The system of lighting to be provided should consider all the relevant factors, such as the presence of factories, or places of public resort, the character of the street, aesthetic considerations, the properties of the carriageway surface, the existence of humps, bends or long straight stretches and overhanging trees. According to IS 1944 (Part I and II) – 1970 categories of the road [46], Lighting design parameters are as below:

TABLE: 4.1 - Lighting Design parameters: IS 1944

Classification of road lighting installation	GROUP A1	GROUP A2	GROUP B1	GROUP B2
Average illumination on road surface (E_{avg})	30	15	8	4
Longitudinal Uniformity ratio (Emin. /Eavg.)	0.4	0.4	0.3	0.3
Transverse or overall uniformity ratio ($E_{min.}$ /$E_{max.}$) (%)	33	33	20	20

N.B.: 1. Emin: Minimum Illuminance on road surface.

2. Emax: Maximum Illuminance on road surface.

Types of Luminaire arrangement:

TABLE: 4.2 - Guide for Placement of Luminaire: IS 1944

SINGLE SIDED	Width equal or less than mounting height
STAGGARED	Width not equal or less than mounting height but not greater than 1.5 times mounting height
OPPOSITE	Width greater than 1.5 times mounting height
CENTRAL ARRANGEMENT	Mainly dual carriageway mounting height equal or greater than equal to effective width

The above Table: 2.2 provide the guidance for the arrangement of Luminaries according to width of the road and mounting height of the luminaries.

Standard Pole Layout

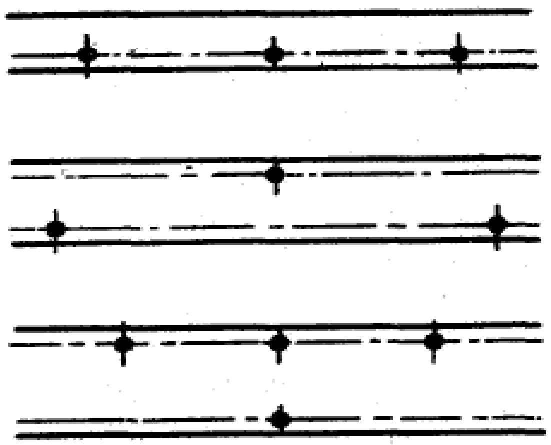


Figure 3: Standard Pole Layouts

Mounting Height: -

The minimum mounting height should be chosen considering the power of the sources, the light distribution of the luminaries and the geometry of the installation.

Mounting height should be greater to avoid glare and better longitudinal Uniformity.

Spacing: -

Luminaire spacing between two poles is measured and compared with the standard data available. The standard data for luminaire spacing to height ratio is given in the following Table.4.3 and Table 4.4 is a guide to choose type of Luminaire according to height of the road.

Type of Luminaire	*Maximum Spacing/Height Ratio*
Cut-off	3
Semi-cut-off	3·5
Non-cut-of	4

TABLE: 4.3 - Guide for choosing Type of Luminaire for a particular spacing ratio: IS 1944

The four IESNA classifications are defined as follows (IESNA 2000):

- **Full Cut-off –**A luminaire light distribution where zero candela intensity occurs at or above an angle of 90° above nadir. Additionally, the candela per 1000 lamp lumens does not numerically exceed 100 (10 percent) at or above a vertical angle of 80° above nadir. This applies to all lateral angles around the luminaire.

- **Cut-off -** A luminaire light distribution where the candela per 1000 lamp lumens does not numerically exceed 25 (2.5 percent) at or above an angle of 90° above nadir, and 100 (10 percent) at or above a vertical angle 80° above nadir. This applies to all lateral angles around the luminaire.

- **Semi cut-off** - A luminaire light distribution where the candela per 1000 lamp lumens does not numerically exceed 50 (5 percent) at or above an angle of 90° above nadir, and 200 (20 percent) at or above a vertical angle 80° above nadir. This applies to all lateral angles around the luminaire.

- **Non-cut-off-** A luminaire light distribution where there is no candela limitation in the zone above maximum candela.

TABLE: 4.4 - Guide for type of luminaire and mounting height of luminaire according to classes of roads: IS 1944

Class of road	**Mounting Height**	**Type of luminaire preferred**	**Type of luminaire permitted**
GROUP A	9-10	cut off	semi cut-off
GROUP B	7.5-10	cut off or semi cut-off	non cut off
GROUP C	less than 7.5	semi cut off	non cut off

4.2. IESNA RP-8-00[1]**:**

4.2.1.IESNA Definitions: RP-8-00:

Illuminance method is the classical method used from 1928. The design criteria consider lighting system alone i.e., lamp, luminaries and ANSI/IESNA RP-8-00: American National Standard Practice for Roadway Lighting Revised in 2000 have three separate design methods**:**

- Illuminance

– Luminance

– Small Target Visibility (STV)

a) <u>Design Methods: Illuminance</u>

photometry and system geometry and one uniformity criterion: average to minimum. It has no constraint on maximum illuminance. Includes veiling luminance criterion, from luminance calculation.

b) <u>Design Methods: Luminance</u>

Luminance method is almost recent method from 1983. It considers roadway and lighting system interaction like lamp, luminaire and photometry, system geometry roadway surface. It has two uniformity criteria average to minimum and maximum to minimum. It considers "moving observer" & glare calculations.

c) <u>Design Methods: STV</u>

Small Target Visibility method (STV) is the brand new in 2000 document unfamiliar and complex metric VL uses luminance, both horizontal and vertical, contrast weighted over entire roadway veiling luminance included. It is mainly extension of luminance calculations radically different design techniques not suitable for optimization. No values of luminance yet standardized according to this method.

4.2.2. Roadway Lighting Classification & Definition:

4.2.2.1. Classification of roads as per IESNA:

a. Freeway– A divided major roadway with full control of access and with no crossings at grade.

a.1. *Freeway A*- Roads with greater visual complexity and high traffic volumes.

a.2. *Freeway B*- All divided roads with full control of access where lighting is needed.

b. *Expressway*– A divided major roadway for through traffic with partial control of access.

c. *Major*– The part of roadway systems that serves as principal network for through traffic flow.

d. *Collector*– The roadways serving traffic between major and local roadways.

e. *Local* – Roadways used primarily for direct access to residential, commercial, industrial etc.

f. *Alley*: Narrow public ways within a block.

g. *Sidewalk*: Paved or otherwise improved areas for pedestrian use, located within public street rights of way.

h. *Pedestrian Walkway*: A public walk for pedestrian traffic.

i. *Isolated Interchange*: A grade-separated roadway crossing.

j. *Isolated Intersection*: The general area where two or more non continuously lighted roadways join or cross at the same level.

k. *Bikeway*: Any road, street, path, or way that is specifically designated as being open to bicycle travel.

l. *Median*: The portion of a divided roadway physically separating the travelled ways for traffic in opposite directions.

4.2.2.2. Areas of classification as per IESNA:

a. Commercial – That portion of a municipality in a business development where large number of pedestrian present and heavy demand of perking space during the traffic period.

b. Intermediate – That portion of a municipality that is outside of a downtown area but generally within the zone of influence of a business or industrial development.

c. Residential – A residential development or a mixture of residential and commercial establishments.

TABLE: 4.5. - Road surface classifications

Class	**Mean luminance coefficient**	**Description**	**Mode of reflectance**
R1	0.10	Portland cement concrete road surface, asphalt with minimum 15%artifial brightener	Mostly diffused
R2	0.07	Asphalt surface with 60% gravel	Diffuse and specular
R3	0.07	Asphalt surface with dark aggregate	Slightly specular
R4	0.08	Asphalt surface with very smooth structure	Mostly specular

<u>Illuminance Criteria</u>: -

The illuminance method of roadway lighting design determines the amount of light incident on the roadway surface from the roadway lighting system. Because the amount of light seen by the driver is the portion that reflects from the pavement towards the driver, and because different pavements exhibit varied reflectance characteristics, different illuminance levels are needed for each type. The recommended illuminance values and the uniformity ratio are in **Table 2.5**

TABLE: 4.6. - Lighting design criteria as per maintained illuminance values (E_{avg}) in lux

ROAD AREA CLASSIFICATION	Type	R1	R2 & R3	R4	E_{avg}/E_{min}
Freeway Class A		6	9	8	3
Freeway Class B		4	6	5	3
Expressway	Commercial	10	14	13	3
	Intermediate	8	12	10	3
	Residential	6	9	8	3
Major	Commercial	12	17	15	3
	Intermediate	9	13	11	3
	Residential	6	9	8	3
Collector	Commercial	8	12	10	4
	Intermediate	6	9	8	4
	Residential	4	6	5	4
Local	Commercial	6	9	8	6
	Intermediate	5	7	6	6
	Residential	3	4	4	6

<u>Luminance Criteria</u>: -The luminance method of roadway lighting design determines how "bright" the road is by determining the amount of light reflected from the pavement in the direction of the driver. **Table 2.6**provides the recommended luminance design requirements, uniformity, and the relationship between average luminance (Lavg) and the veiling luminance (Lv).

Table 4.7.: Lighting design criteria per luminance values as maintained (Lavg)

ROAD AREACLASSIFICATION	Type	AVERAGE LUMINANCE (Lavg)in cd/m^2	Lavg/Lmin	Lmax/L min	Veiling luminance Ratio Lvmax/Lavg
Freeway Class A		0.6	3.5 to 1	6 to 1	0.3 to 1
Freeway Class B		0.4	3.5 to 1	6 to 1	0.3 to 1
Expressway	Commercial	1	3 to 1	5 to 1	
	Intermediate	0.8	3 to 1	5 to 1	0.3 to 1
	Residential	0.6	3.5 to 1	6 to 1	
Major	Commercial	1.2	3 to 1	5 to 1	
	Intermediate	0.9	3 to 1	5 to 1	0.3 to 1
	Residential	0.6	3.5 to 1	6 to 1	
Collector	Commercial	0.8	3 to1	5 to 1	
	Intermediate	0.6	3.5 to 1	6 to 1	0.4 to 1
	Residential	0.4	4 to 1	8 to 1	
Local	Commercial	0.6	6 to 1	10 to 1	
	Intermediate	0.5	6 to 1	10 to 1	0.4 to 1
	Residential	0.3	6 to 1	10 to 1	
	Intermediate	0.5	6 to 1	10 to 1	0.4 to 1
	Residential	0.3	6 to 1	10 to 1	

Small Target Visibility (STV) Criteria: -

The STV method of design determines the visibility level of an array of targets on the roadway considering the following factors:

(a) The luminance of the targets

(b) The luminance of the immediate background

(c) The adaptation level of the adjacent surroundings

(d) The disability glares

The values of STV are included in **Table 2.7**as well as uniformity ratios and luminance.

Table 4.8: Small Target Visibility - Recommended Values

ROAD AND PEDESTRIAN CONFLICT AREA		STV CRITERIA	LUMINANCE CRITERIA		
ROAD AREACLASSIFICATION	Type	WEIGHTING AVERAGE	L_{avg} cad/m2 Median <7.3 m	L_{avg} cad/m2 Median >7.3 m	Uniformity Ratio
		VL			L_{max}/L_{min}
Freeway Class A		3.2	0.5	0.4	6.0
Freeway Class B		2.6	0.4	0.3	6.0
Expressway		3.8	0.5	0.4	6.0
Major	Commercial	4.9	1.0	0.8	6.0
	Intermediate	4	0.8	0.7	6.0
	Residential	3.2	0.6	0.6	6.0
Collector	Commercial	3.8	0.6	0.5	6.0
	Intermediate	3.2	0.5	0.4	6.0
	Residential	2.7	0.4	0.4	6.0
Local	Commercial	2.7	0.5	0.4	10.0
	Intermediate	2.2	0.4	0.3	10.0
	Residential	1.6	0.3	0.3	10.0

High Mast Lighting: -

Ordinarily, conventional lighting along streets and highways involves mounting heights of 15 meters (49.2 ft.) or less. Poles of 20 meters (65.6 ft.) or greater height have been utilized in several situations:

• Large parking lots - such as regional shopping centres, and stadiums

• Interchanges and complex intersections in both urban and rural areas and tangent sections with more than six lanes.

Opinions differ on whether light levels can be lower when high mast lighting is used, compared with the use of conventional poles of 15 meters (49.2 ft.) or less. Typically, the surround conditions are more uniform with the high mast design and, seeing is easier.

High mast lighting typically consists of clusters of three to six or more luminaires mounted on rings, which can be mechanically lowered to near ground levels for servicing.

Designs for high mast lighting can utilize the illuminance method. Unique high mast luminaires and both symmetrical and asymmetrical distributions have been used. Cutoff luminaires are desirable to avoid excessive glare. Large lamps consuming up to 1000 watts are sometimes employed.

4.3. <u>CIE 180:2007</u>

4.3.1. Description of CIE 180: 2007[2]:

The recommendations of the International Commission on Illumination (CIE) are geared to the conditions in the industrialized countries, with their heavy levels of high-speed traffic, dominated by the private motor car.

Considering the vehicle types (and hence speeds and stopping distances) frequently found in the less industrialized countries, the following values are suggested. This should be regarded as for guidance only: it is generally better to relax the “quality" indicators of uniformity and threshold increment rather than have no lighting at all.

For areas where most of the "traffic" consists of pedestrians and non-motorized vehicles the illuminance value is given, for recognized traffic routes the luminance value is given, but roughly equivalent values of illuminance, for moderately dark road surfaces are given in parenthesis as shown in Table: 2.8.

TABLE: 4.9 - Recommended light levels for different roads as per CIE: 180-2007

Category	Average level of Light	Overall uniformity (min/max)	Longitudinal Uniformity (min/avg)	Threshold increment

Residential areas, pedestrians and many non-motorized vehicle	1-2 lux	0.2	Not available	Not available
Largely residential but some motorized vehicles	4-5 lux	0.2	Not available	Not available
Major access roads, distributors and minor roads	0.5cd/m^2 (~8 lux)	0.4	0.5	Not available
Important rural and urban traffic routes	1.0cd/m^2 (~15 lux)	0.4	0.6	20%
High speed roads, dual carriageways	1.5cd/m^2 (~25 lux)	0.4	0.7	15%

Lighting standards: -

The overall quality of an installation has several components: -

1. **Average luminance level**. This is all-important, as it not only impinges on the safety benefits but also largely determines the power requirements and hence the running costs. In most simpler design processes, and for checking the performance of an installation, this translates into average illuminance level.

2. **Overall uniformity** of luminance, or illuminance, both across and along the roadway. Defined as the minimum divided by the average, and designated *U*0.

3. **Uniformity of luminance, or illuminance, along the axis of the road**, usually an axis which coincides with a typical driver's eye position. Defined as the ratio of the minimum to the maximum, and designated *U*1.

4. **The lighting of the area adjacent to the carriageway** to illuminate any footpath or surroundings. Considering two strips 5 meters wide (one in the road, the other alongside), the illuminance on the off-road strip should be at least 50% of the other.

5. **Glare**. As glare has the effect of reducing contrast, a luminaire's "glare performance", or optical control, can be expressed in terms of the increase in background luminance necessary to compensate (threshold increment, *TI*). The lower the figure the better. In highly motorized countries 10% is specified for motorways, with 15% and even 30% allowed for general traffic routes. These percentages are determined by the amount of light the luminaires project near the horizontal. This light also causes problems of sky-glow.

6. **Guidance**. Whilst glare must be kept under control, a small amount of direct light from the luminaires gives a useful sense of the "run" of the road ahead and can forewarn the approach of junctions or roundabouts.

4.4. BS EN 13201:2003[4]: The purpose of introducing lighting classes is to make it easier to develop and use road lighting products and services in CEN member countries. The lighting classes have been defined with consideration of road lighting standards in these countries aiming at harmonization of requirements where possible. However, some lighting classes and subclasses reflect situations and national approaches based on traditional, climatic, or other conditions.

The ME classes are intended for drivers of motorized vehicles for user on traffic routes, and in some countries also residential roads, allowing medium to high driving speeds.

The CE classes are also intended for drivers of motorized vehicles, but for use on conflict areas such as shopping streets, road intersections of some complexity, roundabouts, and queuing areas. These classes have applications also for pedestrians and pedal cyclists.

The S and A classes are intended for pedestrians and pedal cyclists for use on footways and cycle ways, emergency lanes and other road areas lying separately or along the carriageway of a traffic route, residential roads, pedestrian streets, parking areas, schoolyards etc.

The ES classes are intended as an additional class in situations where public lighting is necessary for the identification of persons and objects and in road areas with a higher-than-normal crime risk.

The EV classes are intended as an additional class in situations where vertical surfaces need to be seen in such road areas as toll stations interchange areas etc.

The requirements of the lighting classes reflect the category of road user in question or the type of road area. Thus, the ME classes are based on the road surface luminance, while the CE, S and A classes are based on the illumination of the road area. The S and A classes reflect different priorities to the road lighting. The ES classes are based on semi-cylindrical illuminance, while the EV classes are based on the vertical plane illuminance.

The ME classes present increasingly stronger requirements in the order ME 6, ME 5…ME 1 forming steps of the lighting level as measured for instance in illuminance. The other classes are arranged in the same way, and so that their steps interlock.

Environmental aspects of road lighting are considered in clause 7 in terms of daytime appearance, night-time appearance and light emitted in directions, where it is neither necessary nor desirable. The purpose is to point to matters that can be included in tender specifications or similar, when relevant.

Installed intensity classes for the restriction of disability glare and control of obtrusive light G.1, G.2, G.3, G.4, G.5 and G.6 are introduced in the informative annex A. The use of G classes is mentioned in clause 5 for conflict areas and in clause 7 on appearance and environmental aspects.

Installed glare index classes for the restriction of discomfort glare D.0, D.1, D.2, D.3, D.4, D.5 and D.6 are introduced in the informative annex A as well. These classes are intended mainly for road areas lighted for the benefit of pedestrians and pedal cyclists.

Local lighting of pedestrian crossings is considered in the informative annex B. The intention of local lighting is to attract the attention of drivers of motorized vehicles to the presence of the pedestrian crossing and to illuminate pedestrians in or at the crossing area.

4.4.1. <u>ME/MEW-series of lighting classes</u>: The ME and MEW classes in Tables 2.9 and 2.10 are intended for drivers of motorized vehicles on traffic routes of medium to high driving speeds. Table A and Table B are shown below

Table 2.9– ME –series of lighting classes

Class	Luminance of the road surface of the carriageway for the dry road surface condition			Disability glare	Lighting of surroundings
	$\overline{L}$ in cd/m^2 [minimum maintained]	U_o [minimum]	U_l [minimum]	TI in %[a] [maximum]	SR^{2b} [minimum]
ME1	2,0	0,4	0,7	10	0,5
ME2	1,5	0,4	0,7	10	0,5
ME3a	1,0	0,4	0,7	15	0,5
ME3b	1,0	0,4	0,6	15	0,5
ME3c	1,0	0,4	0,5	15	0,5
ME4a	0,75	0,4	0,6	15	0,5
ME4b	0,75	0,4	0,5	15	0,5
ME5	0,5	0,35	0,4	15	0,5
ME6	0,3	0,35	0,4	15	no requirement

Table 4.11– MEW –series of lighting classes

Class	Luminance of the road surface of the carriageway for the dry and wet road surface condition				Disability glare	Lighting of surroundings
	Dry condition			Wet		
	$\overline{L}$ in cd/m^2 [minimum maintained]	U_o [minimum]	U_l [a] [minimum]	U_o [minimum]	TI in % [b] [maximum]	SR[c] [minimum]
MEW1	2,0	0,4	0,6	0,15	10	0,5
MEW2	1,5	0,4	0,6	0,15	10	0,5
MEW3	1,0	0,4	0,6	0,15	15	0,5
MEW4	0,75	0,4	no requirement	0,15	15	0,5
MEW5	0,5	0,35	no requirement	0,15	15	0,5

4.4.2. <u>CE-series of lighting classes</u>: The CE classes in Table 2.11 are intended for drivers of motorized vehicles, and other road users, on conflict areas such as shopping streets, road intersections of some complexity, roundabouts, queuing areas etc.

Table 4.12– CE –series of lighting classes

Class	Horizontal illuminance	
	$\overline{E}$ in lx [minimum maintained]	U_o [minimum]
CE0	50	0,4
CE1	30	0,4
CE2	20	0,4
CE3	15	0,4
CE4	10	0,4
CE5	7,5	0,4

4.4.3. <u>S-, A-, ES- and EV- series of lighting classes</u>: The S classes in Table 2.12 or the A classes in Table 2.13 are intended for pedestrians and pedal cyclists on footways, cycle ways, emergency lanes and other road areas lying separately or along the carriageway of a traffic route, and for residential roads, pedestrian streets, parking places, schoolyards etc.

The ES classes in Table 2.14 are intended as additional classes for pedestrian areas for the purposes of reducing crime and suppressing feelings of insecurity.

The EV classes in Table 2.15 are intended as additional classes in situations where vertical surfaces need to be seen, e.g., interchange areas.

Table 4.13– S –series of lighting classes

Class	Horizontal illuminance	
	$\overline{E}$ in lx [a] [minimum maintained]	E_{min} in lx [maintained]
S1	15	5
S2	10	3
S3	7,5	1,5
S4	5	1
S5	3	0,6
S6	2	0,6
S7	performance not determined	performance not determined

Table 4.14–A–series of lighting classes

Class	Hemispherical illuminance	
	$\overline{E}_{hs}$ in lx [minimum maintained]	U_0 [minimum]
A1	5	0,15
A2	3	0,15
A3	2	0,15
A4	1,5	0,15
A5	1	0,15
A6	performance not determined	performance not determined

Table 4.15– ES –series of lighting classes

Semi-cylindrical illuminance	
Class	$E_{sc,min}$ in lx [maintained]
ES1	10
ES2	7,5
ES3	5
ES4	3
ES5	2
ES6	1,5
ES7	1
ES8	0,75
ES9	0,5

Table 4.16– EV –series of lighting classes

Vertical plane illuminance	
Class	$E_{v,min}$ in lx [maintained]
EV1	50
EV2	30
EV3	10
EV4	7,5
EV5	5
EV6	0,5

4.5. NATIONAL HIGHWAY AUTHORITY OF INDIA RECOMMENDATION[8]: instead of following the IS 1944(Part I & Part II)-1970, Highway Authority of India recommends for lighting of highway. According to NHAI recommendation requirements are shown in table 2.16 below:

Table: 4.17– National Highway Authority of India

Average illumination on road surface (Eavg.) (lux)	**Overall Uniformity ratio (Emin. /Eavg.)**	**Longitudinal uniformity ratio (Emin. /Emax.) (%)**
40	0.4	33

CHAPTER 5

INTRODUCTION TO THE COMPUTER AIDED LIGHTING DESIGN

5.1. Introduction: Lightning simulation software are being used to simulate and visualize any design virtually. Different lighting software is now developed to design any lighting installation such as DIALux, AGi 32, Lighting Reality pro, Relux, CGLux, Calculux, Photolux, Sunlux, Lumen Micro, Lumen Designer etc.

All the lighting software is different, but the aim is same. Different lighting company uses different lighting software. In Wipro lighting mostly DIALux software has been used for lighting design. Description of some commonly used software are given below:

5.2. DIALux: DIALux is a complete free lighting software which has been developed by DIAL Company for professional light planning and is open to luminaires of all manufacturers.

Virtual worlds can be created simply and intuitively with DIALux. Results can be documented in photorealistic visualizations. Daylight and artificial light scenarios can also be simulated. CAD data of other architectural software can be imported in this software to provide for accurate simulation and to provide a design background and the same can be exported easily.

While designing, DIALux determines the energy of your light solution requires and supports you in complying with the respective national and international regulations. DIALux supports the luminaires of the world's leading manufacturers and therefore have the greatest possible freedom in the design process.

Benefits of DIALux:

- Simple, effective, and professional light planning
- Support any photometric data file in required format(.ies)
- Latest photometric data files of the world's leading manufacturers
- Results can be compared with international standard result
- Dynamic light scenes with LED or other colour changing luminaires
- Planning 3D model and simulate photometric data to any buildings, landscape, façade, or roadway model
- CAD file can be imported or exported

5.3. AGi32: Comprehensive lighting calculations, ease of modelling, and fast, high-quality rendering for almost any interior or exterior environment, can be done by AGI 32. It is not a free software customer need to purchase.

Benefits of AGi32:

1. Smooth, effective, and professional light planning,
2. Simulation time is far less than many other software,
3. Support any photometric file in required format(.ies),
4. Result can be compared with international standard results.
5. Dynamic light scenes with LED or other color changing luminaires
6. Planning 3D model and simulate photometric data to any buildings, landscape, facade, or roadway model,
7. Better realistic view can be achieved,
8. CAD file can be imported or exported.

CHAPTER 6

LUMINAIRE AND ITS PHOTOMETRIC CHARACTERISTICS USED FOR THE STREET LIGHTING DESIGN

6.LUMINAIRE AND IT'S PHOTOMATRIC CHARACTERISTICS USED FOR THE ROAD LIGHTING DESIGN: -

A luminaire is a device that controls the distribution of the light given by a lamp or lamps and which includes all the items necessary for fixing and protecting those lamps and for connecting them to the supply circuit.
The luminaires employed in road lighting are of three basic types: conventional luminaires, catenary luminaires, and floodlights. Conventional luminaires are all those designed for column, wall, or span wire mounting such that the main vertical plane of symmetry lies at right angles to the axis of the road thus throwing the main part of their light along the road. This contrasts with catenary luminaires, which are designed to be suspended from a cable (catenary) with the main plane of symmetry parallel to the axis of the road thus throwing the main part of their light across the road. Finally, there is the floodlight. Unlike conventional and catenary luminaires, the floodlight is completely free as far as any fixed orientation with respect to the road is concerned.

6.1 PRINCIPAL CHARACTERISTICS

The principal characteristics of the various luminaires employed in road lighting can be listed under the following headings

(a) Photometric: luminous intensity distribution and light output ratio; luminaire luminance

(b) Thermal: heat resistance; operating temperature within the luminaire

(c) Mechanical and aerodynamic: sturdiness; toughness (degree of vandal proofing); weight, size, and shape

(d) Electrical: nature of control-gear housing; electrical connections; safety

(e) Installation and maintenance; ergonomic construction; accessibility of lamps and control gear; clean ability

(f) Resistance to atmospheric attack and pollution; corrosion resistance; resistance to ultraviolet and visible radiations; resistance to ingress of dust and dirt

(g) Type of mounting: post top, bracket, or cable suspended

(h) Aesthetics: general appearance and styling.

6.1.1 PHOTOMETRIC CHARACTERISTICS

Light distribution and light output ratio
The desired luminous intensity or light distribution of a luminaire is achieved through the application of one or more of the physical phenomena: reflection, refraction, and diffuse transmission, although the last mentioned is normally only employed where optical control is not critical, as in many of the more decorative luminaires designed for use in pedestrian areas. Most road lighting luminaires also make use of shielding in one form or another, principally to obtain the required degree of glare control. The shielding function may be performed by mirror reflectors, by white-painted surfaces or, where very stringent glare control is required, by mat-black surfaces.
The way in which these various control techniques are employed in a given luminaire, and the optical properties of the materials used will combine to determine the light output ratio of

the luminaire. This is defined as the ratio of the light output of the luminaire to the sum of the light outputs of the lamps it contains. Of particular concern in road lighting is a luminaire's downward light output ratio, the flux emitted below the horizontal (and thus in the general direction of the road) as a fraction of total lamp flux. The downward light output ratio is thus a measure of luminaire efficiency: the higher the ratio, the higher the efficiency.

Luminaire luminance
The size and luminance of the lamp have an important bearing on the composition, dimensions and shape required for the optical system. For example, the mirror reflector system employed with a lamp having a small light-emitting area (such as the SON/T and HPI/T lamps) can be kept relatively small whilst still producing a well-controlled light distribution. Of course, such a small luminaire will have a relatively high luminance, so that to prevent glare, special attention must be given to the light distribution. With small lamps, any irregularity in the mirror will show up as a discontinuity in the luminous intensity distribution and consequently as a patch of different brightness on the surface of the road. The mirror is therefore sometimes given a faceted or a hammered-finish or is used in combination with a diffusing panel placed near the lamp to overcome this difficulty.
Lamps with larger light-emitting areas call for correspondingly larger optical systems. However, the lower luminaire luminance associated with these systems means that glare can more easily be restricted and small irregularities in the optical system will not cause disturbing irregularities in the luminance pattern on the road surface. Tolerances in lamp dimensions and in lamp positioning can also be greater without severely disturbing the light distribution.

6.1.2 THERMAL CHARACTERISTICS

Heat resistance
The materials used within the body of the luminaire and the body materials themselves should be capable of withstanding the heat produced by the lamp used in it.

Operating temperature
The temperature should not rise so high during operation as to upset the correct functioning of the lamp or lamps. The volume of a luminaire, especially if it is of the totally enclosed type, is important in this respect, and in some small luminaires fins on the housing are needed to promote cooling, especially where high-wattage sources are employed.

6.1.3 MECHANICAL AND AERODYNAMIC CHARACTERISTICS

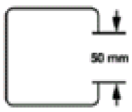
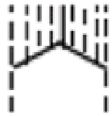
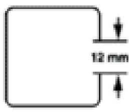
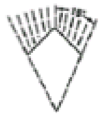
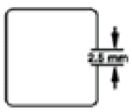
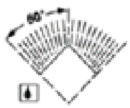
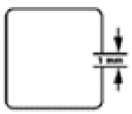
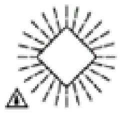
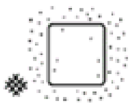
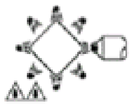
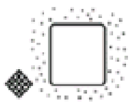
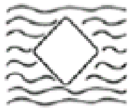
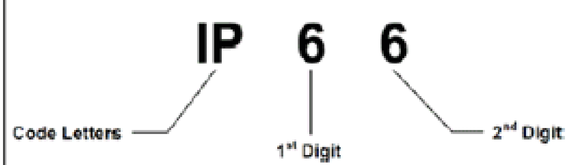
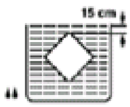
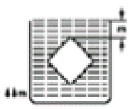
Sturdiness
The luminaire and its mounting attachments should be of sturdy construction to ensure a good, steady positioning of the luminaire and its contents. Any weakness here could lead to changes in the luminaire 's light distribution and consequent changes in the planned lighting quality of the installation.

Toughness
Luminaires mounted low down in residential areas are especially vulnerable to attack by vandals. They should therefore be constructed of tough materials as far as possible.

Weight, size, and shape
The weight, size, and shape of a luminaire determine the strength of the mast or cable needed to support it and withstand wind forces and vibrations caused by air currents and passing road traffic. The demands placed on mast strength will be lowest for a light luminaire that presents

a small, streamlined area to the wind, the streamlining of a luminaire being denoted by its "shape factor".

Reference Table of IP Rating Code

1st Digit	Symbol	Solid Object Protection	2nd Digit	Symbol	Water Protection
0		Not protected	0		Not protected
1		Protected against solid objects greater than 50mm	1		Protected against vertically dripping water
2		Protected against solid objects greater than 12.5mm	2		Protected against dripping water when tilted up to 15°
3		Protected against solid objects greater than 2.5mm	3		Protected against spraying water
4		Protected against solid objects greater than 1.0mm	4		Protected against splashing water
5		Protected from the amount of dust	5		Protected against jetting water
6		Dust tight	6		Protected against powerfully jetting water
			7		Protected against temporary immersion in water
			8		Protected against continuous immersion in water

6.1.4 ELECTRICAL CHARACTERISTICS

Table 6.1: IEC/CEE classification of luminaires according to type of electrical protection.

Luminaire Class	Electrical Protection
0	A luminaire having functional insulation, but not double insulation or reinforced insulation throughout, and without provision for earthing.
I	A luminaire having at least functional insulation throughout and provided with an earthing terminal or earthing contact, and, for luminaires designed for connection by means of a flexible cable or cord, provided with either an appliance inlet with earthing contact, or a non-detachable flexible cable or cord with earthing conductor and a plug with earthing contact.
II	A luminaire with double insulation and/or reinforced insulation throughout and without provision for earthing.
III	A luminaire designed for connection to extra-low-voltage circuits, and which has no circuits, either internal or external, which operate at a voltage other than extra-low safety voltage

The construction of a luminaire should be such as to render it safe electrically to all those involved in its handling. The International Electrotechnical Commission (IEC) and the International Commission on Rules for the Approval of Electrical Equipment CEE) classify luminaires according to the degree of protection afforded against electrical shock; those described as class 0 (no provision for earthing) are not suitable for road-lighting purposes and should therefore not be used.
Minimum sizes of the electrical conductors (wires and connecting blocks) used in the luminaire should be suitable for the actual electrical load. The cable insulation must be sufficient for the high ignition voltages (which may be far higher than the operating voltage) and must withstand the often-high temperature in the luminaire during operation. To relieve possible strain on the cables and their connections a means of clamping the cables is often required.

6.1.5 OPTICALCHARACTERISTICS

The desired light distribution of a luminaire is obtained through the application of one or more of the physical phenomena: reflection, refraction, and diffuse transmission. Many luminaires also make use of shielding in one form or another, principally to obtain the required degree of glare control and to limit light pollution. The shielding function may be performed by refractors, diffusers, mirror reflectors or, where very stringent glare control is required, by black surfaces.

The way in which these various control techniques are employed in each luminaire and the optical properties of the materials used also determine the light output ratio of the luminaire.

Reflectors

The reflector creates multiple images of the light source which, with a suitable reflector shape, overlap each other to form a uniform luminance pattern on the area to be lighted. The most widely used material is sheet aluminium, which has the strength needed to produce a stable reflector. To obtain a highly specular finish, the aluminium is polished: mechanically, chemically, electrolytically, or by a combination of these processes. Reflectance values are around0.70.

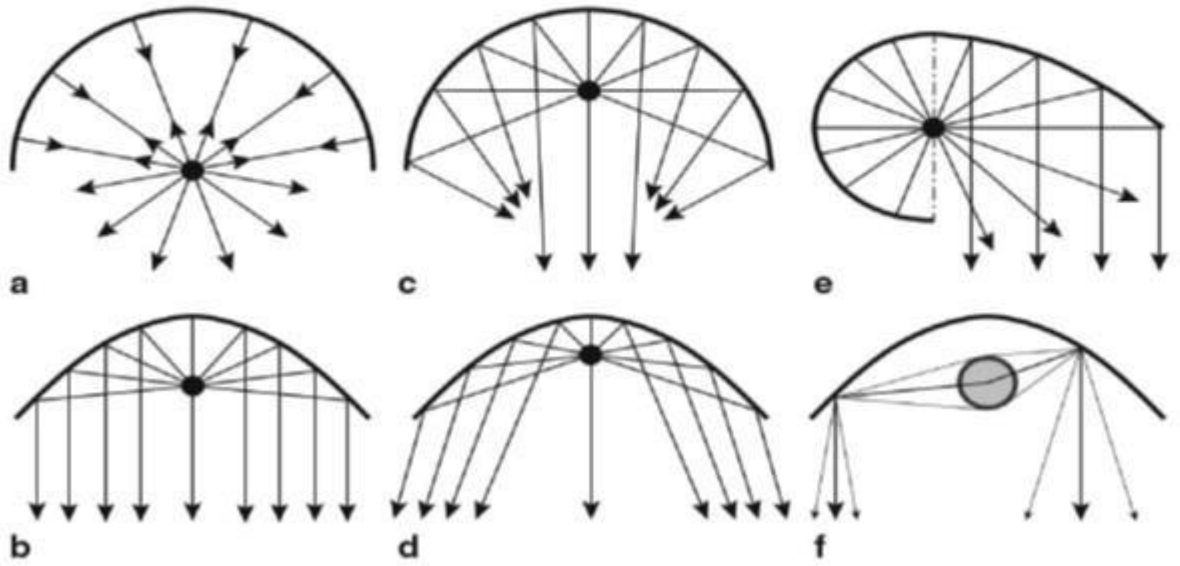


Figure 4 Reflector shapes: a cylindrical and b parabolic reflector with point light source at focal point; c and d point light source outside focal point; e: combination of cylindrical and parabolic reflector; f diverging rays because of a non-point source

Refractors and Lenses

Refracting devices are either lenses or prisms. They bend the light that passes through them. The angle through which the light is bent is dependent on both the shape of the refractor and its refractive index (Snell's law). Plastic prismatic controllers are used in road lighting, especially in residential area lighting applications. Refracting glass bowls were in the past sometimes used for high-pressure mercury and sodium road-lighting luminaires but have now become obsolete. This is partly because they are heavy, but more so because lighting control in the upwards direction, and therefore control of light pollution, is not easily attainable. Today, in LED luminaires, advanced lens-type refractors, one for each individual LED point, are often employed. These make it possible to accurately shape the light distribution. Such a system makes it possible to modify the light distribution by switching or dimming different individual LEDs with different lenses in front of them. This allows the designer to adapt the light distribution to suit the actual luminaire spacing and road width or to changing weather conditions and changes in the road- surface reflection properties.

Diffusers

Translucent diffusers increase the apparent size of the light source. They scatter the light from the lamp in all directions without defining its light distribution. They serve mainly to reduce the brightness of the luminaire and thus the glare created by it. Diffusers are made of translucent plastics, commonly acrylic or polycarbonate. The material should be such that it scatters the light whilst producing the minimum amount of absorption. Diffusers are normally only employed where optical control is not critical, which is sometimes the case in the more decorative luminaires designed for use in pedestrian areas. Usually, a top mirror or shield is incorporated into the design to restrict at least some of the upward light to help limit some light pollution.

6.1.6 INSTALLATION AND MAINTENANCE CHARACTERISTICS

Ergonomic design

Mounting, relamping and cleaning must usually be carried out high above ground level, so the ergonomic design of the luminaire should be such as to make these operations as easy as possible to perform; covers, for example, should be hinged so that the electrician has his hands free to work on the lamp and ballast and to make or check the various electrical connections.

Accessibility and cleanability

A luminaire of simple construction with clean lines will, by improving accessibility and facilitating cleaning, not only help to shorten relamping and cleaning times (thereby reducing maintenance costs), but it will also reduce the time a road or part of a road is out of commission whilst maintenance of the lighting installation is in progress.

6.1.7 RESISTANCE TO ATMOSPHERIC ATTACK AND POLLUTION

Corrosion, dirt, and moisture-resistance

The atmosphere can contain many potentially corrosive gases which, in the presence of moisture vapor, will form highly corrosive compounds. Luminaires made from corrosion-resistant materials or having protective finishes should therefore be chosen for use in all areas where this danger is known to exist.

Closed luminaires afford much better protection against corrosion and dirt accumulation than do open luminaires. However, due to the variation in temperature between the air inside and that outside a luminaire after switching on or off, pressure differences across the luminaire ‘s cover-seal are bound to occur. The seal should therefore be able to ‘breathe ‘, whilst retaining its dust and moisture proof properties, otherwise the corrosive gases, moisture, and dirt will be sucked into the luminaire during the cooling off period thereby giving rise to corrosion and fouling of the possibly untreated, or unprotected, inner surfaces.

Radiation resistance

Any plastics materials used in the fabrication of a luminaire should be impervious to ultraviolet and visible radiations. It is especially important that no discoloration of the outer body of the luminaire should occur.

6.1.8 AESTHETICS

No less important than the functional characteristic of a luminaire is what may be termed its aesthetic appeal, its general appearance and styling. It must be remembered that during the hours of daylight, while the lighting installation is not in use, it will be clearly visible to all. In pedestrian areas especially, even a dormant installation can make a positive contribution to the attractiveness of the locality. But no matter what the type of installation, it must always harmonies as far as possible with its surroundings.

6.2. CONVENTIONAL AND CATENARY LUMINAIRES

6.2.1 Photometric Classification

To be able to indicate the suitability or otherwise of a luminaire for a given application, some form of system that classifies luminaires according to their photometric characteristics is needed. Several such classification systems have been formulated.

Classification system of the International Commission on Illumination (CIE)

The CIE in its Publication No. 34(1976a) entitled Road Lighting Lantern and Installation Data-photometrics, Classification and Performance proposes a luminaire classification based upon three features of photometric performance:

(a) The extent to which the light from the luminaire is ‘thrown ‘in the lengthwise direction of the road, called the ‘throw ‘of the luminaire

(b) The extent to which the light is ‘spread out ‘across the road, called the ‘spread ‘of the luminaire

(c) The extent of the facility for controlling glare, called the ‘control ‘of the luminaire.

The ***throw*** is defined by the angle (γ_{max}) that the beam axis makes with the downward vertical. The beam axis is defined by the direction midway between the two directions of 90% Imax in the vertical plane of maximum intensity, Throw.
The ***spread*** is determined by the position of the line running parallel to the road axis that just touches the far side of the 90% Imax contour on the road surface. The position of this line is defined by the angle $\gamma 90°$.
The ***control*** is determined by those luminaire characteristics that also determine its glare control mark, G. Control is therefore defined by the specific luminaire index, SLI.
The CIE recognizes three degrees of throw, spread and control. These are defined in table together with the corresponding names.

Table 6.2: Definition of the CIE classification system for the photometric properties of luminaires

Throw	Spread	Control
Short (γmax<60°)	Narrow (γ90<45°)	Limited (SLI<2)
Intermediate (60°≤γmax≤70°)	Average (45°≤γ90≤55°)	Moderate (2≤SLI≤4)
Long (γmax>70°)	Broad (γ90>55°)	Tight (SLI>4)

The throw and spread of a luminaire are of course most easily determined from an isocandela diagram in which the isocandela contours are projected on the plane illuminated by the luminaire. If such a diagram is not available, they can also be determined from the isocandela diagram in zenithal projection.

6.2.2 Photometric Documentation

For conventional road-lighting luminaires two kinds of photometric documentation can be distinguished:

(a) Photometric specification of individual luminaires----data sheets

(b) Photometric performance of typical installations as calculated for different luminaire types----performance sheets.

Several different types of projection are possible, that preferred for road lighting applications being the so-called equal-area zenithal projection. In this projection the plane is tangential to the sphere, perpendicular to the road surface, and at right angles to the road axis.
The fact that equal areas on the sphere surrounding the luminaire are represented by equal areas on the projection (i.e., equal solid angles), means that the luminous flux in each zone can be quickly and easily calculated, using the formula

$Ø=2A/r^2.\ I$

Where, Ø=luminous flux (in lm) in zone

A=area of zone (in cm^2) on diagram

r= radius (in cm) of the diagram

I= average luminous intensity (in cd) in zone

Useful as the photometric data sheets are in calculating the various quantity and quality parameters of an installation, the job of design is made much easier if the lighting engineer is in possession of a set of pre calculated performance sheets for the range of luminaires being considered.

CHAPTER 7

COMPARATIVE CASE STUDIES FOR DIFFERENT ARRANGEMENTS FOR DIFFERENT CLASS OF ROADS WITH LED LUMINAIRES

7.1. LIST OF LUMINAIRES USED IN THE DESIGN ON DIALux-

Project 1

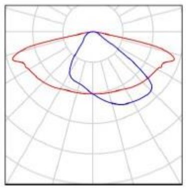
DIALux
26.05.2022

Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

11 Pieces PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 6800 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 60.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 85
Fitting: 1 x LED80-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



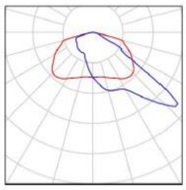
Project 1

DIALux
26.05.2022

Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

10 Pieces PHILIPS BGP530 T25 1 xLED80/830 DK
Article No.:
Luminous flux (Luminaire): 6720 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 61.0 W
Luminaire classification according to CIE: 100
CIE flux code: 31 75 98 100 84
Fitting: 1 x LED80/830/- (Correction Factor 1.000).

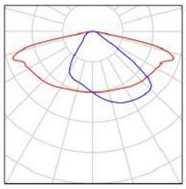


Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

10 Pieces PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

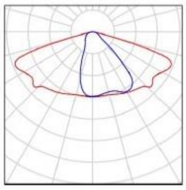
See our luminaire catalog for an image of the luminaire.



Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

13 Pieces PHILIPS BGP340 1xLED92-3S/740 DM
Article No.:
Luminous flux (Luminaire): 7912 lm
Luminous flux (Lamps): 9200 lm
Luminaire Wattage: 71.0 W
Luminaire classification according to CIE: 100
CIE flux code: 45 79 98 100 86
Fitting: 1 x LED92-3S/740 (Correction Factor 1.000).



Operator
Telephone
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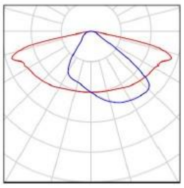
e-Mail

Project 1 / Luminaire parts list

6 Pieces

PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 8400 lm
Luminous flux (Lamps): 10000 lm
Luminaire Wattage: 78.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED100-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
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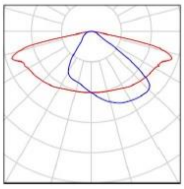
e-Mail

Project 1 / Luminaire parts list

11 Pieces

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
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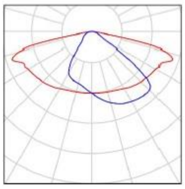
e-Mail

Project 1 / Luminaire parts list

6 Pieces

PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



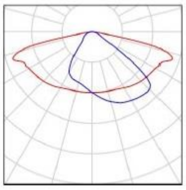
Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

11 Pieces

PHILIPS BGP531 T25 1 xLED165-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 13695 lm
Luminous flux (Lamps): 16500 lm
Luminaire Wattage: 100.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED165-4S/740 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



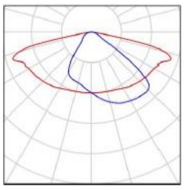
Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

6 Pieces

PHILIPS BGP531 T25 1 xLED175-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 14525 lm
Luminous flux (Lamps): 17500 lm
Luminaire Wattage: 108.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED175-4S/740 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



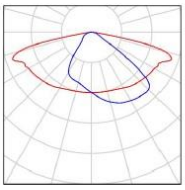
Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

11 Pieces

PHILIPS BGP531 T25 1 xLED150-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 12450 lm
Luminous flux (Lamps): 15000 lm
Luminaire Wattage: 116.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED150-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.

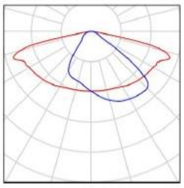


Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

13 Pieces PHILIPS BGP531 T25 1 xLED170-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 13940 lm
Luminous flux (Lamps): 17000 lm
Luminaire Wattage: 126.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED170-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.

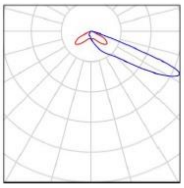


Operator
Telephone
Fax
e-Mail

Project 1 / Luminaire parts list

13 Pieces PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



7.2. List of DIALux reports for different classes of road

Operator
Telephone

Fax

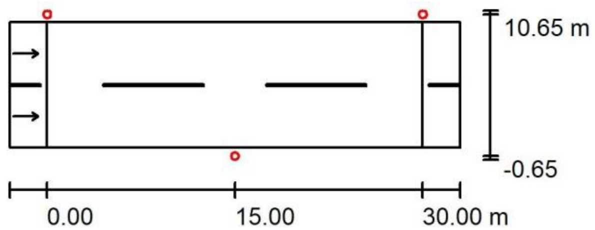
Street 1 / Planning data

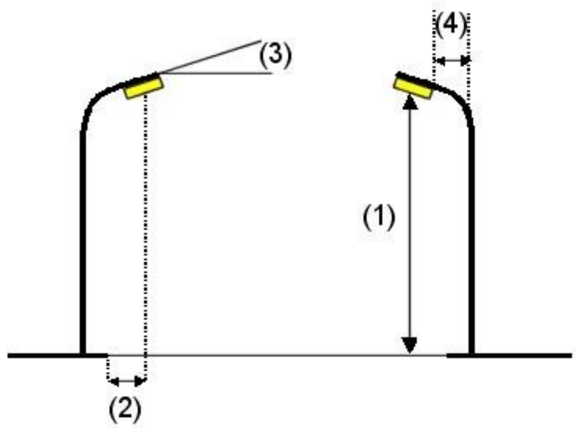
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





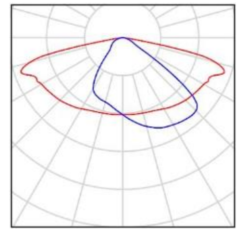
Luminaire:	PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830		
Luminous flux (Luminaire):	6800 lm	Maximum luminous intensities	
Luminous flux (Lamps):	8000 lm	at 70°:	492 cd/klm
Luminaire Wattage:	60.0 W	at 80°:	86 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	30.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

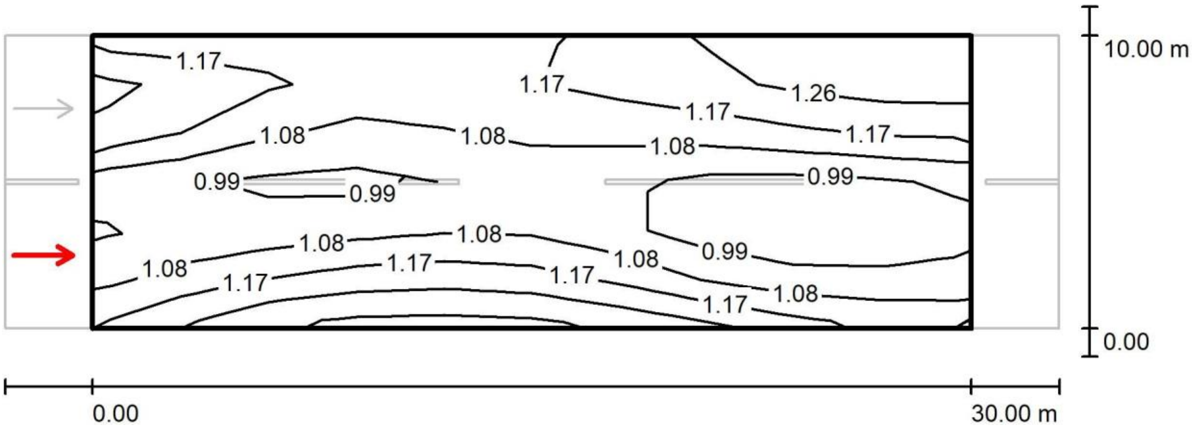
PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 6800 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 60.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 85
Fitting: 1 x LED80-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines

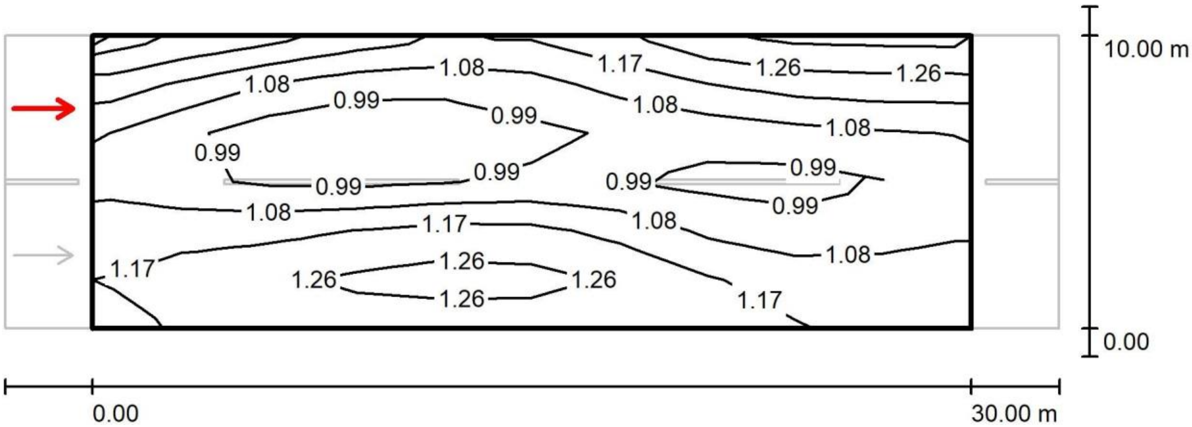


Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.11	0.81	0.80	7
Required values according to class SANS_A3a:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.11	0.81	0.80	7
Required values according to class SANS_A3a:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

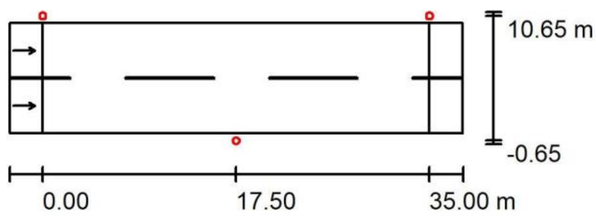
Street Profile

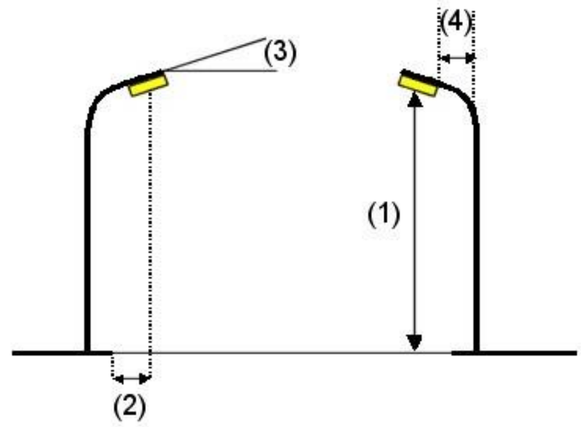
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830
Luminous flux (Luminaire):	6800 lm
Luminous flux (Lamps):	8000 lm
Luminaire Wattage:	60.0 W
Arrangement:	Double row, with offset
Pole Distance:	35.000 m
Mounting Height (1):	10.000 m
Height:	9.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	492 cd/klm
at 80°:	86 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

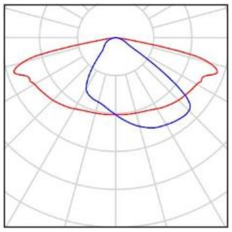
Operator
Telephone

Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 6800 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 60.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 85
Fitting: 1 x LED80-4S/830 (Correction Factor 1.000).

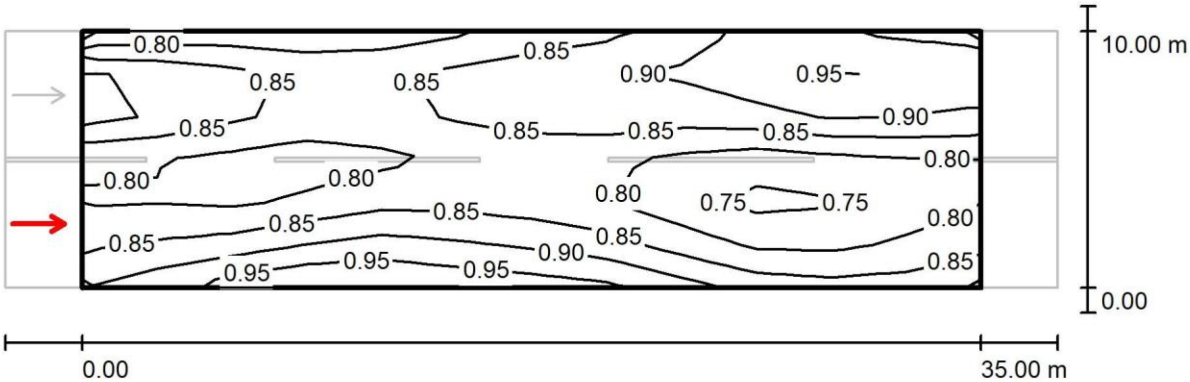
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



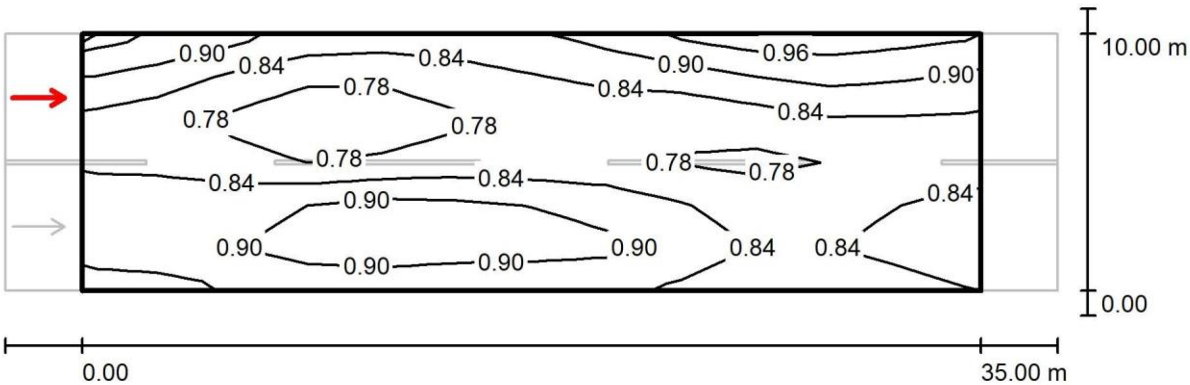
Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.85	0.85	0.84	6
Required values according to class SANS_A3b:	≥ 0.60	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.85	0.84	0.84	6
Required values according to class SANS_A3b:	≥ 0.60	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

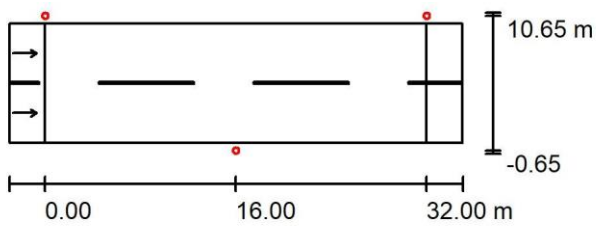
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

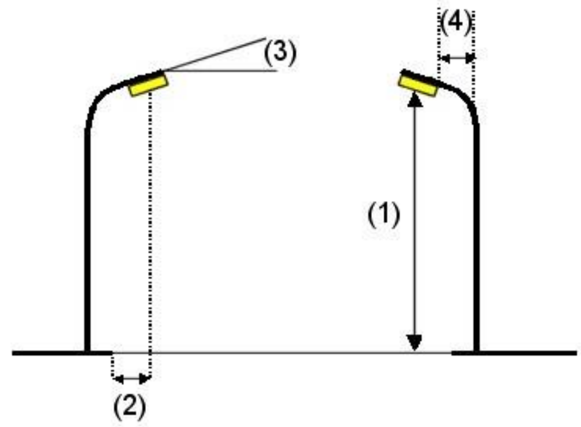
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP530 T25 1 xLED80/830 DK
Luminous flux (Luminaire):	6720 lm
Luminous flux (Lamps):	8000 lm
Luminaire Wattage:	61.0 W
Arrangement:	Double row, with offset
Pole Distance:	32.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

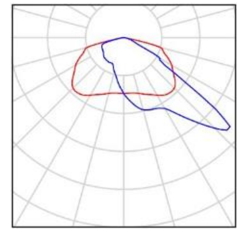
at 70°:	346 cd/klm
at 80°:	20 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G6.
Arrangement complies with glare index class D.6.

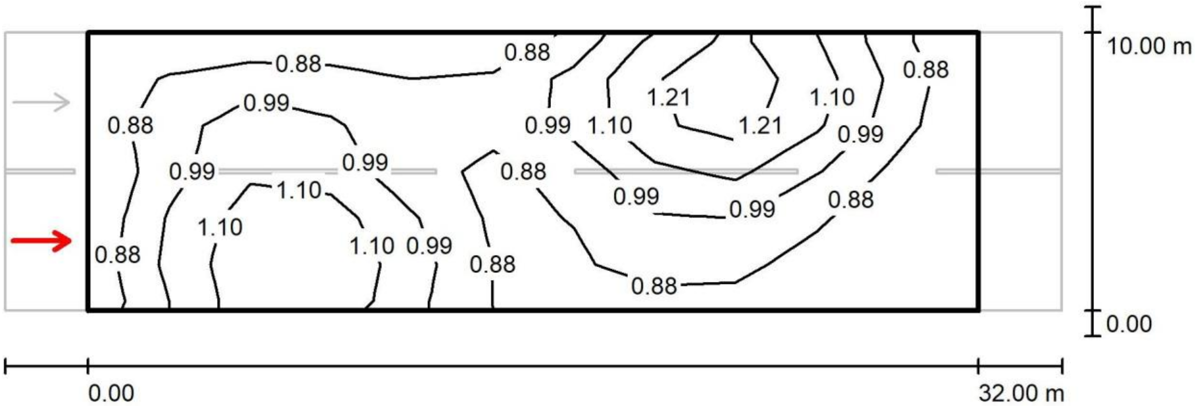
Street 1 / Luminaire parts list

PHILIPS BGP530 T25 1 xLED80/830 DK
Article No.:
Luminous flux (Luminaire): 6720 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 61.0 W
Luminaire classification according to CIE: 100CIE
flux code: 31 75 98 100 84
Fitting: 1 x LED80/830/- (Correction Factor 1.000).



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



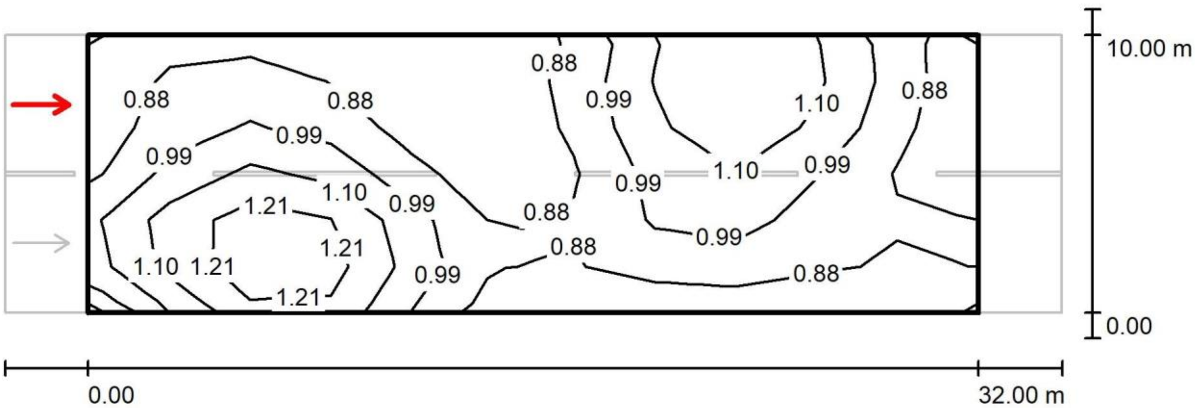
Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.97	0.80	0.63	4
Required values according to class SANS_A2f:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.98	0.79	0.63	4
Required values according to class SANS_A2f:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

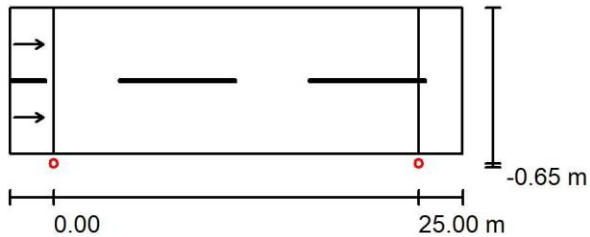
Street Profile

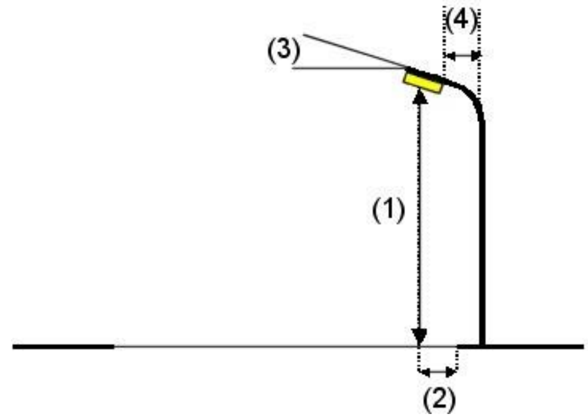
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP530 T25 1 xLED80/830 DK
Luminous flux (Luminaire):	6720 lm
Luminous flux (Lamps):	8000 lm
Luminaire Wattage:	61.0 W
Arrangement:	Single row, bottom
Pole Distance:	25.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	346 cd/klm
at 80°:	20 cd/klm
at 90°:	0.00 cd/klm

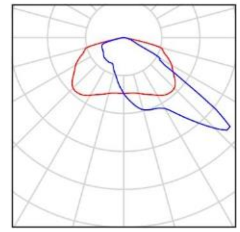
Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G6.
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

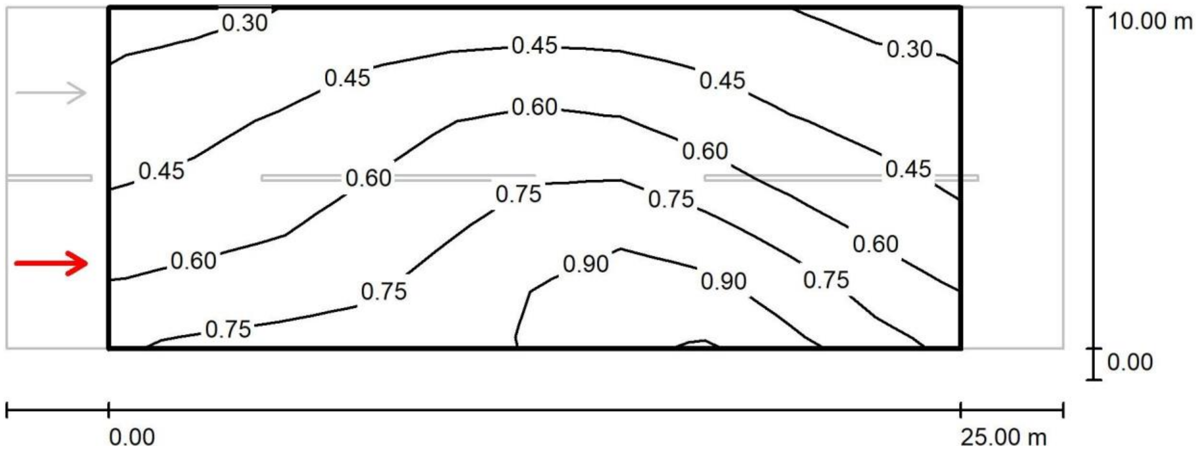
PHILIPS BGP530 T25 1 xLED80/830 DK
Article No.:
Luminous flux (Luminaire): 6720 lm
Luminous flux (Lamps): 8000 lm
Luminaire Wattage: 61.0 W
Luminaire classification according to CIE: 100CIE
flux code: 31 75 98 100 84
Fitting: 1 x LED80/830/- (Correction Factor 1.000).



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



Values in Candela/m², Scale 1 : 222

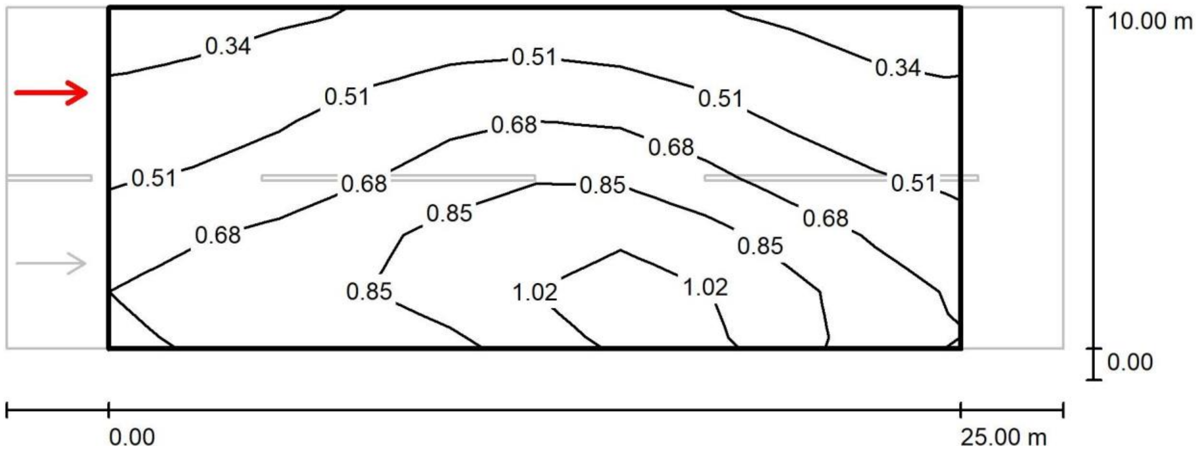
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.60	0.46	0.61	6
Required values according to class SANS_A3c:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.65	0.43	0.61	3
Required values according to class SANS_A3c:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

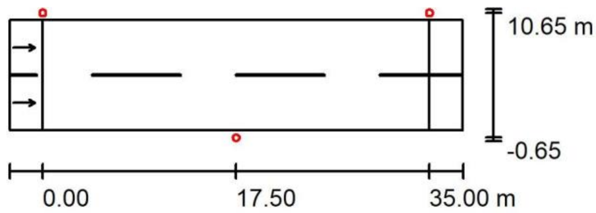
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

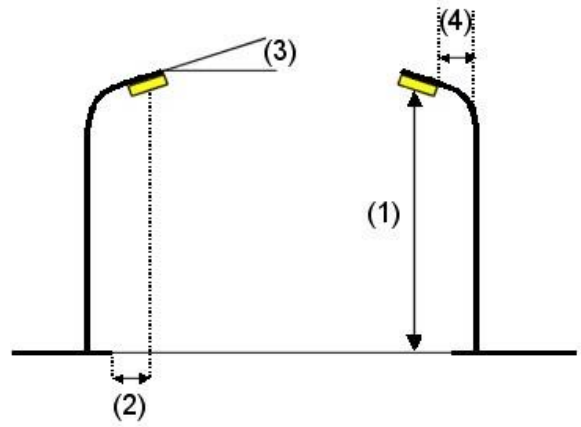
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





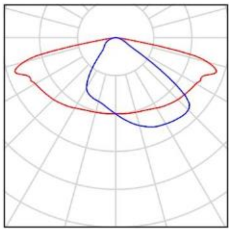
Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10		
Luminous flux (Luminaire):	8820 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10500 lm	at 70°:	487 cd/klm
Luminaire Wattage:	64.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	35.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

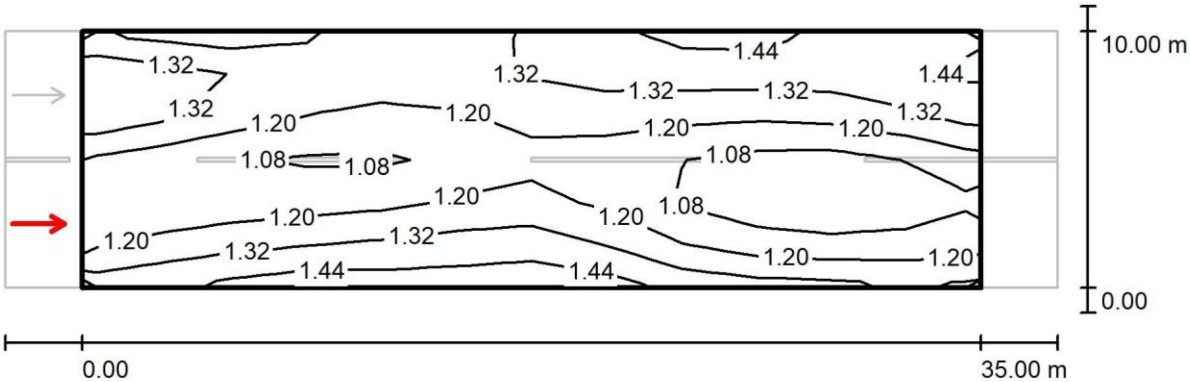
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



Values in Candela/m², Scale 1 : 294

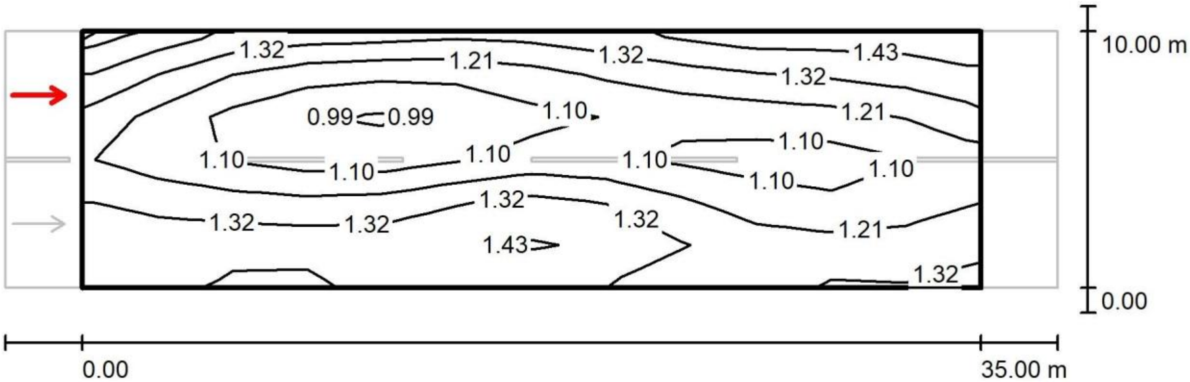
Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.78	0.74	8
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.77	0.74	8
Required values according to class ME3a:	≥ 1.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

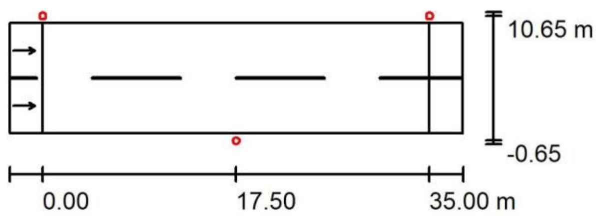
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

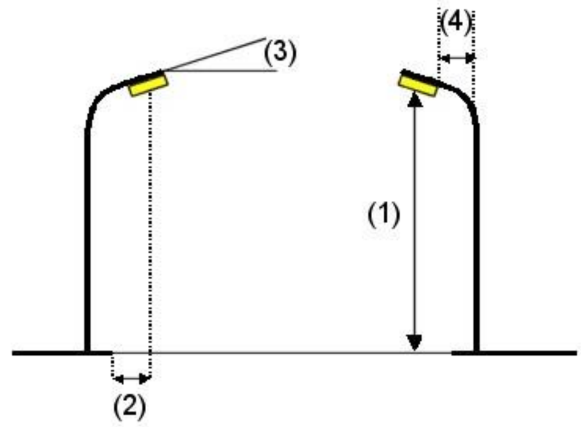
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax



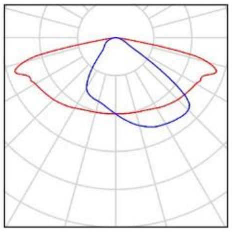


Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10		
Luminous flux (Luminaire):	8820 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10500 lm	at 70°:	487 cd/klm
Luminaire Wattage:	64.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	35.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

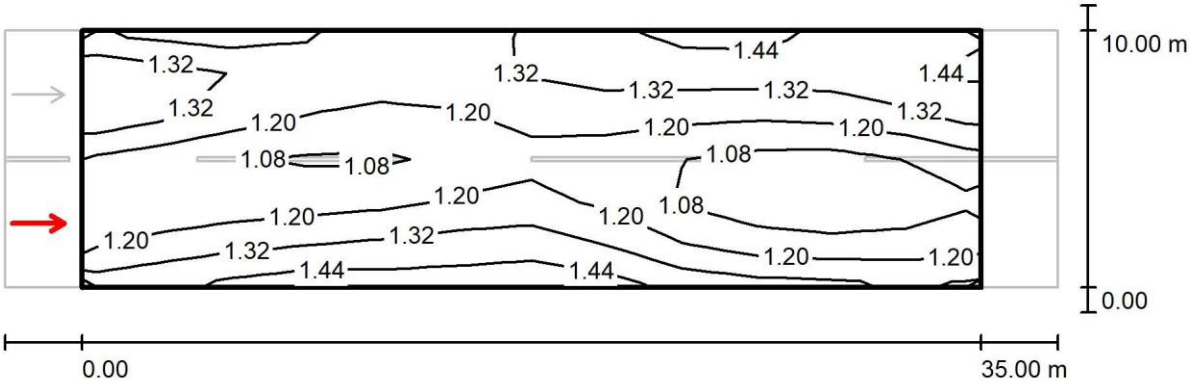
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



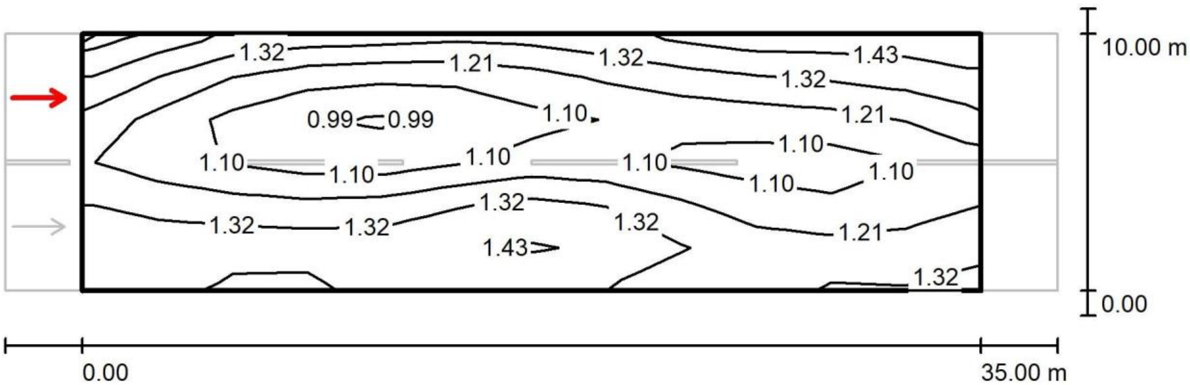
Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.78	0.74	8
Required values according to class ME3b:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.77	0.74	8
Required values according to class ME3b:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

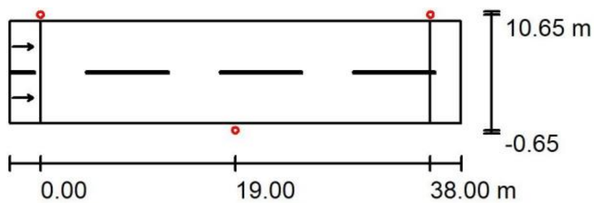
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

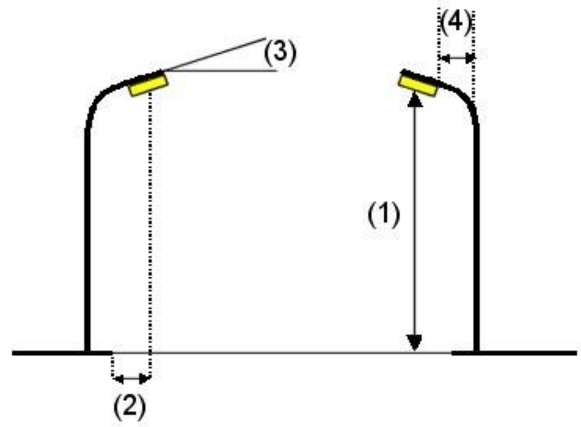
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Luminous flux (Luminaire):	8820 lm
Luminous flux (Lamps):	10500 lm
Luminaire Wattage:	64.0 W
Arrangement:	Double row, with offset
Pole Distance:	38.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	487 cd/klm
at 80°:	85 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

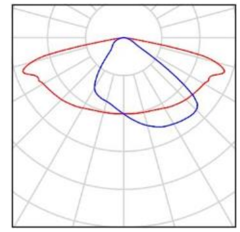
No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

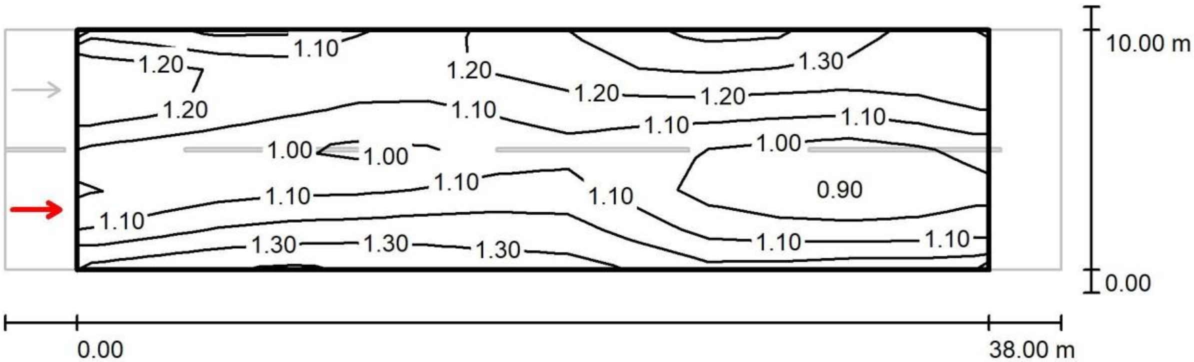
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



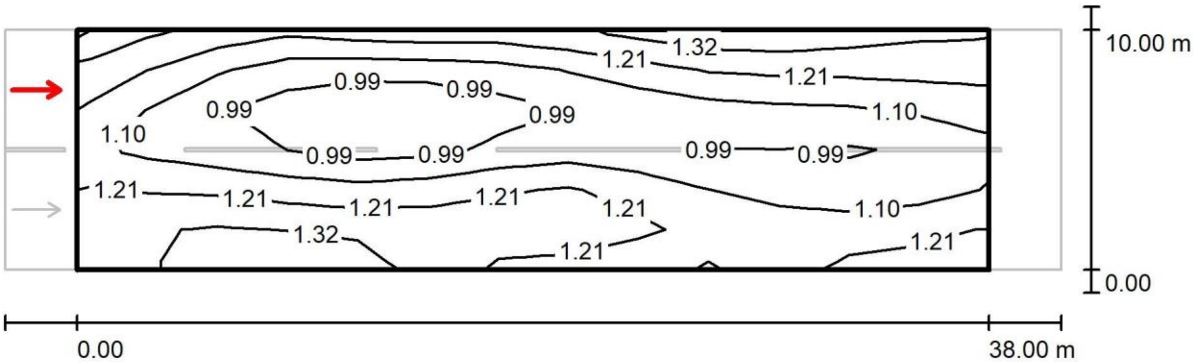
Values in Candela/m², Scale 1 : 315

Grid: 13 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.13	0.78	0.75	8
Required values according to class ME3c:	≥ 1.00	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 315

Grid: 13 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.14	0.73	0.74	8
Required values according to class ME3c:	≥ 1.00	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

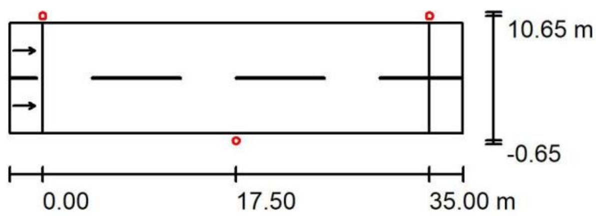
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

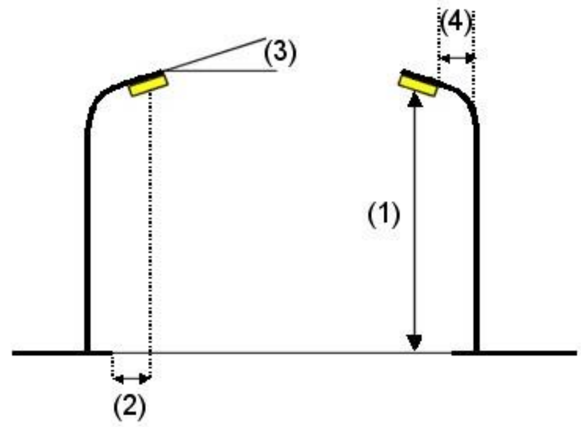
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





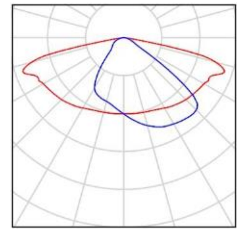
Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10		
Luminous flux (Luminaire):	8820 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10500 lm	at 70°:	487 cd/klm
Luminaire Wattage:	64.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	35.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

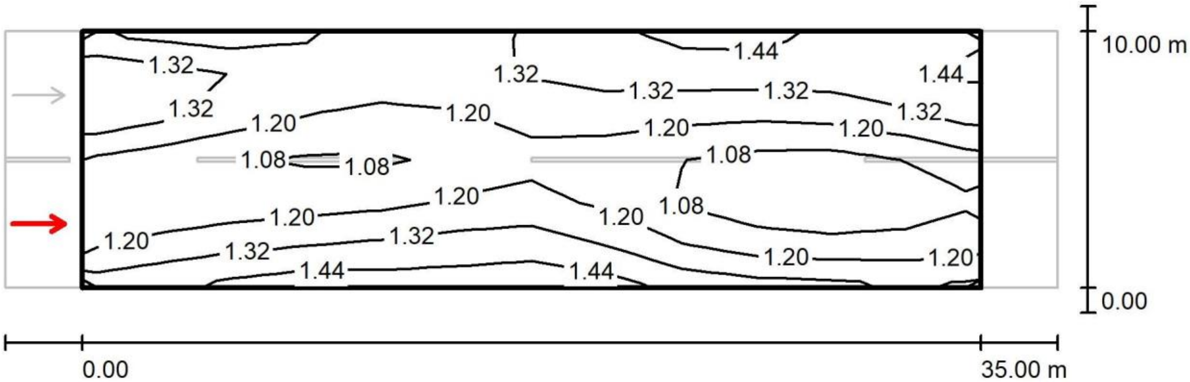
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



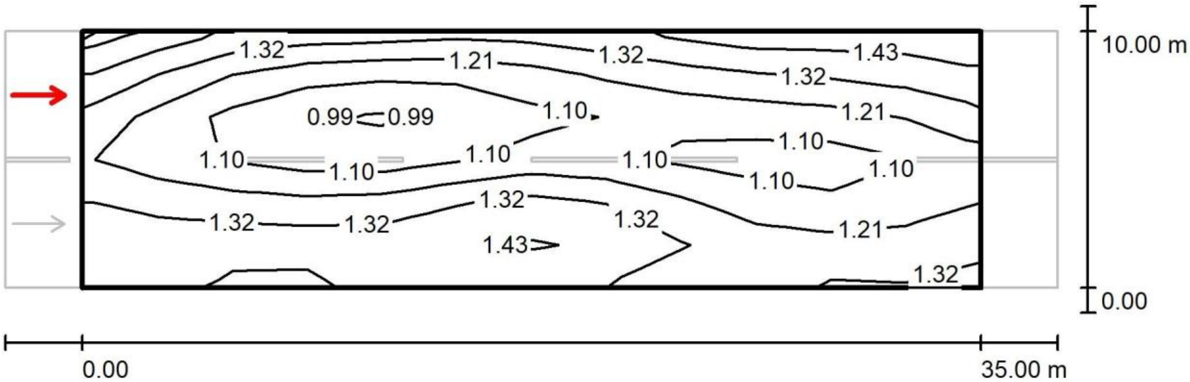
Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.78	0.74	8
Required values according to class SANS_A1f:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.23	0.77	0.74	8
Required values according to class SANS_A1f:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

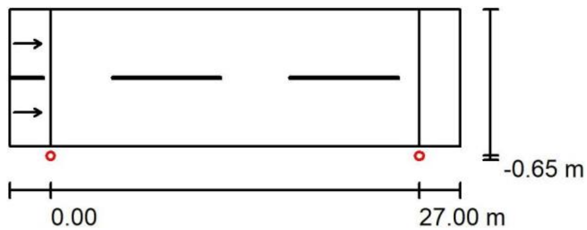
Street 1 / Planning data

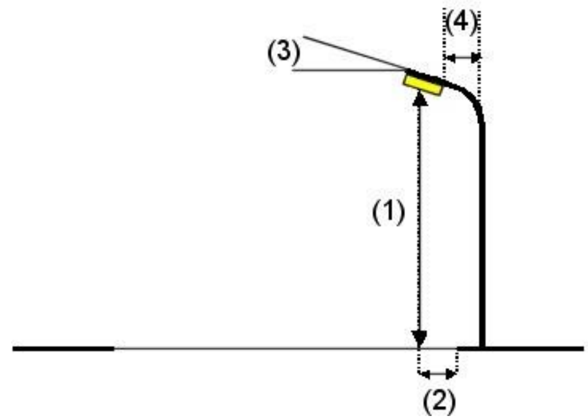
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Luminous flux (Luminaire):	8820 lm
Luminous flux (Lamps):	10500 lm
Luminaire Wattage:	64.0 W
Arrangement:	Single row, bottom
Pole Distance:	27.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities	
at 70°:	487 cd/klm
at 80°:	85 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

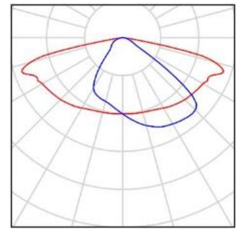
No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

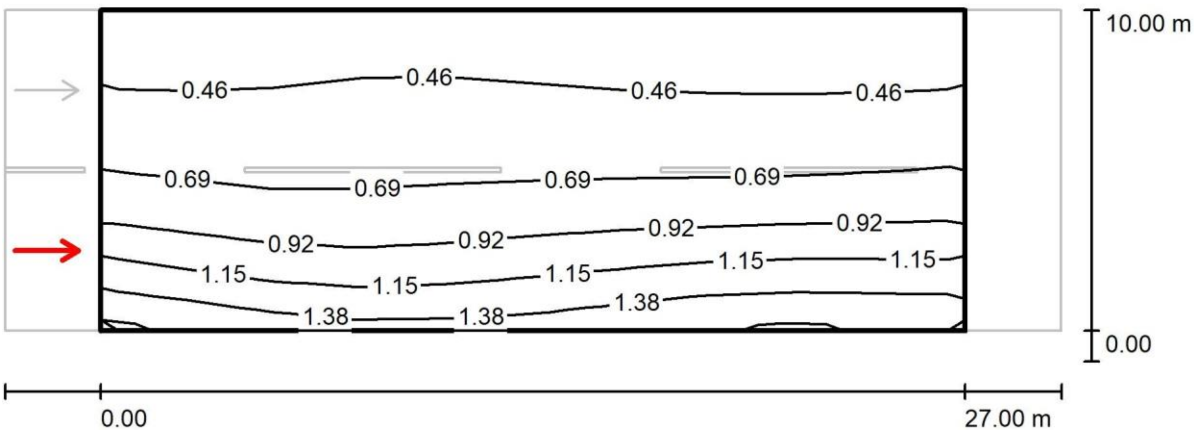
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



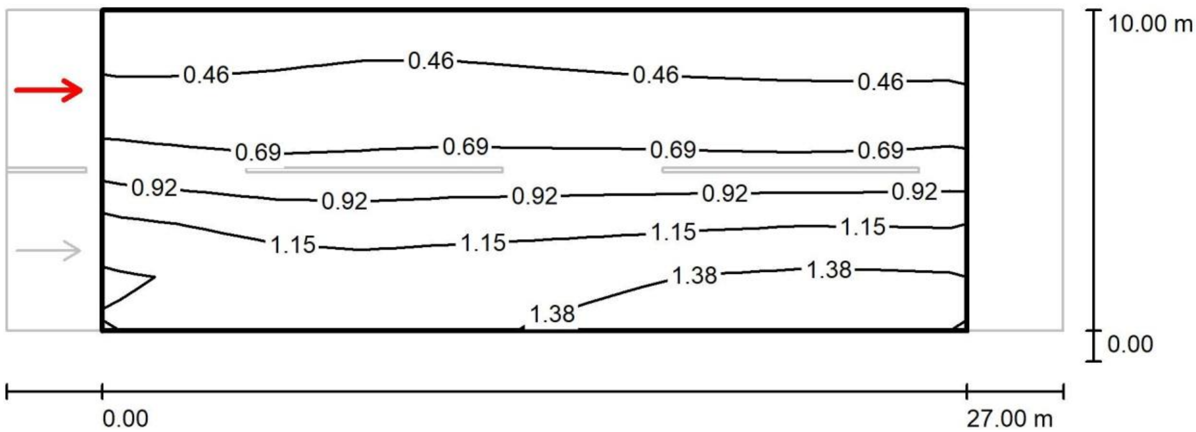
Values in Candela/m², Scale 1 : 236

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.75	0.43	0.83	11
Required values according to class SANS_A4e:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 236

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.85	0.40	0.87	6
Required values according to class SANS_A4e:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

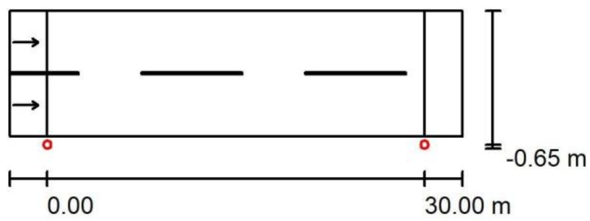
Street Profile

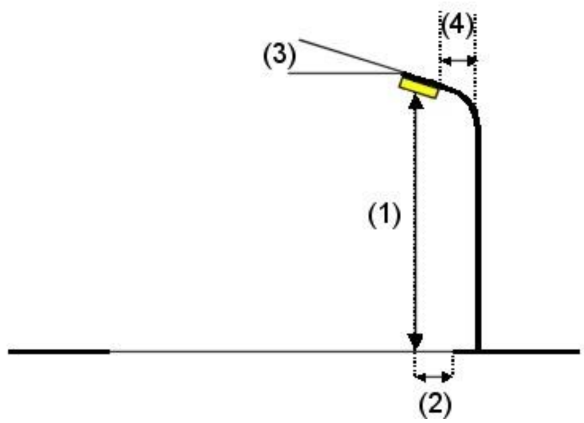
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax



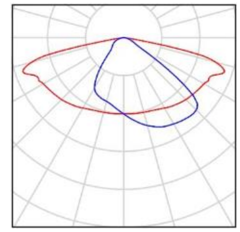


Luminaire:	PHILIPS BGP531 T25 1 xLED105-4S/740 DM10		
Luminous flux (Luminaire):	8820 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10500 lm	at 70°:	487 cd/klm
Luminaire Wattage:	64.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	30.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 8820 lm
Luminous flux (Lamps): 10500 lm
Luminaire Wattage: 64.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED105-4S/740 (Correction Factor 1.000).

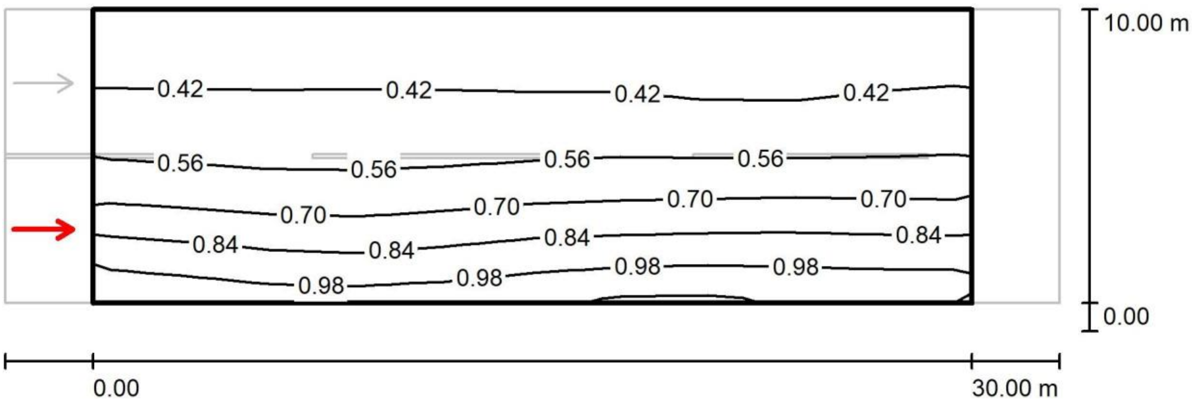
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 11 / Isolines



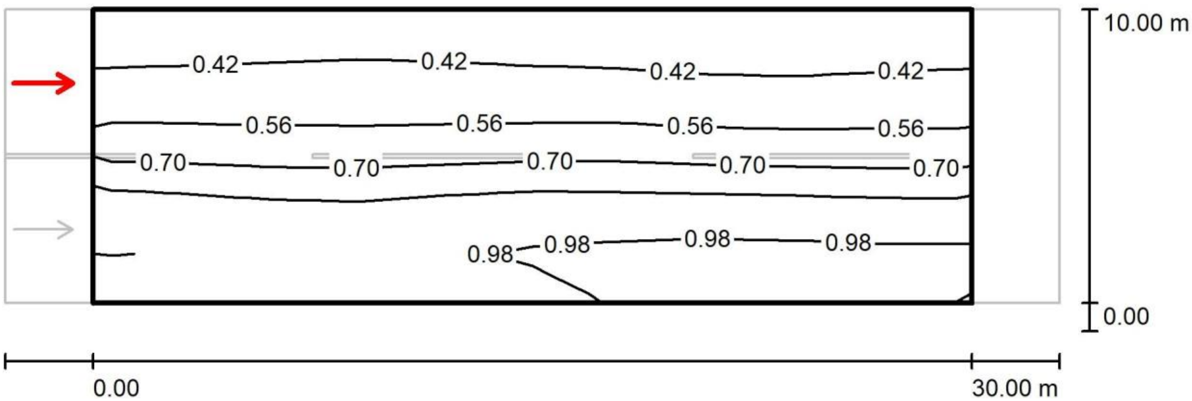
Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.60	0.54	0.88	8
Required values according to class SANS_A4f:	≥ 0.30	≥ 0.30	≥ 0.50	≤ 25
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 12 / Isolines



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.68	0.50	0.90	6
Required values according to class SANS_A4f:	≥ 0.30	≥ 0.30	≥ 0.50	≤ 25
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

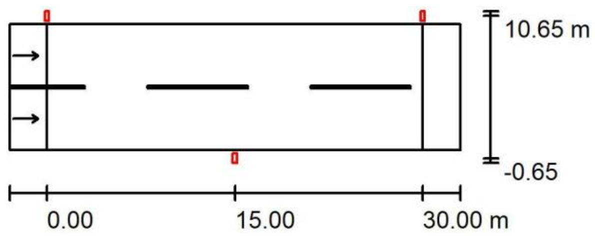
Street Profile

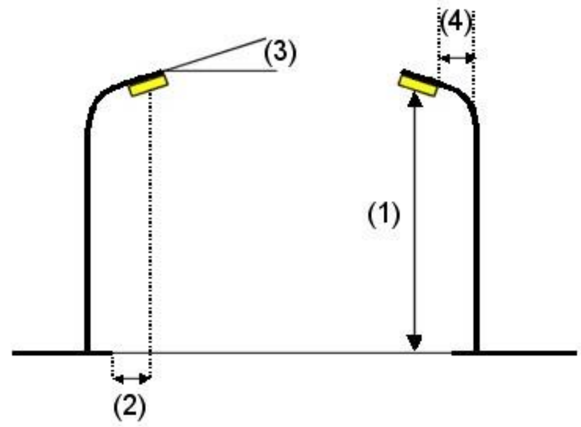
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP340 1xLED92-3S/740 DM
Luminous flux (Luminaire):	7912 lm
Luminous flux (Lamps):	9200 lm
Luminaire Wattage:	71.0 W
Arrangement:	Double row, with offset
Pole Distance:	30.000 m
Mounting Height (1):	10.000 m
Height:	9.793 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	516 cd/klm
at 80°:	30 cd/klm
at 90°:	0.00 cd/klm

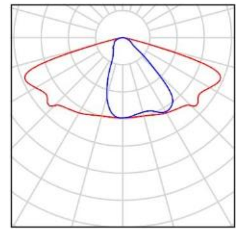
Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G3.
Arrangement complies with glare index class D.5.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

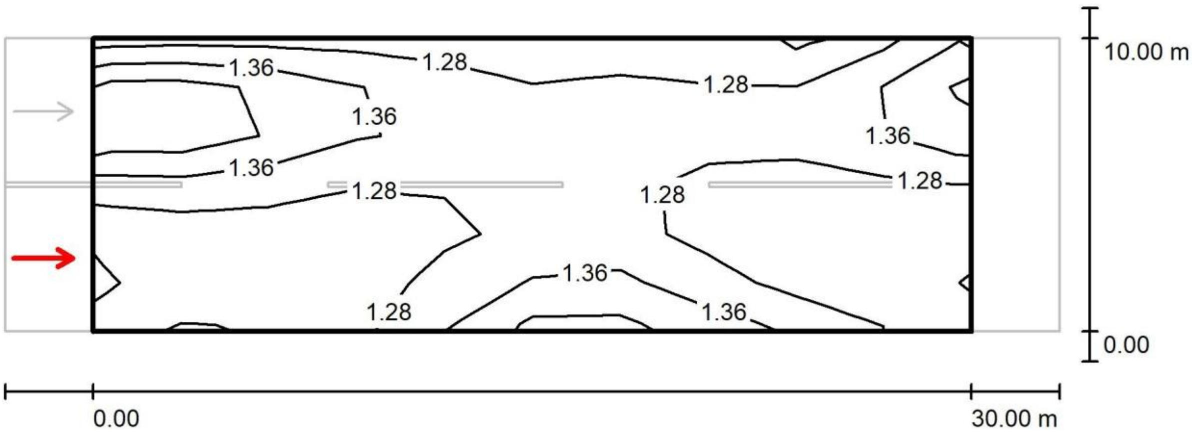
PHILIPS BGP340 1xLED92-3S/740 DM
Article No.:
Luminous flux (Luminaire): 7912 lm
Luminous flux (Lamps): 9200 lm
Luminaire Wattage: 71.0 W
Luminaire classification according to CIE: 100CIE
flux code: 45 79 98 100 86
Fitting: 1 x LED92-3S/740 (Correction Factor1.000).



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



Values in Candela/m², Scale 1 : 258

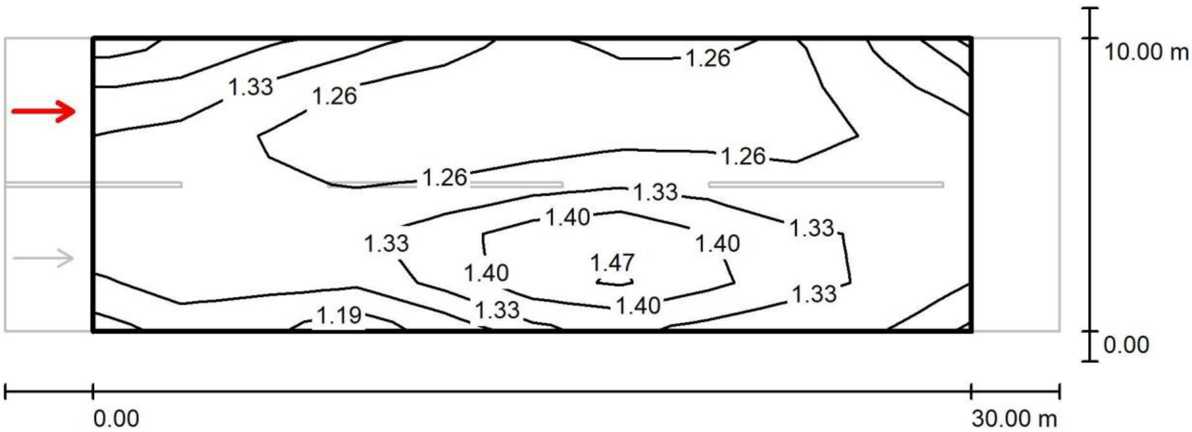
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.31	0.91	0.89	6
Required values according to class SANS_A1c:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.30	0.91	0.89	6
Required values according to class SANS_A1c:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

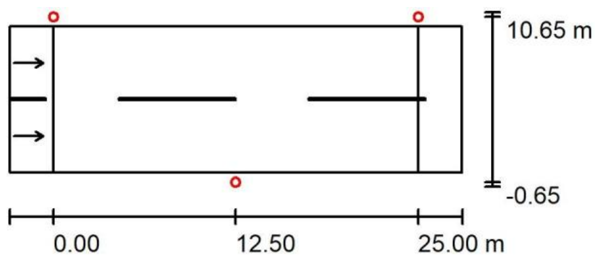
Street Profile

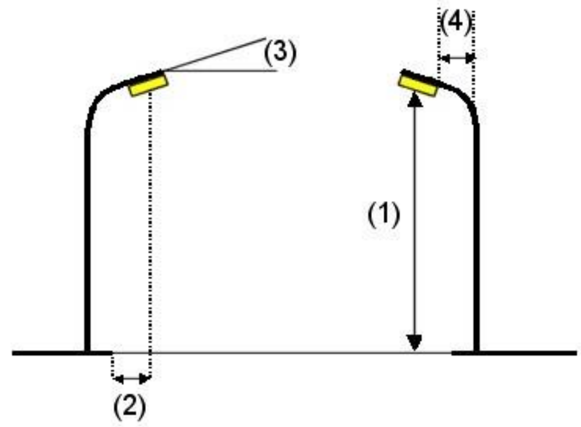
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED115-4S/740 DM10
Luminous flux (Luminaire):	9660 lm
Luminous flux (Lamps):	11500 lm
Luminaire Wattage:	71.0 W
Arrangement:	Double row, with offset
Pole Distance:	25.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	487 cd/klm
at 80°:	85 cd/klm
at 90°:	0.00 cd/klm

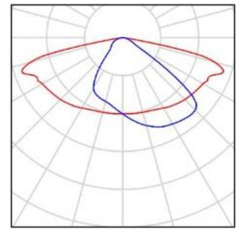
Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Street 1 / Luminaire parts list

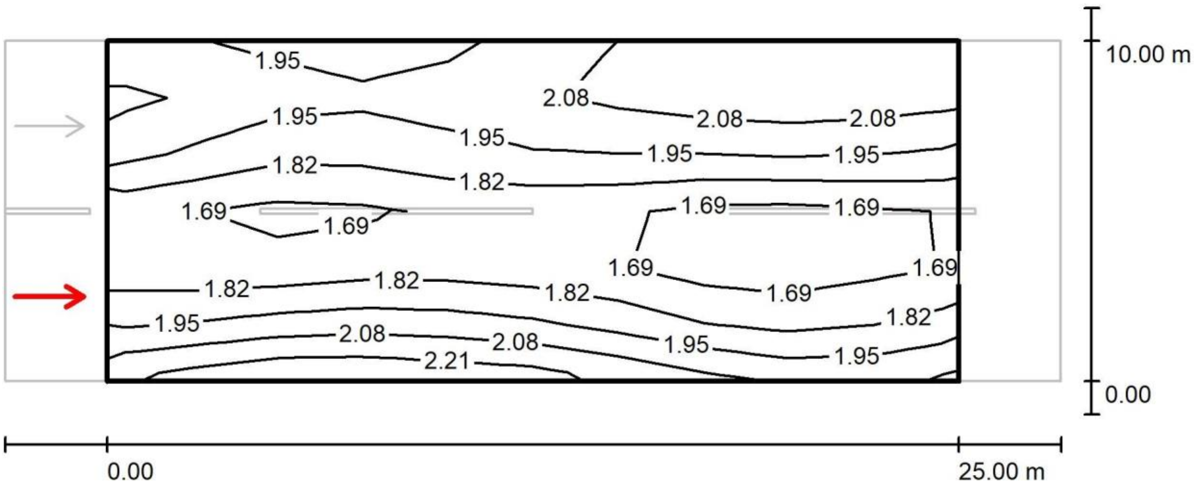
PHILIPS BGP531 T25 1 xLED115-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 9660 lm
Luminous flux (Lamps): 11500 lm
Luminaire Wattage: 71.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED115-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



Values in Candela/m², Scale 1 : 222

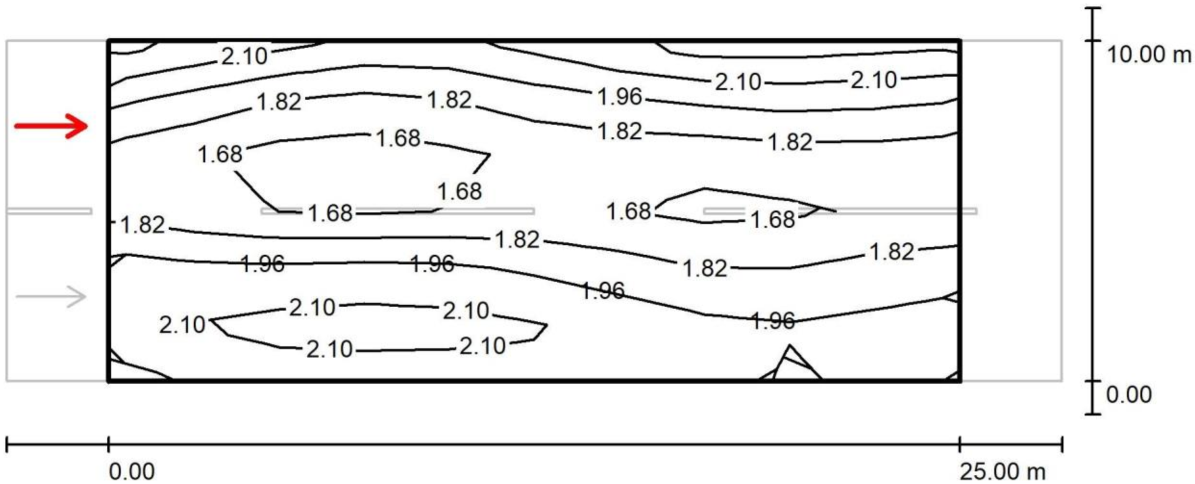
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.90	0.82	0.87	7
Required values according to class SANS_A1e:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.89	0.82	0.87	7
Required values according to class SANS_A1e:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

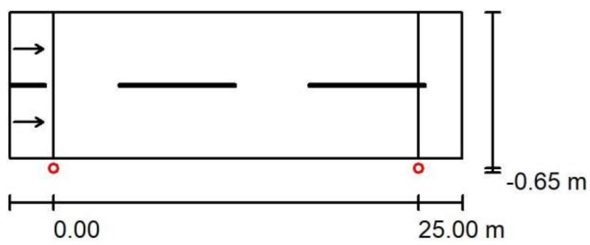
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

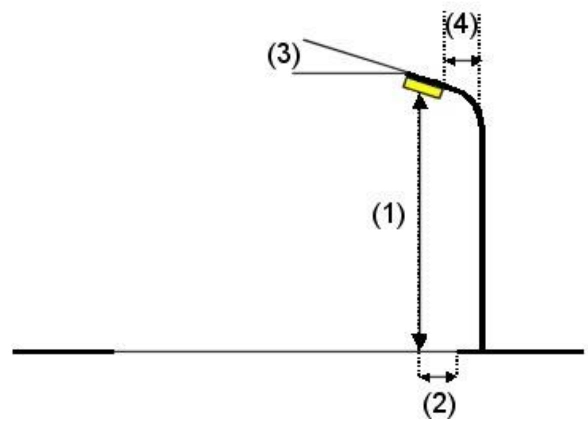
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Luminous flux (Luminaire):	8400 lm
Luminous flux (Lamps):	10000 lm
Luminaire Wattage:	78.0 W
Arrangement:	Single row, bottom
Pole Distance:	25.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	487 cd/klm
at 80°:	85 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

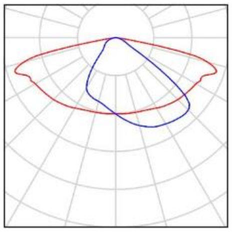
No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

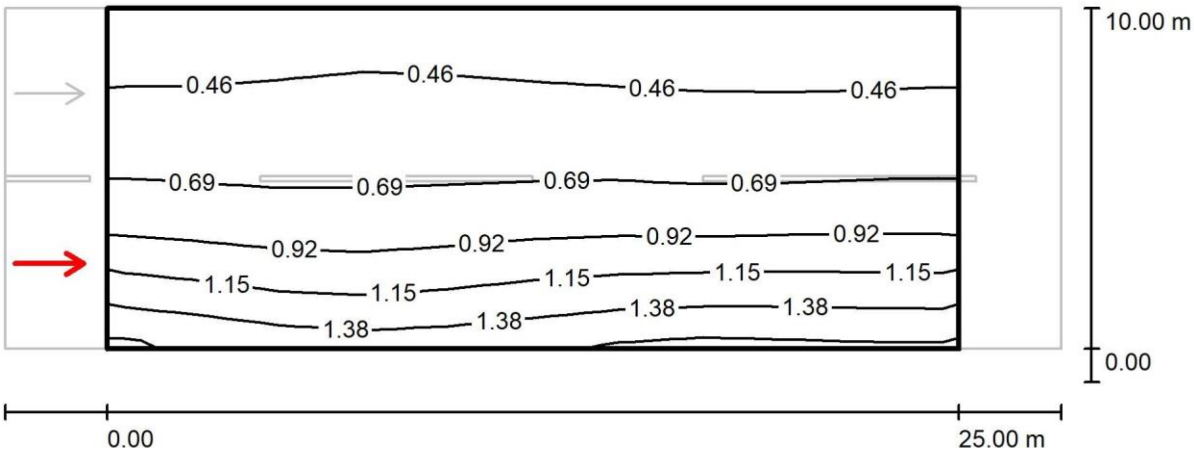
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 8400 lm
Luminous flux (Lamps): 10000 lm
Luminaire Wattage: 78.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED100-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



Values in Candela/m², Scale 1 : 222

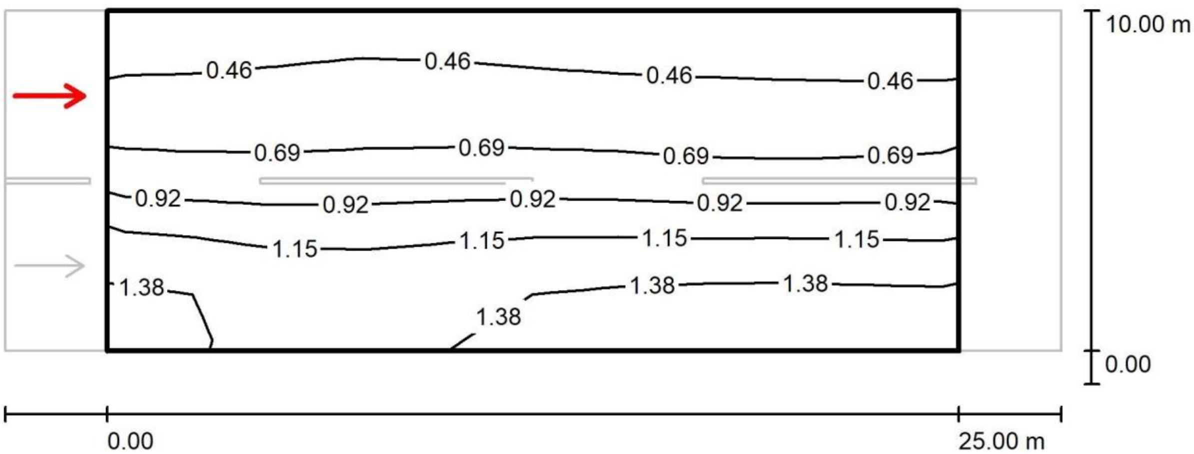
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.77	0.44	0.86	10
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.88	0.41	0.88	6
Required values according to class ME4a:	≥ 0.75	≥ 0.40	≥ 0.60	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

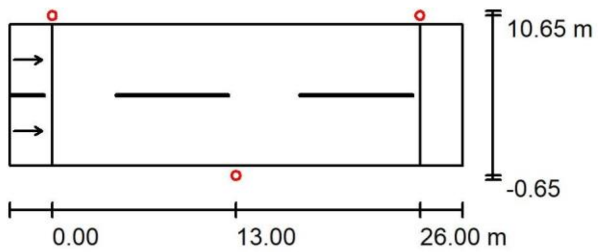
Street Profile

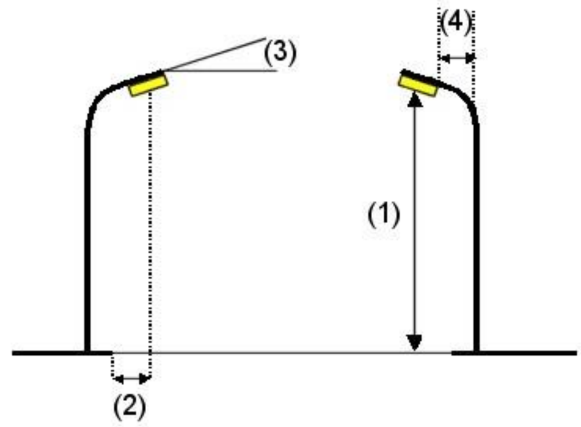
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





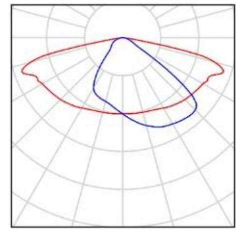
Luminaire:	PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830		
Luminous flux (Luminaire):	8400 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	78.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	26.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

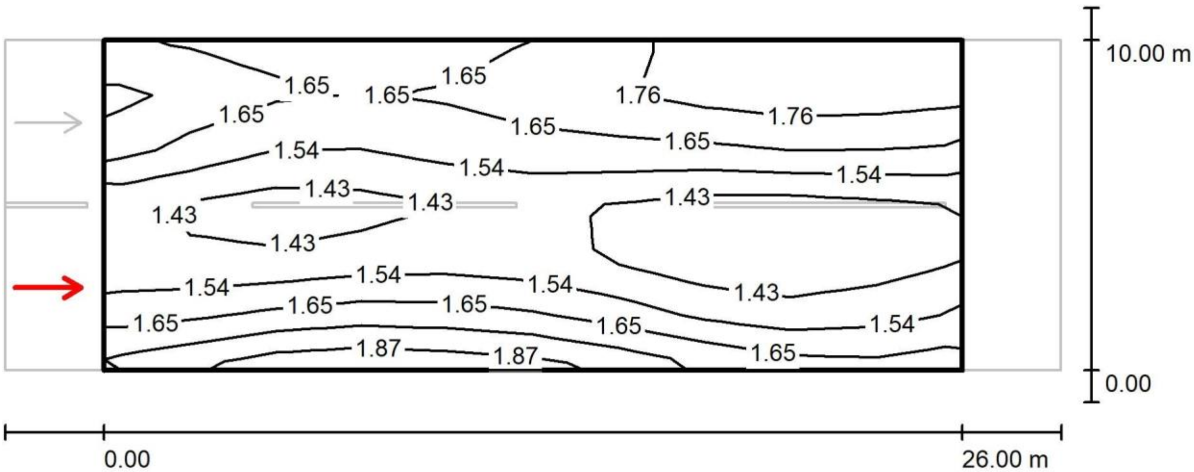
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 8400 lm
Luminous flux (Lamps): 10000 lm
Luminaire Wattage: 78.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED100-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



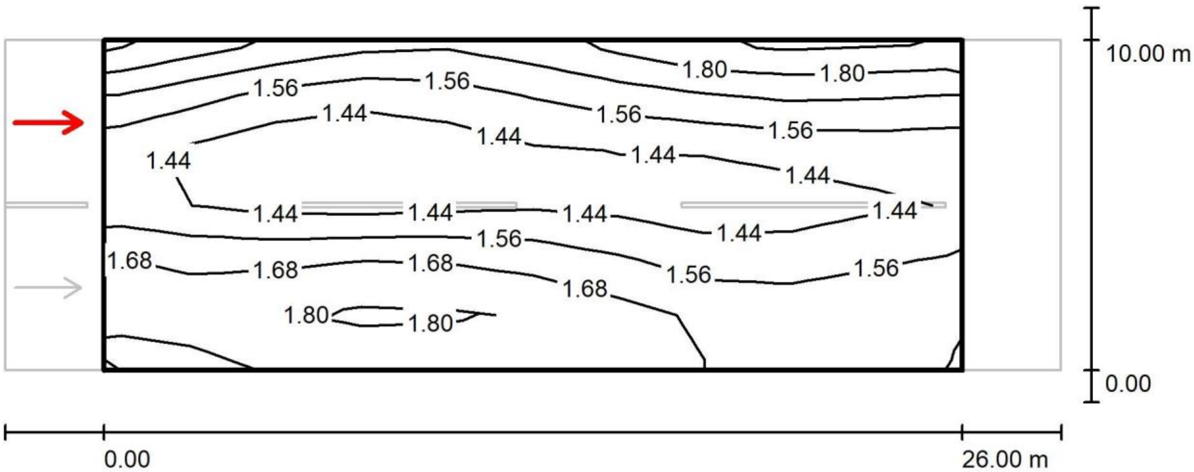
Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.58	0.82	0.85	7
Required values according to class SANS_A2a:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.58	0.82	0.85	7
Required values according to class SANS_A2a:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

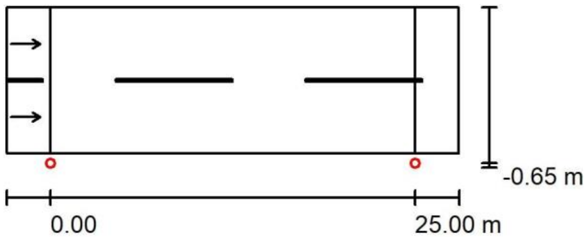
Street Profile

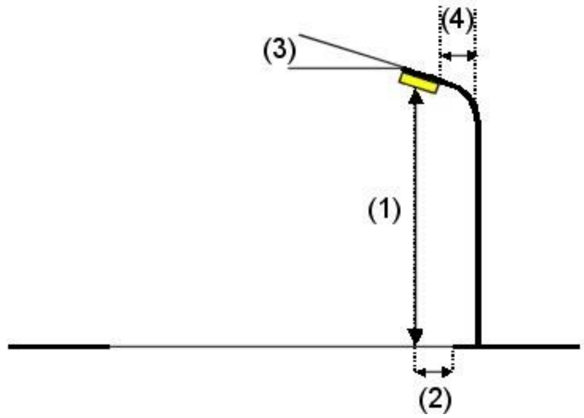
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





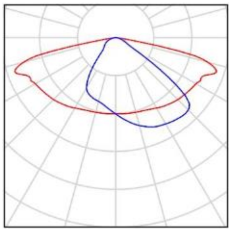
Luminaire:	PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830		
Luminous flux (Luminaire):	8400 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	78.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

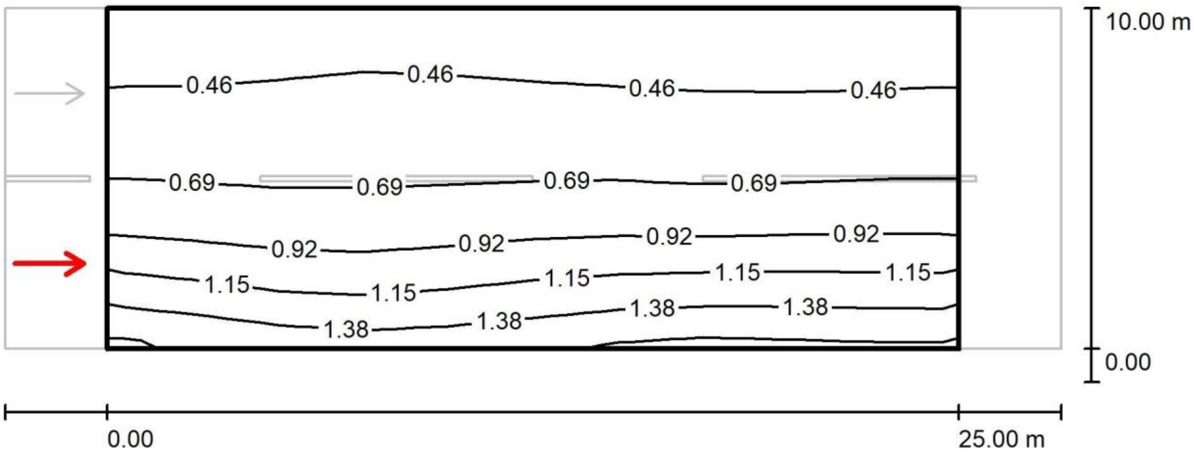
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 8400 lm
Luminous flux (Lamps): 10000 lm
Luminaire Wattage: 78.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED100-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



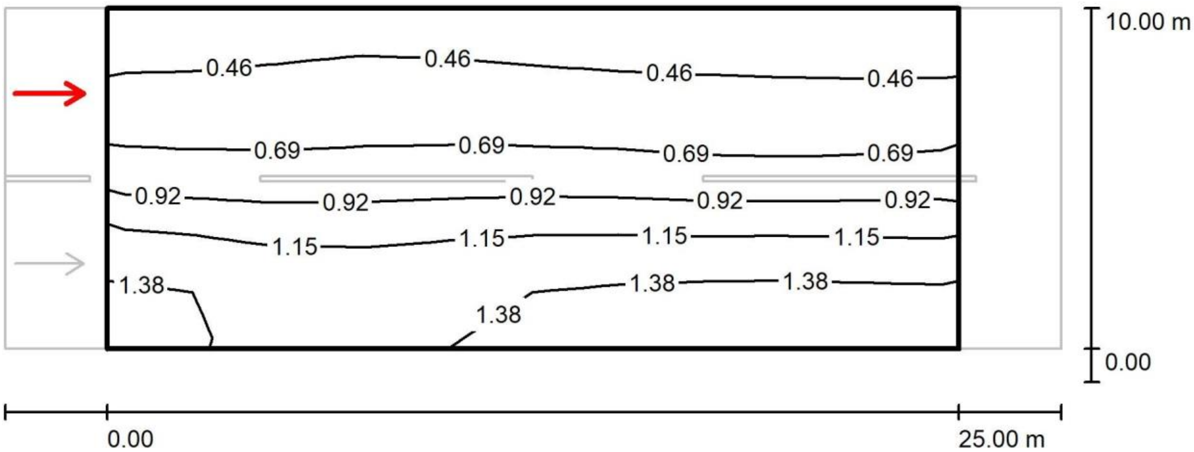
Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.77	0.44	0.86	10
Required values according to class SANS_A4b:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.88	0.41	0.88	6
Required values according to class SANS_A4b:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

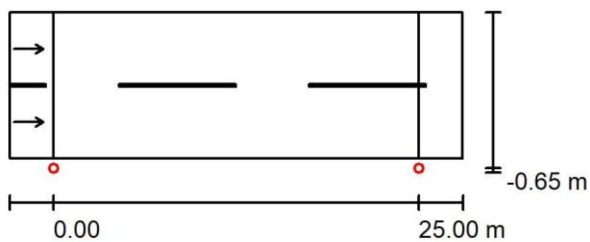
Street Profile

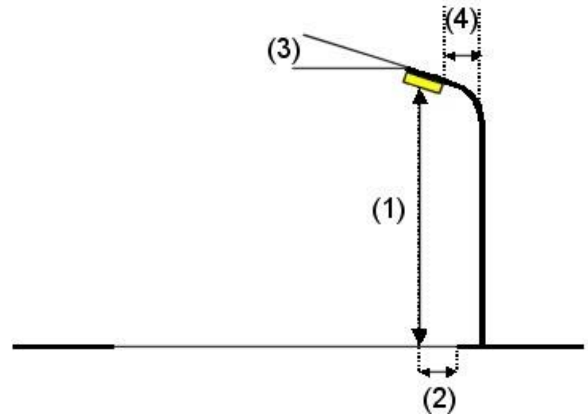
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





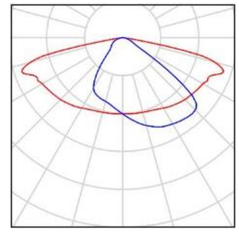
Luminaire:	PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830		
Luminous flux (Luminaire):	8400 lm	Maximum luminous intensities	
Luminous flux (Lamps):	10000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	78.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

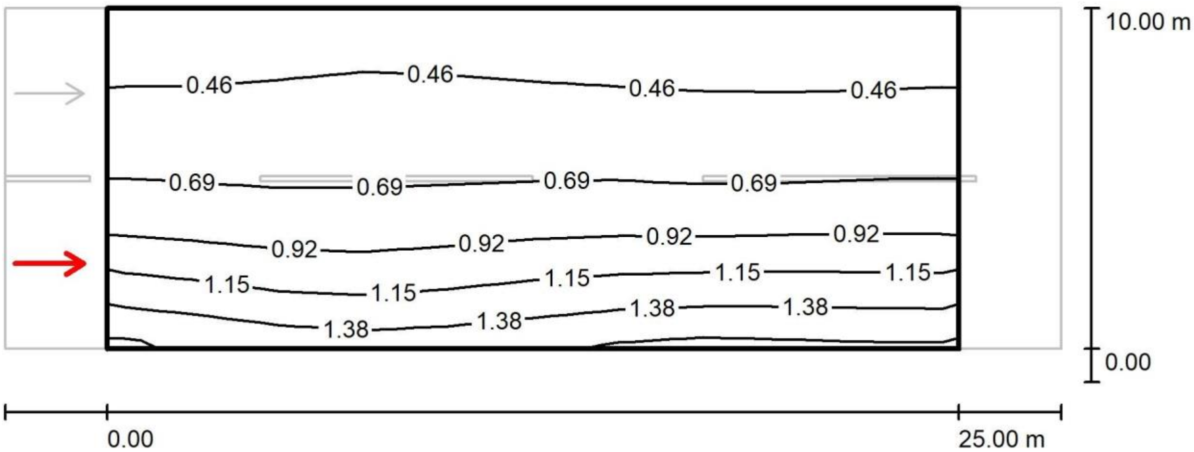
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830
Article No.:
Luminous flux (Luminaire): 8400 lm
Luminous flux (Lamps): 10000 lm
Luminaire Wattage: 78.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED100-4S/830 (Correction Factor 1.000).

See our luminaire catalog for an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



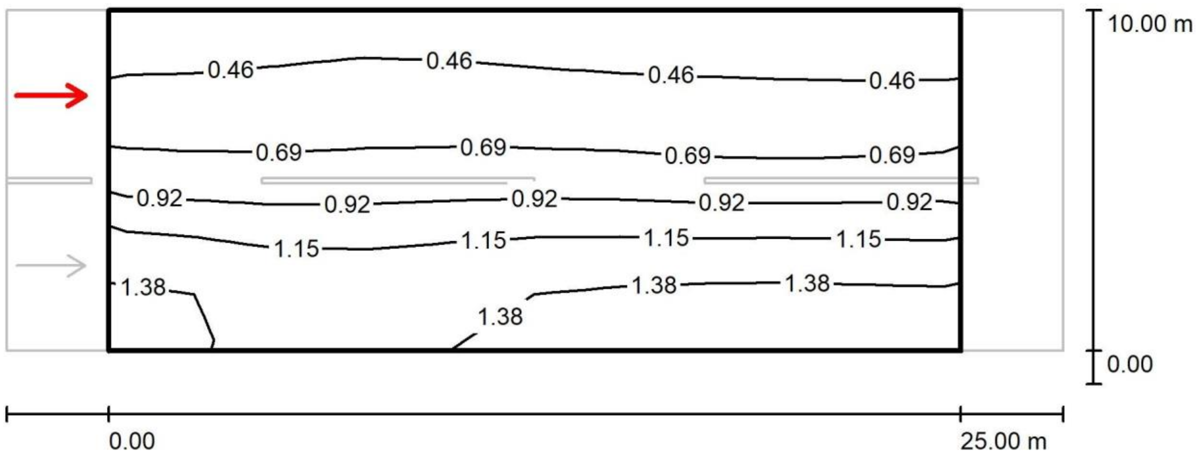
Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.77	0.44	0.86	10
Required values according to class SANS_A4d:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.88	0.41	0.88	6
Required values according to class SANS_A4d:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

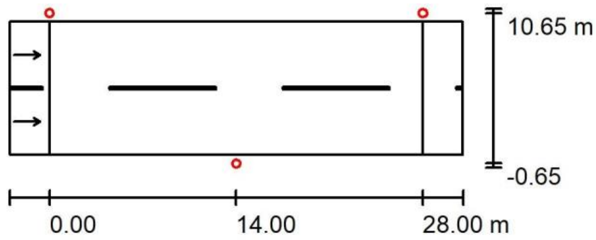
Street Profile

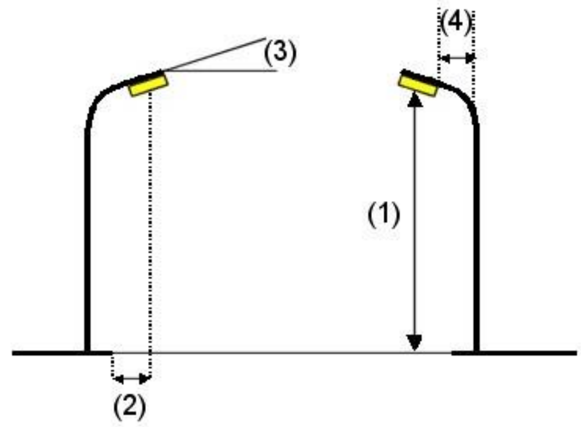
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED110-4S/830 DM10		
Luminous flux (Luminaire):	9240 lm	Maximum luminous intensities	
Luminous flux (Lamps):	11000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	28.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

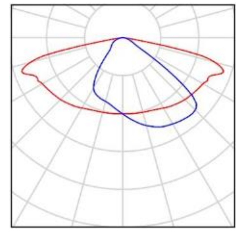
Operator
Telephone

Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

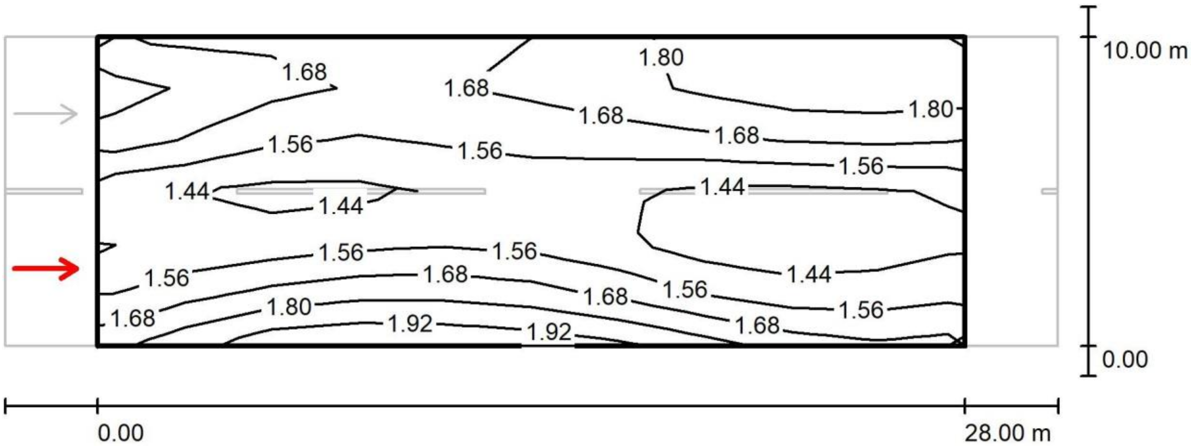
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



Values in Candela/m², Scale 1 : 244

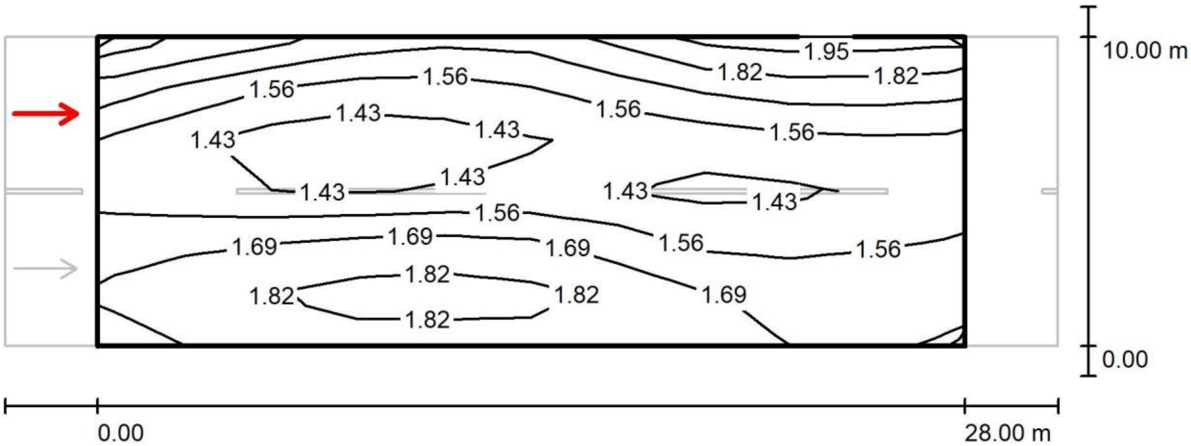
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.62	0.81	0.83	7
Required values according to class ME2:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 10
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 244

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.62	0.81	0.83	7
Required values according to class ME2:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 10
Fulfilled/Not fulfilled:	✓	✓	✓	✓

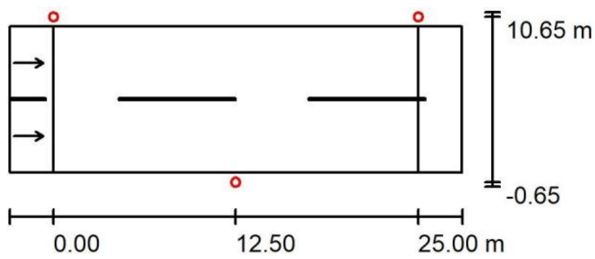
Street 1 / Planning data

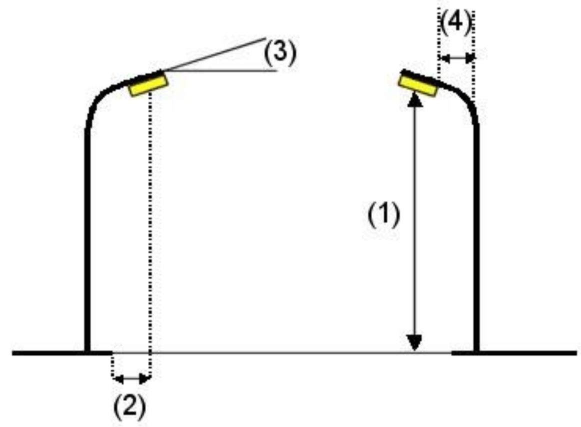
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





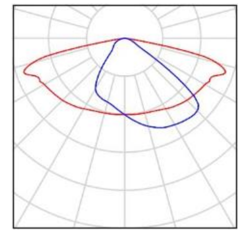
Luminaire:	PHILIPS BGP531 T25 1 xLED110-4S/830 DM10		
Luminous flux (Luminaire):	9240 lm	Maximum luminous intensities	
Luminous flux (Lamps):	11000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

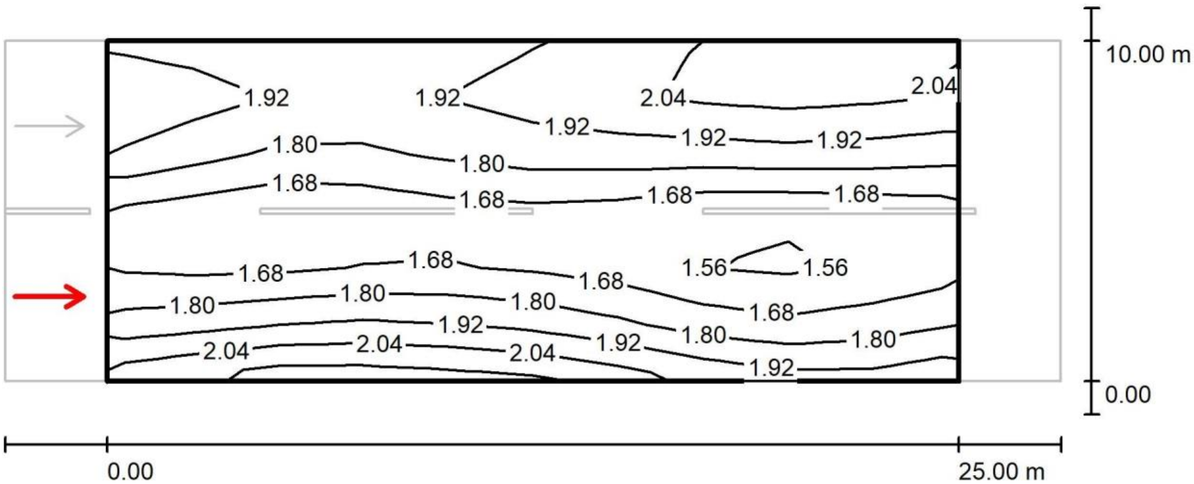
PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



Values in Candela/m², Scale 1 : 222

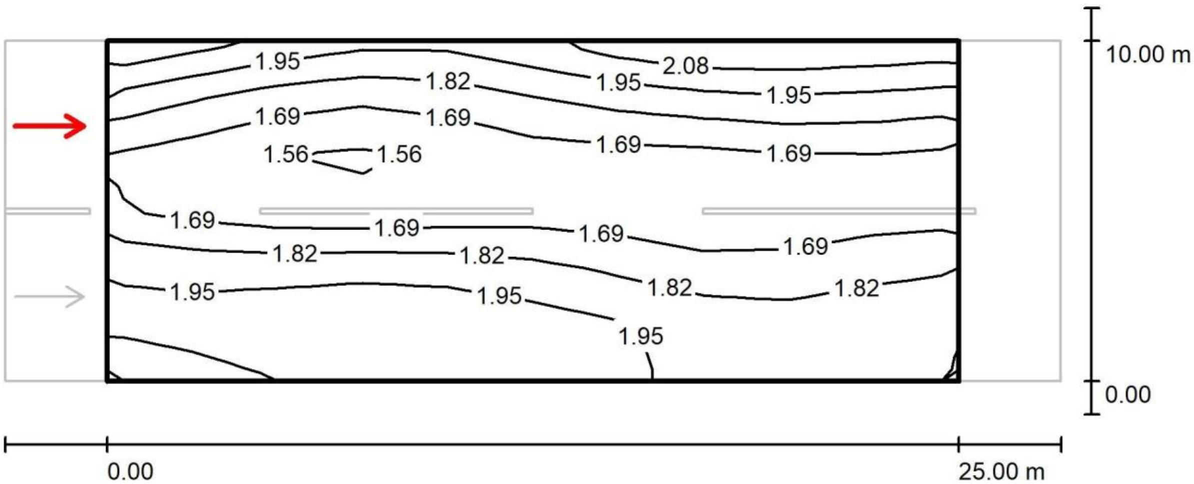
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.81	0.82	0.87	7
Required values according to class SANS_A1b:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.81	0.82	0.87	7
Required values according to class SANS_A1b:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

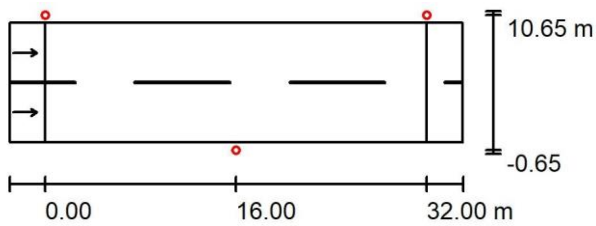
Street Profile

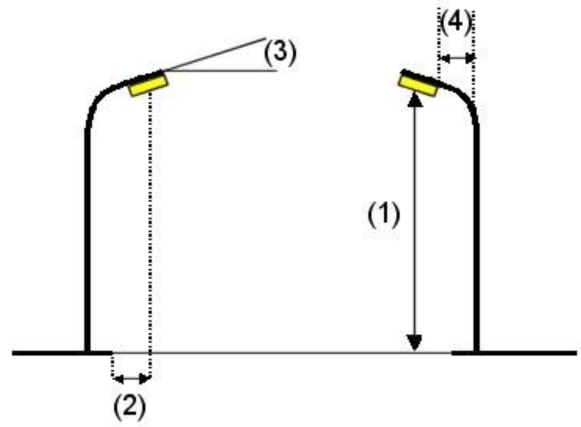
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





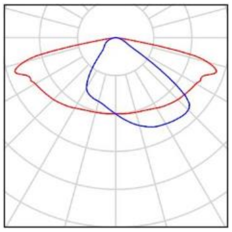
Luminaire:	PHILIPS BGP531 T25 1 xLED110-4S/830 DM10		
Luminous flux (Luminaire):	9240 lm	Maximum luminous intensities	
Luminous flux (Lamps):	11000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	85 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	32.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

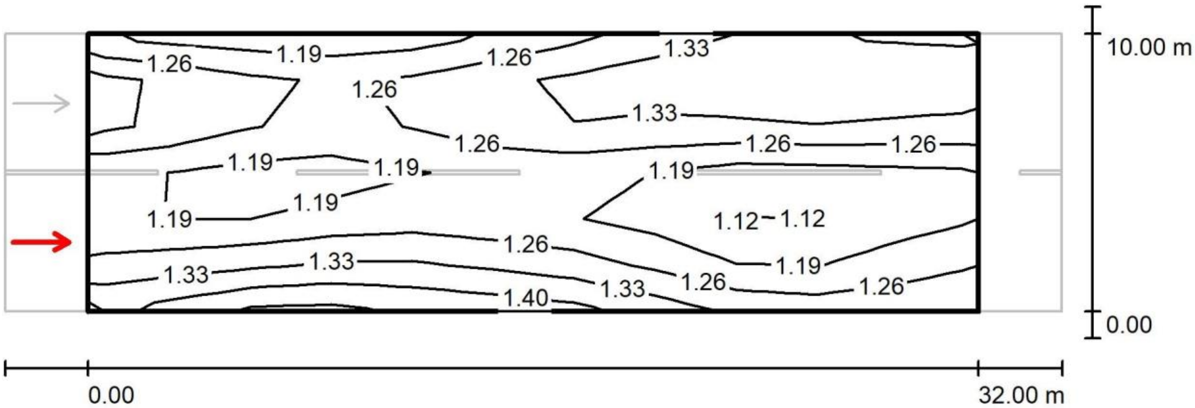
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



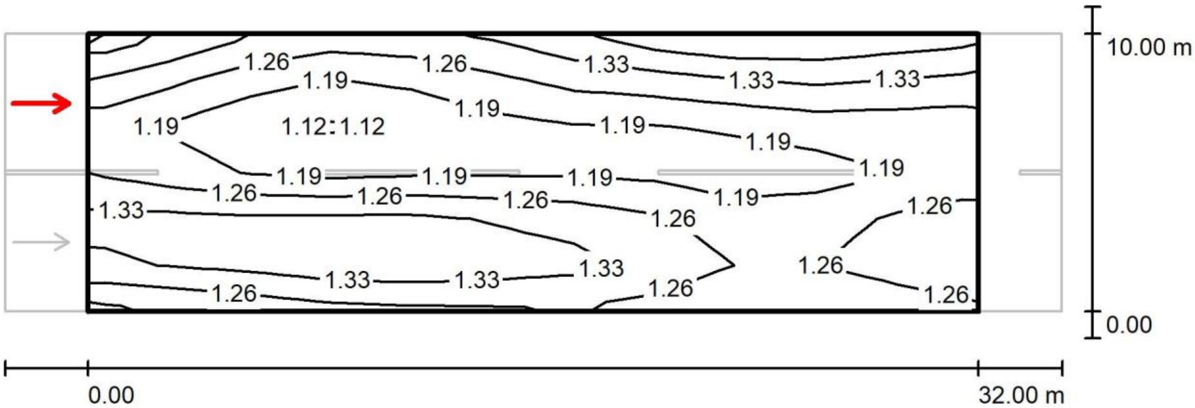
Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.26	0.87	0.86	7
Required values according to class SANS_A2b:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.26	0.87	0.88	6
Required values according to class SANS_A2b:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

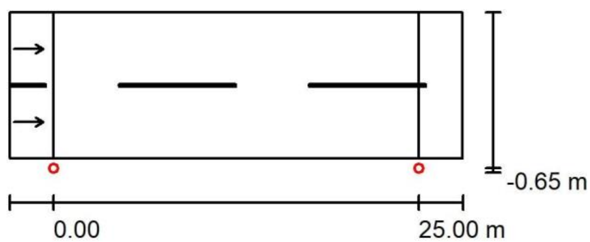
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

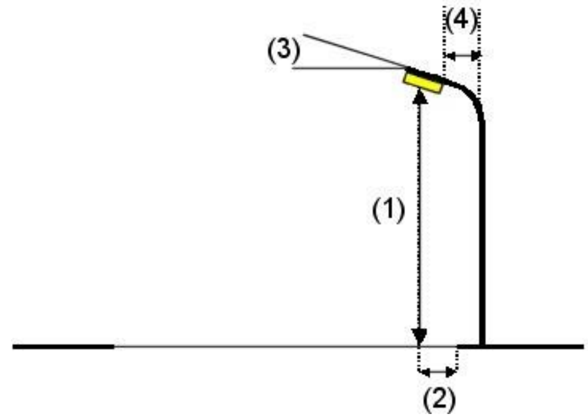
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





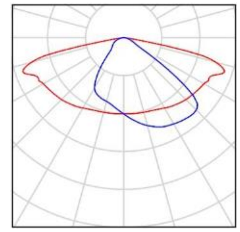
Luminaire:	PHILIPS BGP531 T25 1 xLED110-4S/830 DM10		
Luminous flux (Luminaire):	9240 lm	Maximum luminous intensities	
Luminous flux (Lamps):	11000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

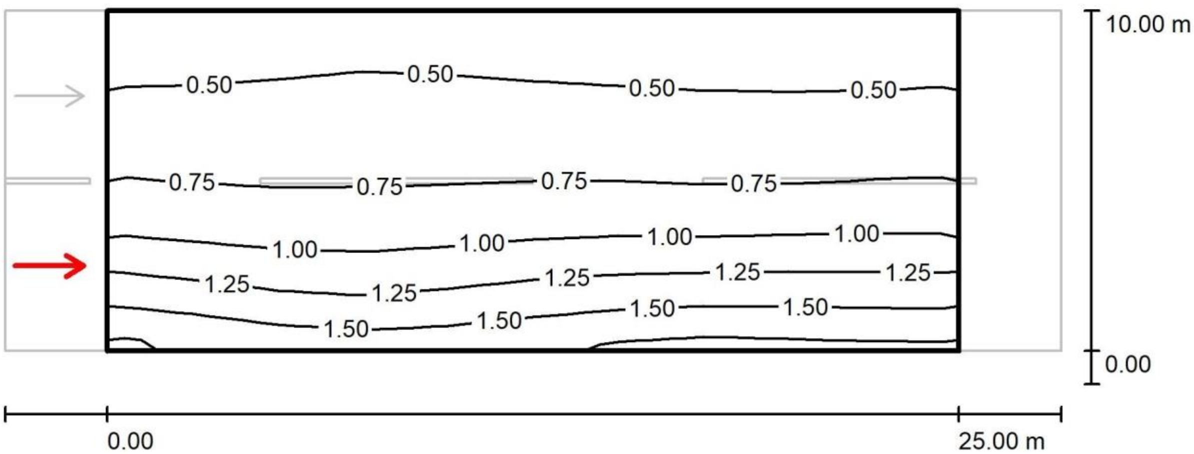
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



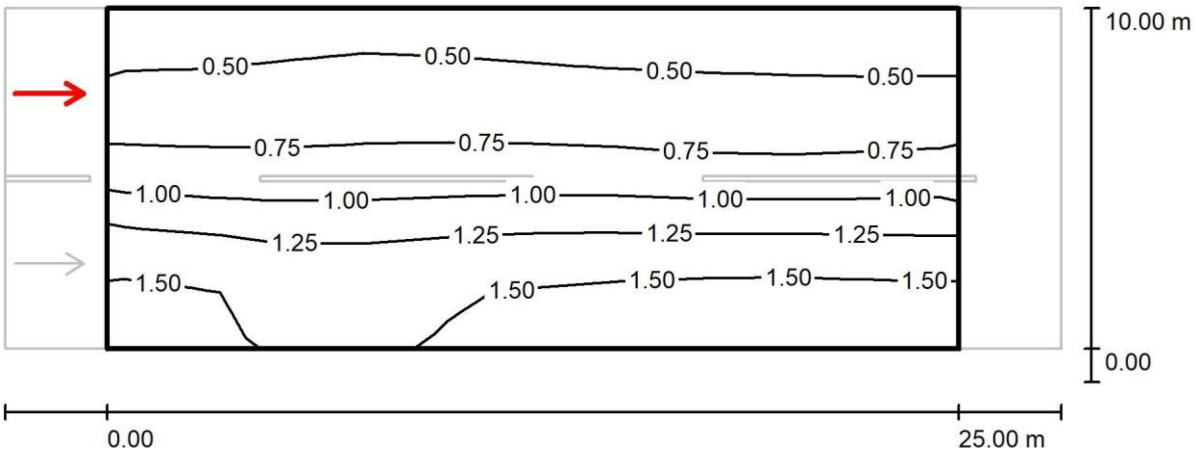
Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.85	0.44	0.86	10
Required values according to class SANS_A4a:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.96	0.41	0.88	6
Required values according to class SANS_A4a:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

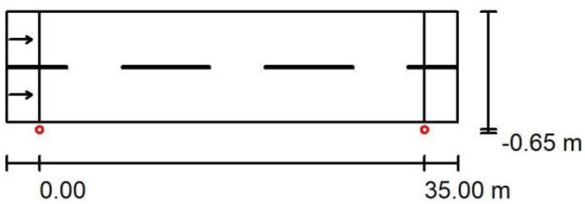
Street Profile

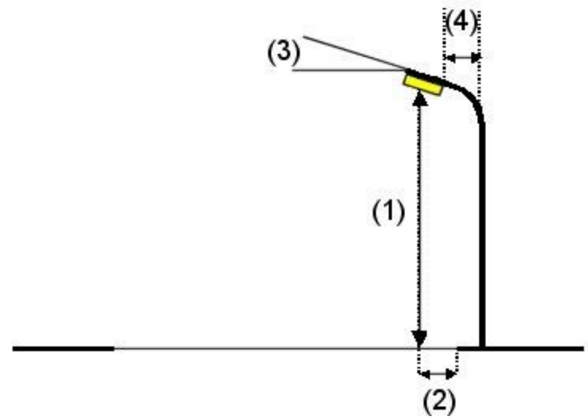
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





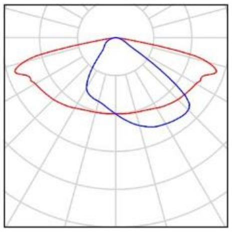
Luminaire:	PHILIPS BGP531 T25 1 xLED110-4S/830 DM10		
Luminous flux (Luminaire):	9240 lm	Maximum luminous intensities	
Luminous flux (Lamps):	11000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	81.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	35.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 9240 lm
Luminous flux (Lamps): 11000 lm
Luminaire Wattage: 81.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED110-4S/830 (Correction Factor 1.000).

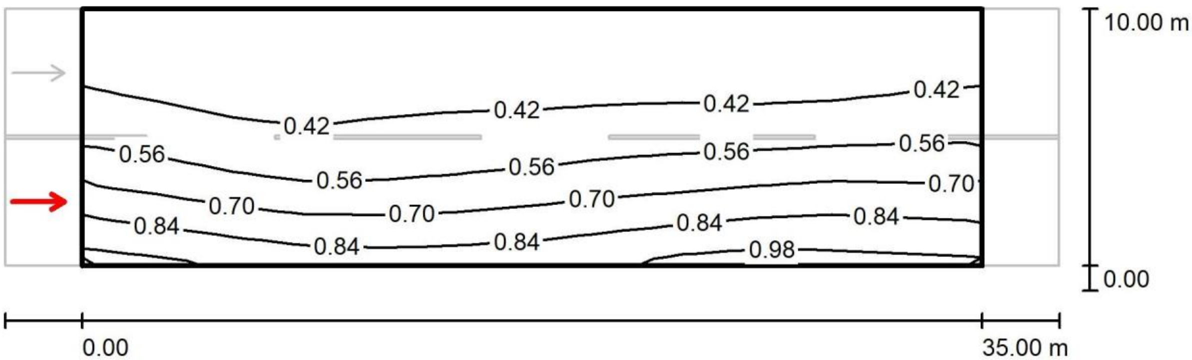
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



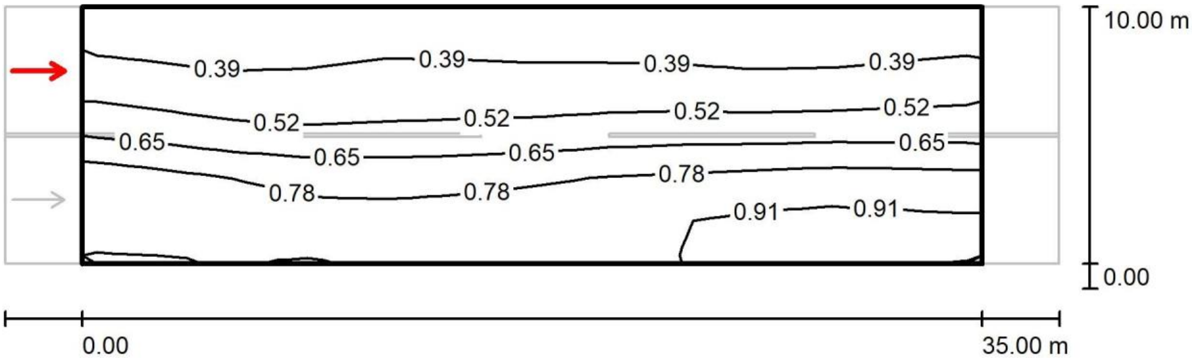
Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.54	0.54	0.79	9
Required values according to class SANS_A4c:	≥ 0.30	≥ 0.30	≥ 0.50	≤ 25
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.61	0.51	0.88	6
Required values according to class SANS_A4c:	≥ 0.30	≥ 0.30	≥ 0.50	≤ 25
Fulfilled/Not fulfilled:	✓	✓	✓	✓

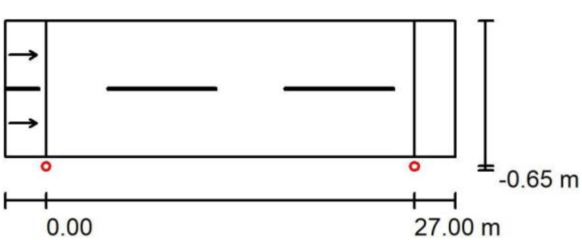
Street 1 / Planning data

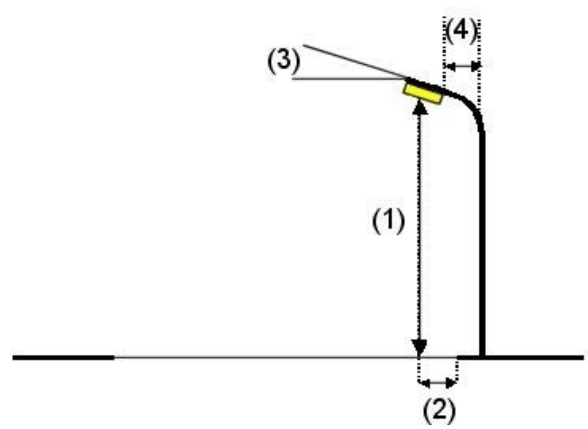
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Operator
Telephone

Fax

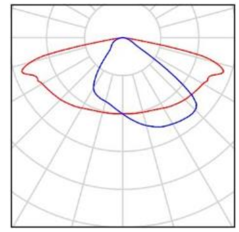
Luminaire:	PHILIPS BGP531 T25 1 xLED120-4S/830 DM10		
Luminous flux (Luminaire):	10080 lm	Maximum luminous intensities	
Luminous flux (Lamps):	12000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	89.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	27.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

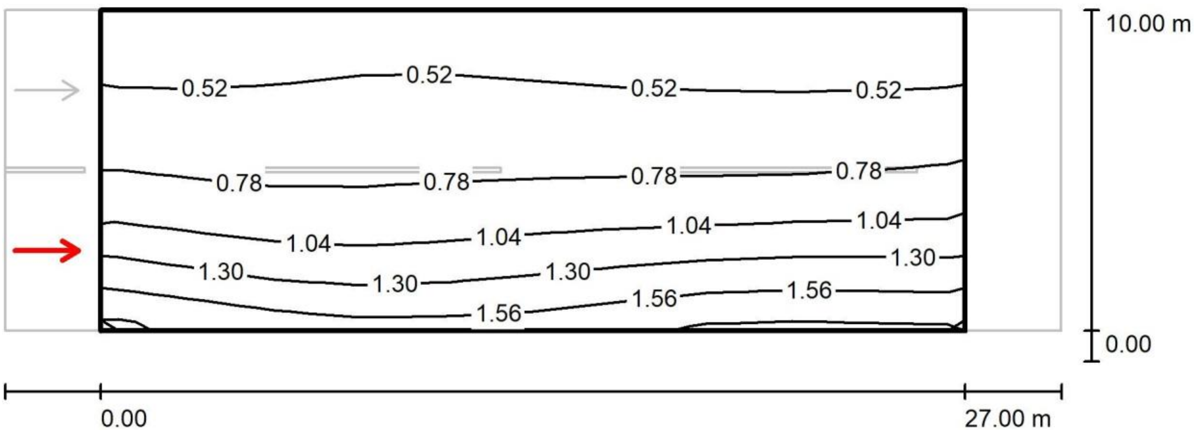
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



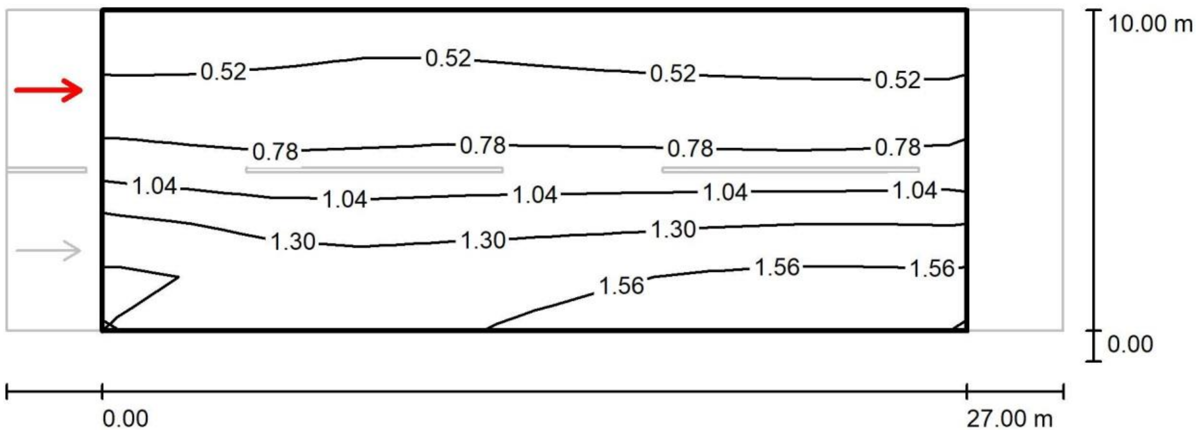
Values in Candela/m², Scale 1 : 236

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

L_{av} [cd/m²]	U0	Ul	L_v [cd/m²]	TI [%]
0.86	0.43	0.83	0.09	11

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 236

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

L_{av} [cd/m²]	U0	Ul	L_v [cd/m²]	TI [%]
0.97	0.40	0.87	0.04	6

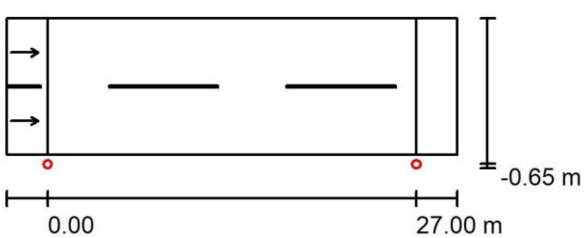
Street 1 / Planning data

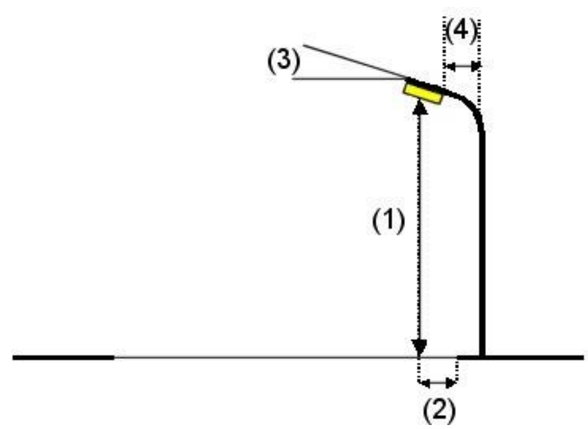
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Operator
Telephone

Fax

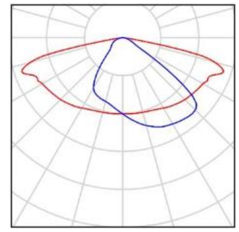
Luminaire:	PHILIPS BGP531 T25 1 xLED120-4S/830 DM10		
Luminous flux (Luminaire):	10080 lm	Maximum luminous intensities	
Luminous flux (Lamps):	12000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	89.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	27.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

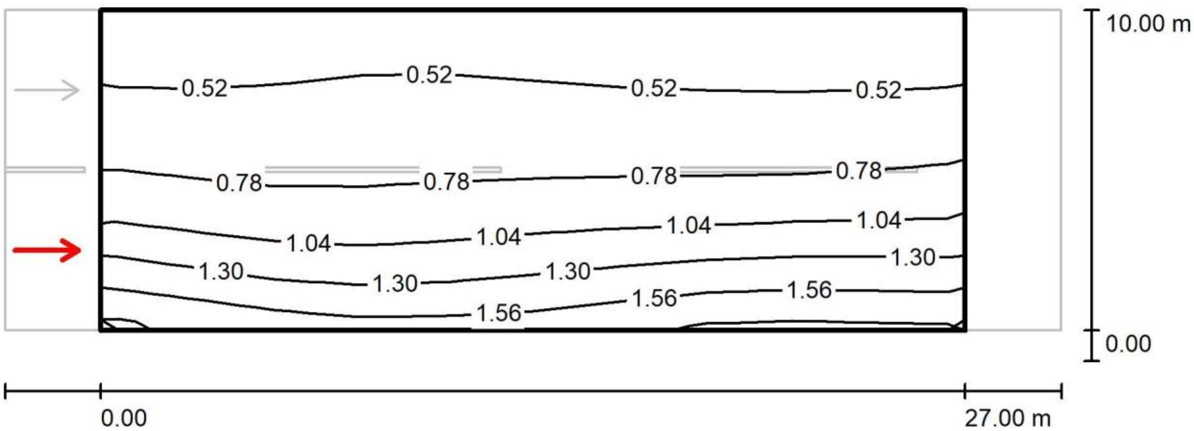
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines



Values in Candela/m², Scale 1 : 236

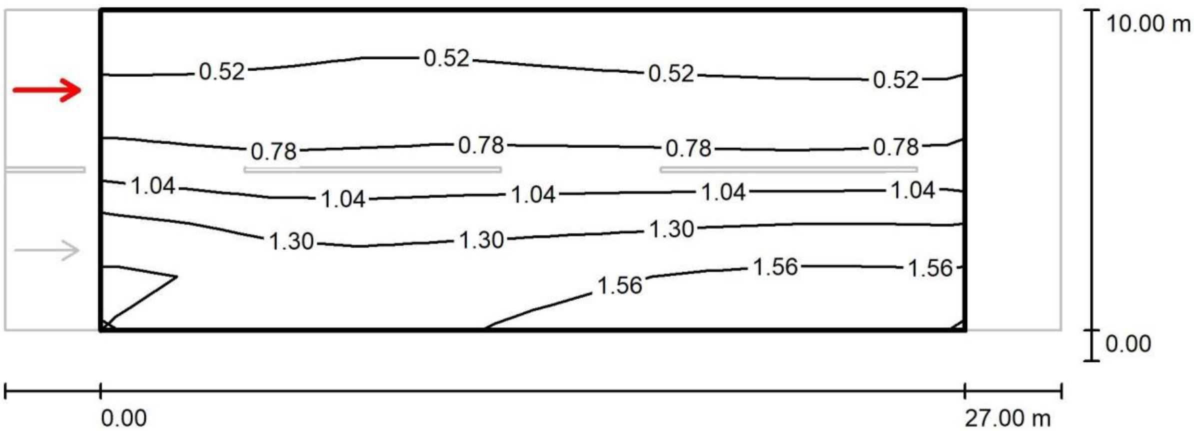
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.86	0.43	0.83	11
Required values according to class ME4b:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 236

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.97	0.40	0.87	6
Required values according to class ME4b:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

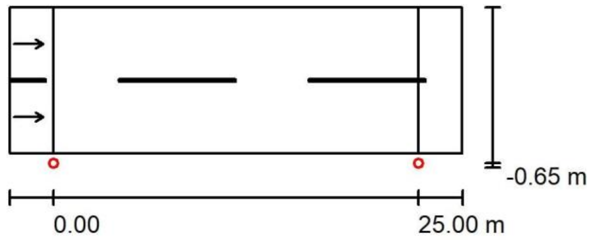
Street Profile

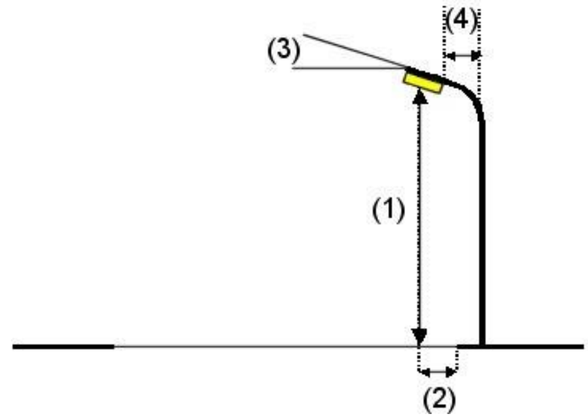
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





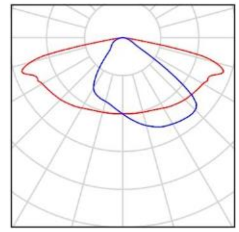
Luminaire:	PHILIPS BGP531 T25 1 xLED120-4S/830 DM10		
Luminous flux (Luminaire):	10080 lm	Maximum luminous intensities	
Luminous flux (Lamps):	12000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	89.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

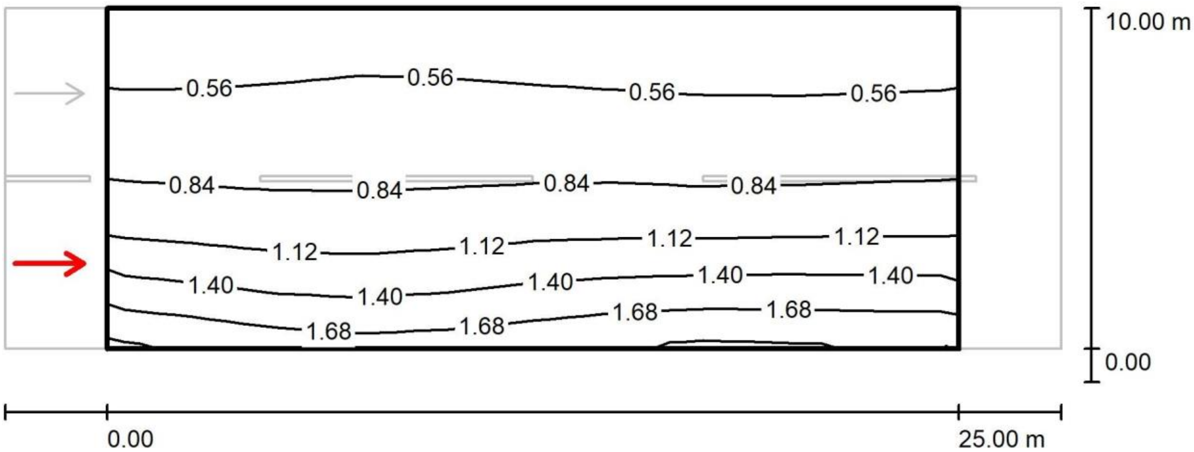
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



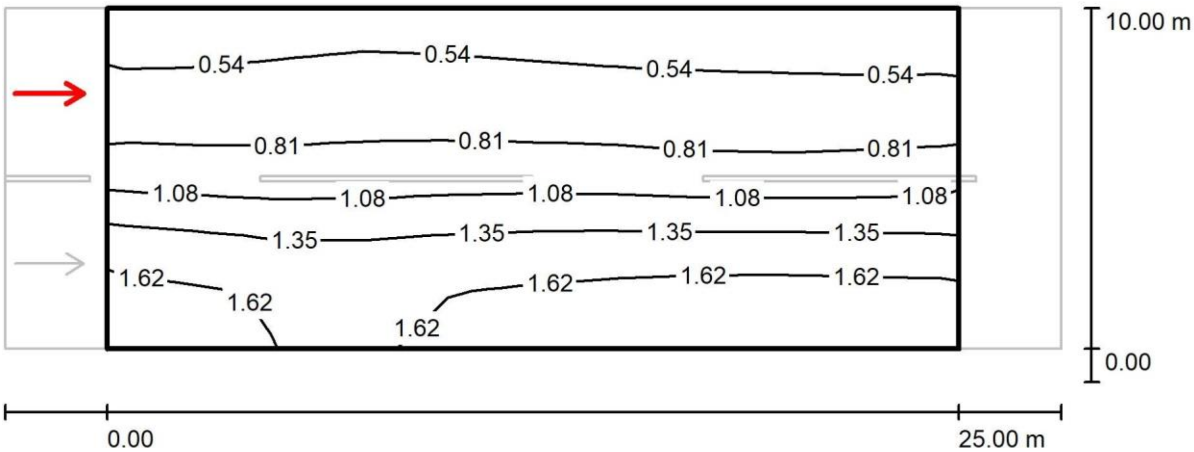
Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.93	0.44	0.86	11
Required values according to class SANS_A2c:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.05	0.41	0.88	6
Required values according to class SANS_A2c:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

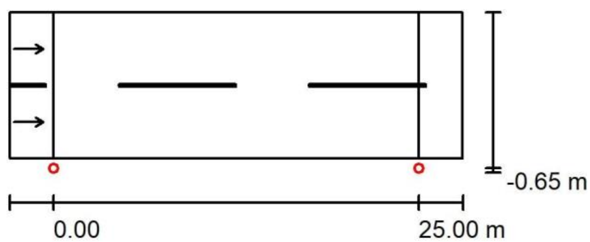
Street Profile

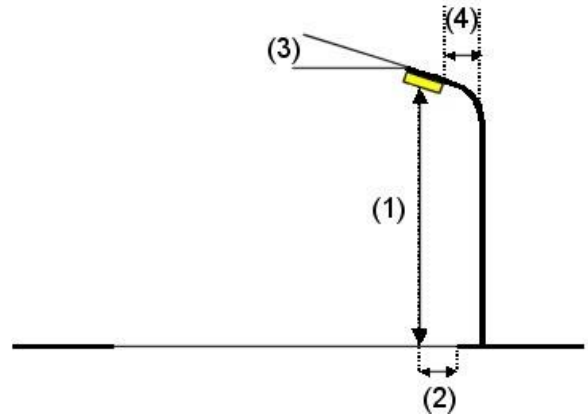
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





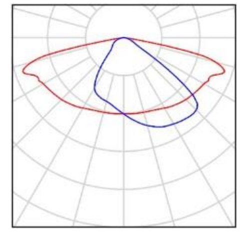
Luminaire:	PHILIPS BGP531 T25 1 xLED120-4S/830 DM10		
Luminous flux (Luminaire):	10080 lm	Maximum luminous intensities	
Luminous flux (Lamps):	12000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	89.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

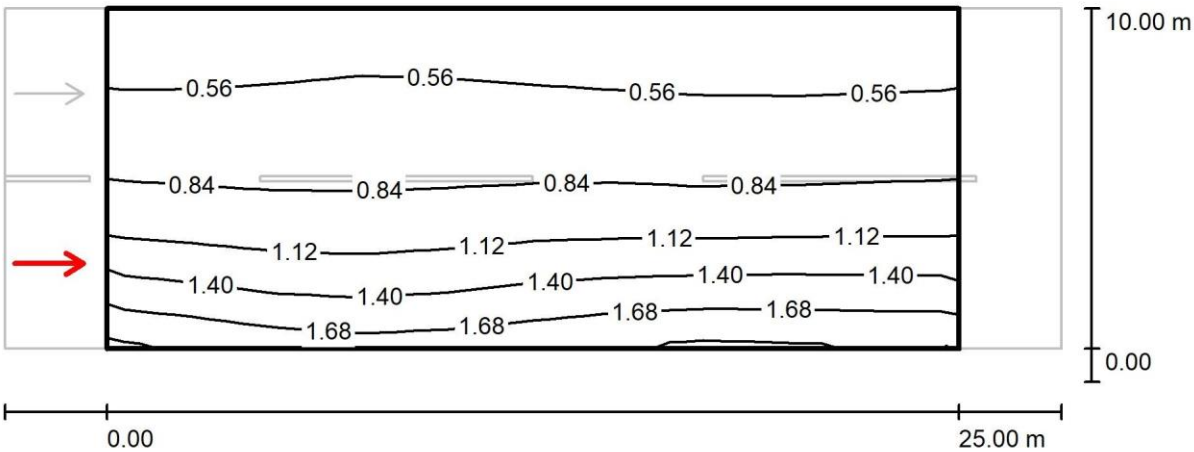
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



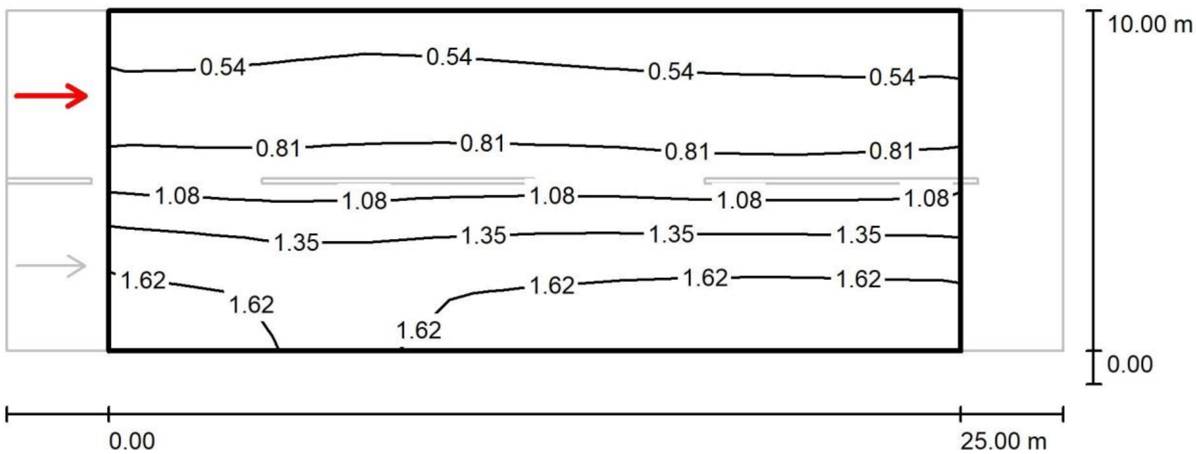
Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.93	0.44	0.86	11
Required values according to class SANS_A2c:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.05	0.41	0.88	6
Required values according to class SANS_A2c:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

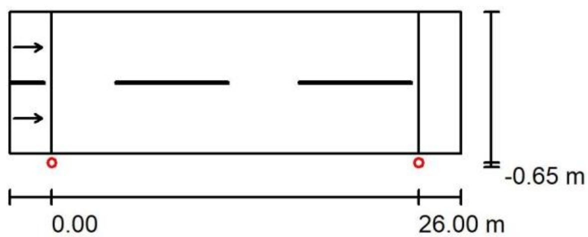
Street Profile

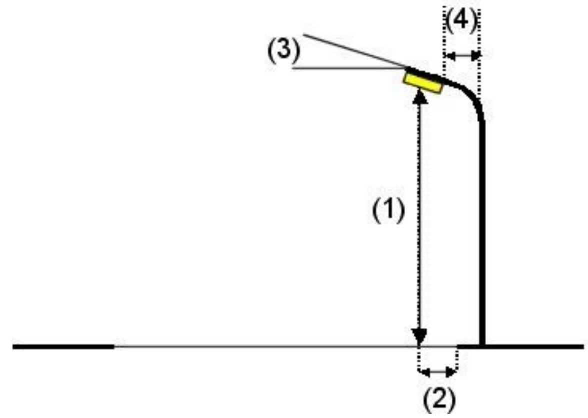
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





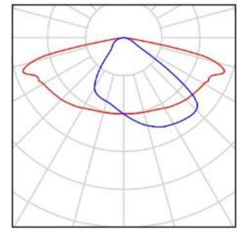
Luminaire:	PHILIPS BGP531 T25 1 xLED120-4S/830 DM10		
Luminous flux (Luminaire):	10080 lm	Maximum luminous intensities	
Luminous flux (Lamps):	12000 lm	at 70°:	487 cd/klm
Luminaire Wattage:	89.0 W	at 80°:	85 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	26.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED120-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 10080 lm
Luminous flux (Lamps): 12000 lm
Luminaire Wattage: 89.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 84
Fitting: 1 x LED120-4S/830 (Correction Factor 1.000).

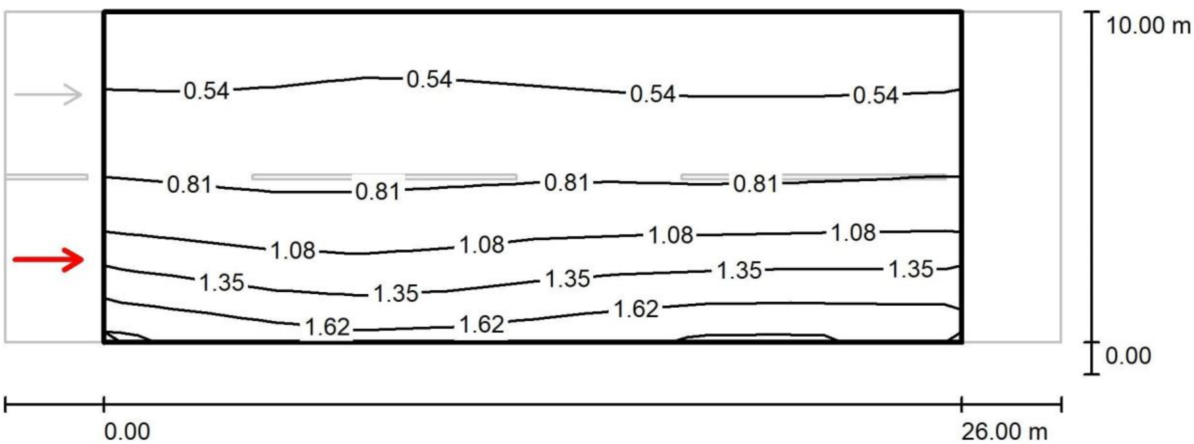
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



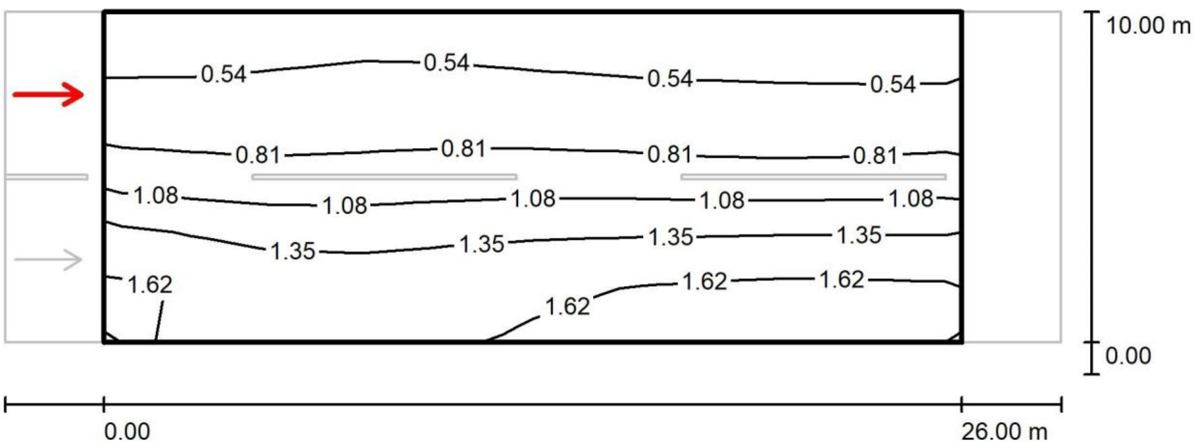
Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.89	0.44	0.85	11
Required values according to class SANS_A3f:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.01	0.40	0.86	6
Required values according to class SANS_A3f:	≥ 0.50	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

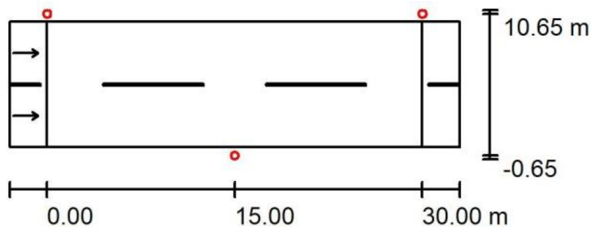
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

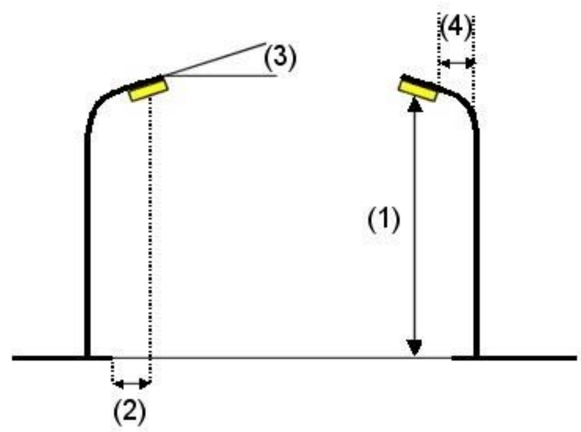
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





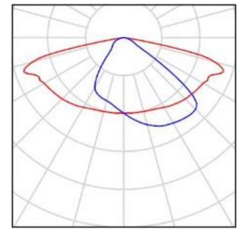
Luminaire:	PHILIPS BGP531 T25 1 xLED165-4S/740 DM10		
Luminous flux (Luminaire):	13695 lm	Maximum luminous intensities	
Luminous flux (Lamps):	16500 lm	at 70°:	482 cd/klm
Luminaire Wattage:	100.0 W	at 80°:	84 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	30.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.5.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED165-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 13695 lm
Luminous flux (Lamps): 16500 lm
Luminaire Wattage: 100.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED165-4S/740 (Correction Factor 1.000).

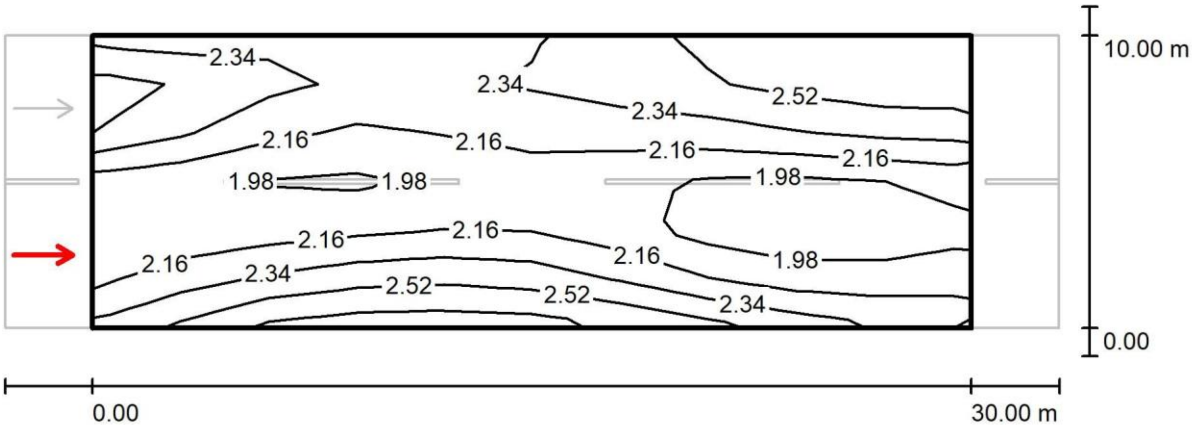
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 16 / Isolines

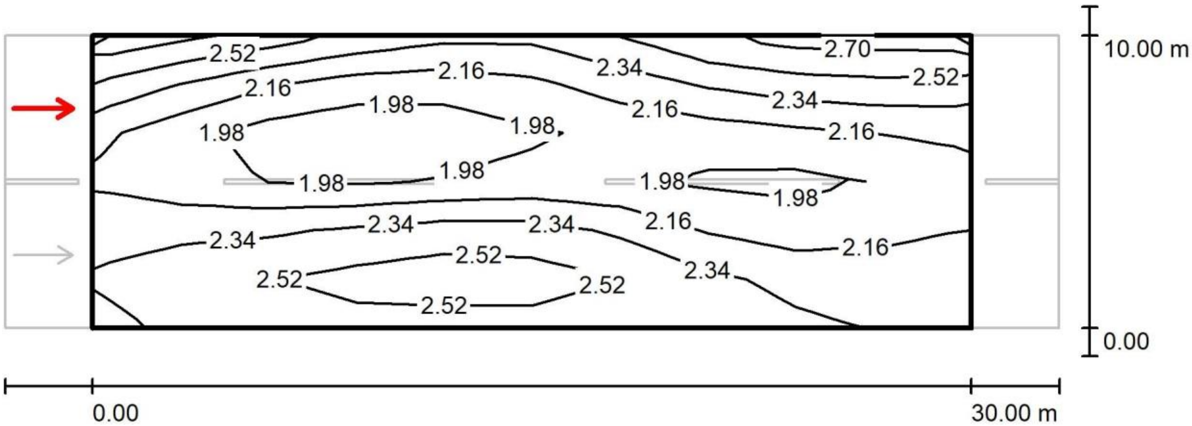


Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.24	0.81	0.80	8
Required values according to class ME1:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 10
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Valuation Field Roadway 1 / Observer 17 / Isolines



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.24	0.81	0.80	8
Required values according to class ME1:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 10
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

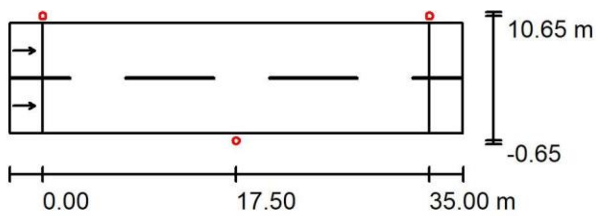
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

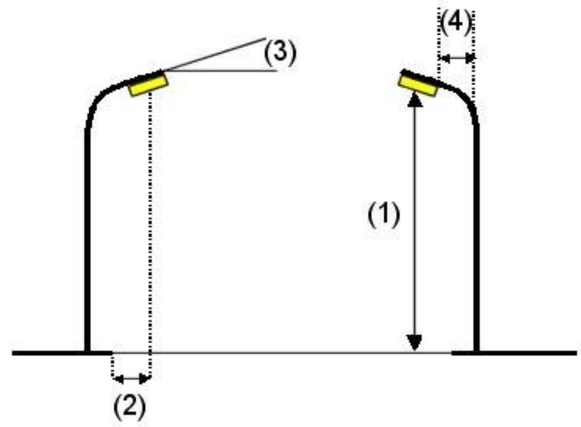
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





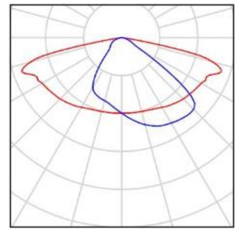
Luminaire:	PHILIPS BGP531 T25 1 xLED165-4S/740 DM10		
Luminous flux (Luminaire):	13695 lm	Maximum luminous intensities	
Luminous flux (Lamps):	16500 lm	at 70°:	482 cd/klm
Luminaire Wattage:	100.0 W	at 80°:	84 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	35.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.5.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

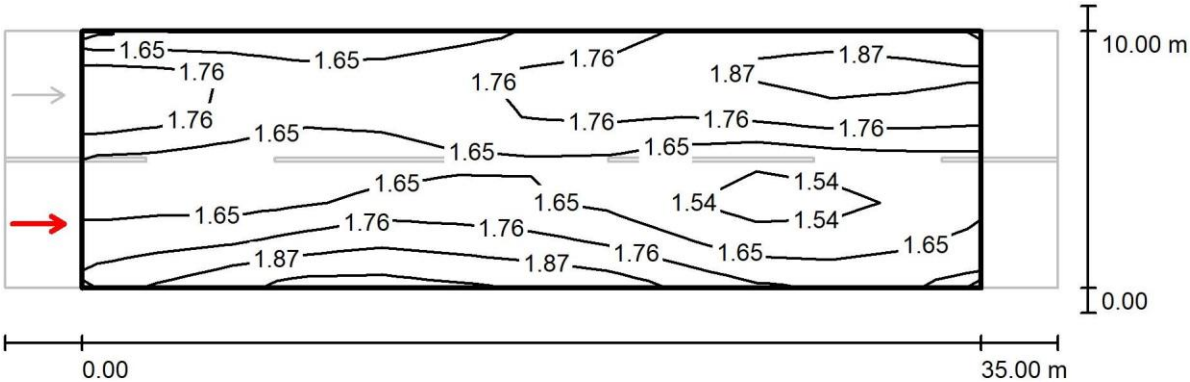
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED165-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 13695 lm
Luminous flux (Lamps): 16500 lm
Luminaire Wattage: 100.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED165-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines

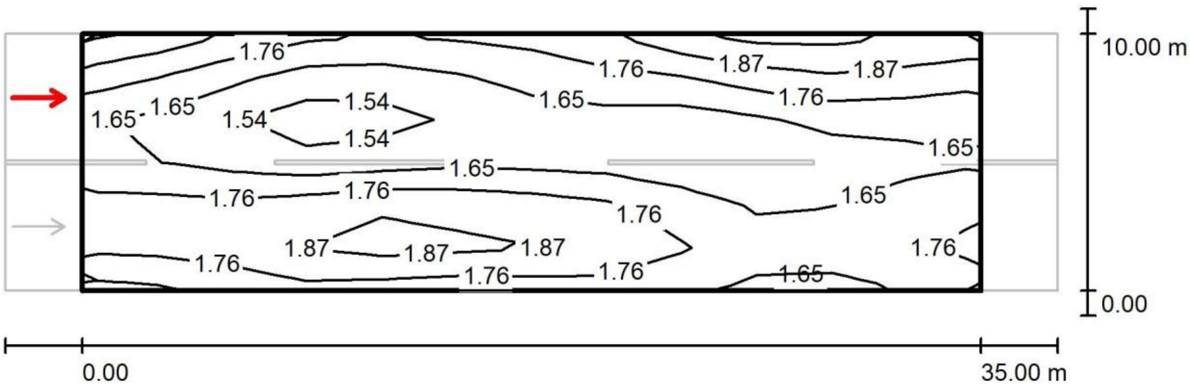


Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.71	0.85	0.84	7
Required values according to class SANS_A2d:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 294

Grid: 12 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.71	0.84	0.84	7
Required values according to class SANS_A2d:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

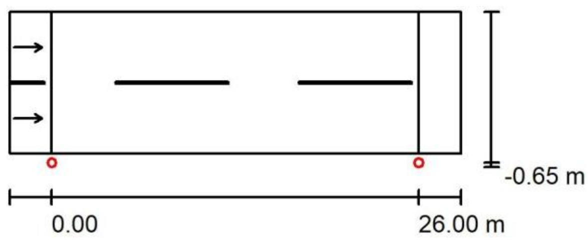
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

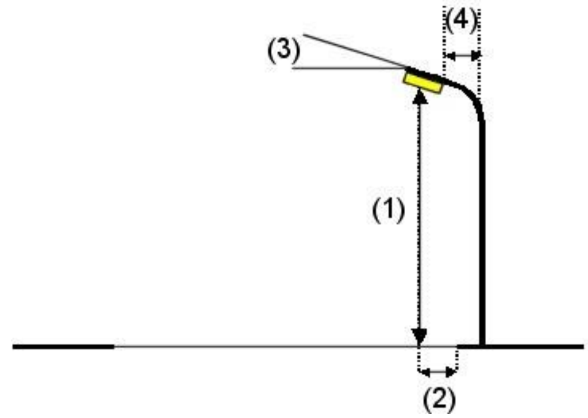
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax



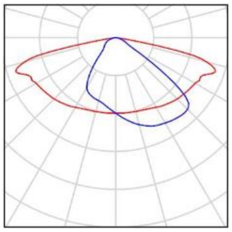


Luminaire:	PHILIPS BGP531 T25 1 xLED165-4S/740 DM10		
Luminous flux (Luminaire):	13695 lm	Maximum luminous intensities	
Luminous flux (Lamps):	16500 lm	at 70°:	482 cd/klm
Luminaire Wattage:	100.0 W	at 80°:	84 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	26.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.5.	
Boom Length (4):	0.000 m		

Street 1 / Luminaire parts list

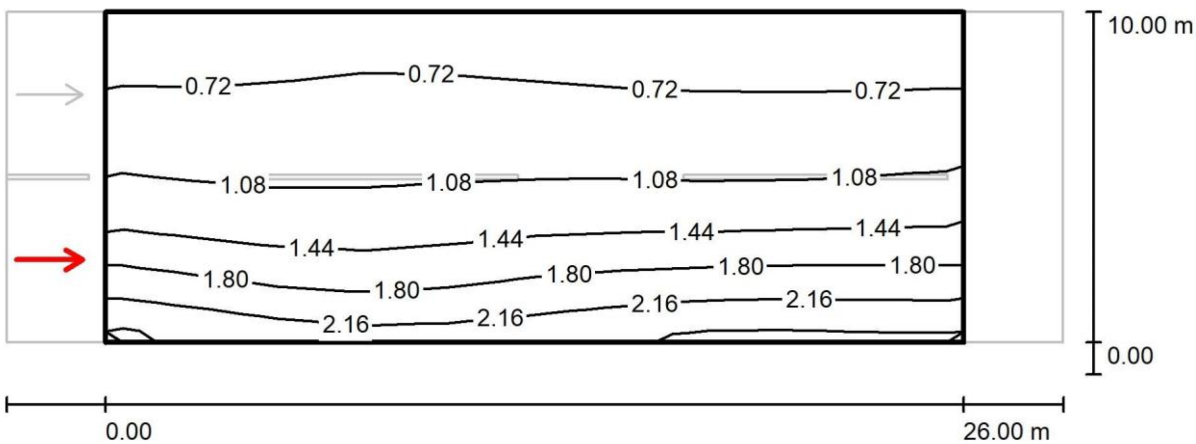
PHILIPS BGP531 T25 1 xLED165-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 13695 lm
Luminous flux (Lamps): 16500 lm
Luminaire Wattage: 100.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED165-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



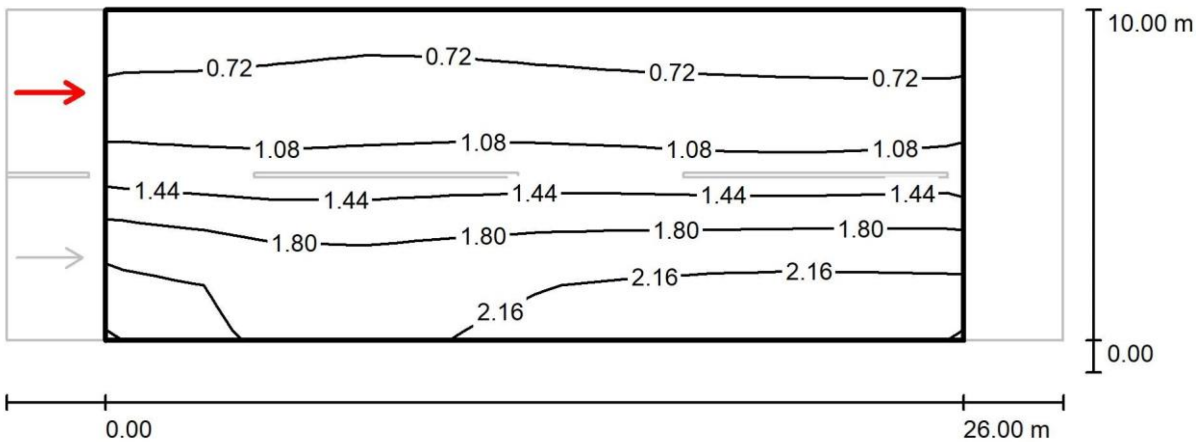
Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.21	0.44	0.85	12
Required values according to class SANS_A3e:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.37	0.40	0.86	7
Required values according to class SANS_A3e:	≥ 0.80	≥ 0.40	≥ 0.50	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

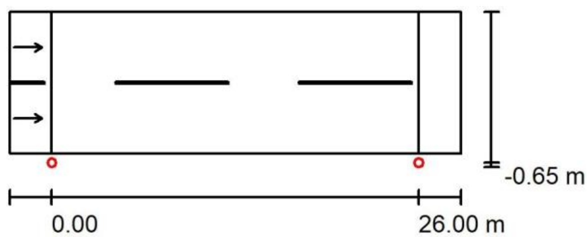
Street 1 / Planning data

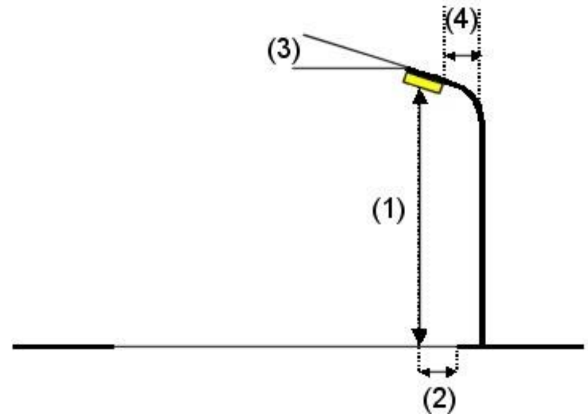
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Luminaire:	PHILIPS BGP531 T25 1 xLED175-4S/740 DM10
Luminous flux (Luminaire):	14525 lm
Luminous flux (Lamps):	17500 lm
Luminaire Wattage:	108.0 W
Arrangement:	Single row, bottom
Pole Distance:	26.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	482 cd/klm
at 80°:	84 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

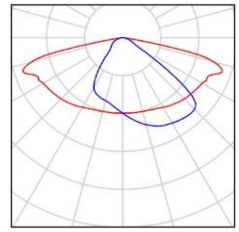
No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.5.

Operator
Telephone
Fax

Street 1 / Luminaire parts list

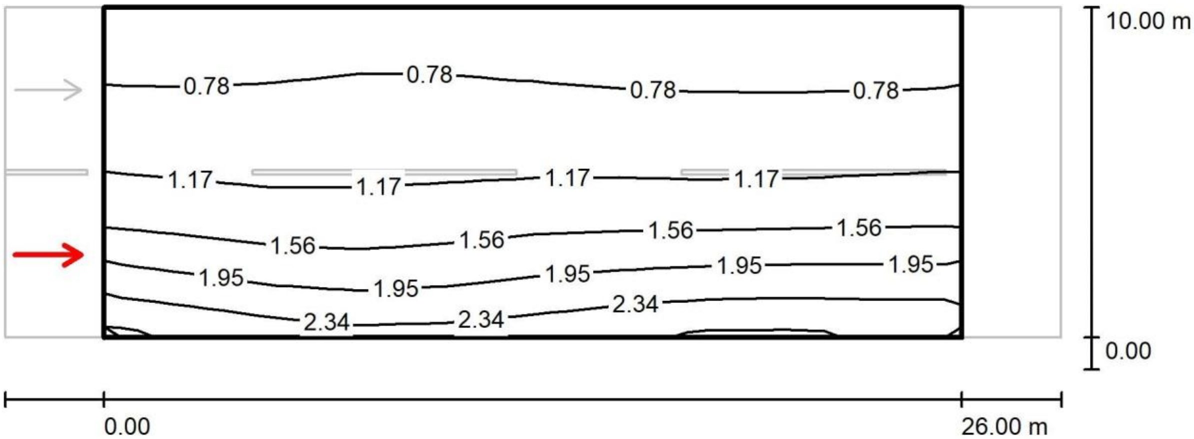
PHILIPS BGP531 T25 1 xLED175-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 14525 lm
Luminous flux (Lamps): 17500 lm
Luminaire Wattage: 108.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED175-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



Values in Candela/m², Scale 1 : 229

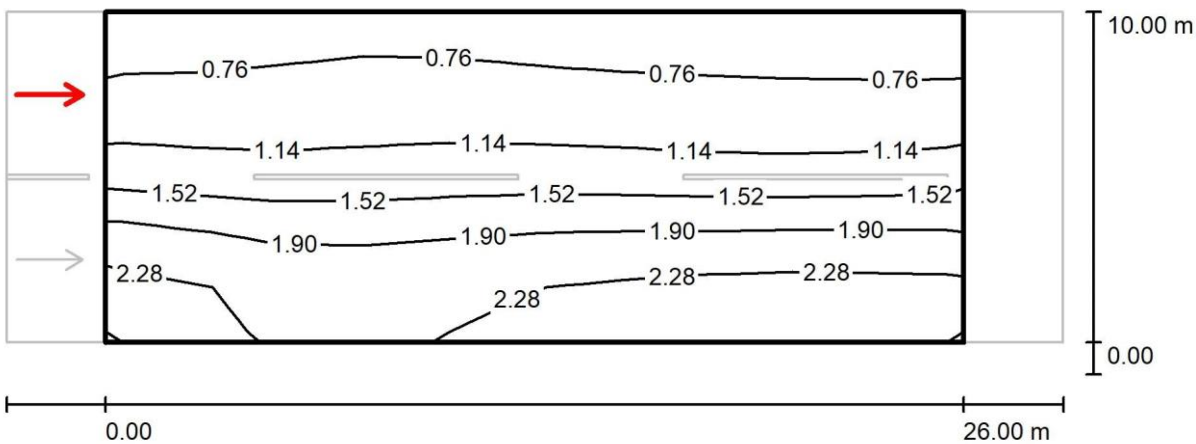
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.29	0.44	0.85	12
Required values according to class SANS_A2e:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.46	0.40	0.86	7
Required values according to class SANS_A2e:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

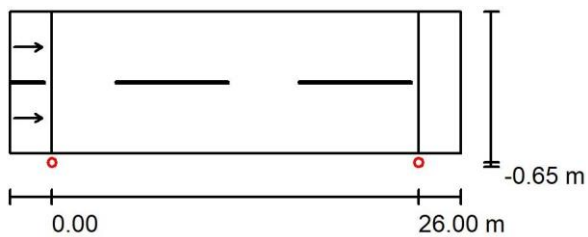
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

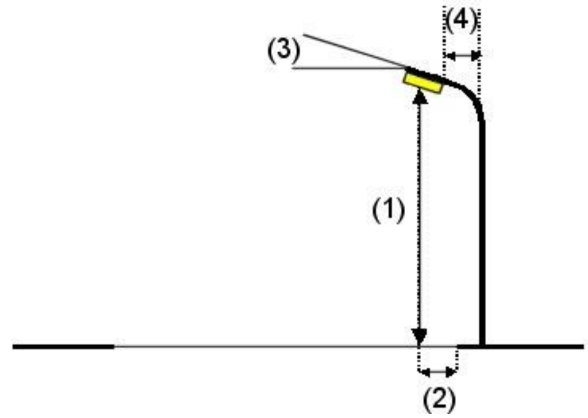
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





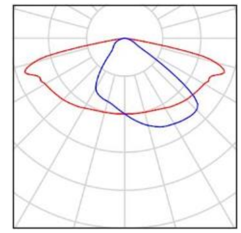
Luminaire:	PHILIPS BGP531 T25 1 xLED175-4S/740 DM10		
Luminous flux (Luminaire):	14525 lm	Maximum luminous intensities	
Luminous flux (Lamps):	17500 lm	at 70°:	482 cd/klm
Luminaire Wattage:	108.0 W	at 80°:	84 cd/klm
Arrangement:	Single row, bottom	at 90°:	0.00 cd/klm
Pole Distance:	26.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.5.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

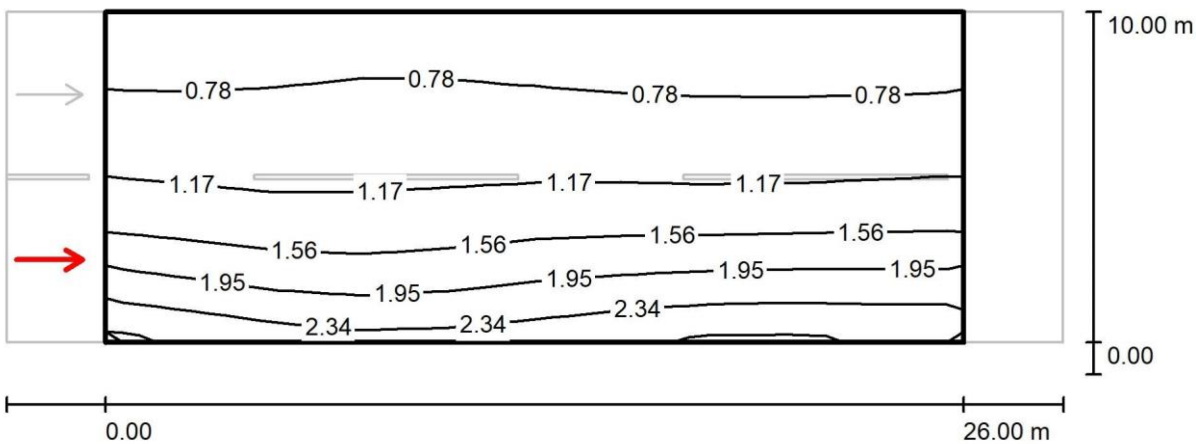
PHILIPS BGP531 T25 1 xLED175-4S/740 DM10
Article No.:
Luminous flux (Luminaire): 14525 lm
Luminous flux (Lamps): 17500 lm
Luminaire Wattage: 108.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED175-4S/740 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



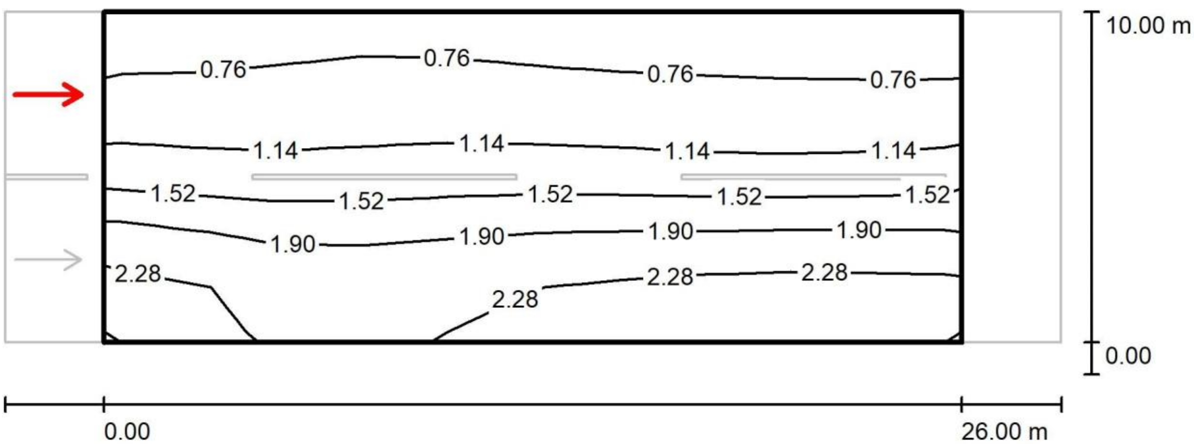
Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.29	0.44	0.85	12
Required values according to class SANS_A3d:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 229

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.46	0.40	0.86	7
Required values according to class SANS_A3d:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

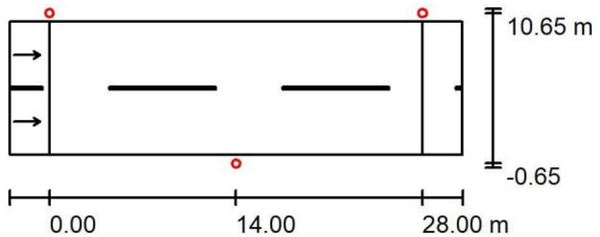
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

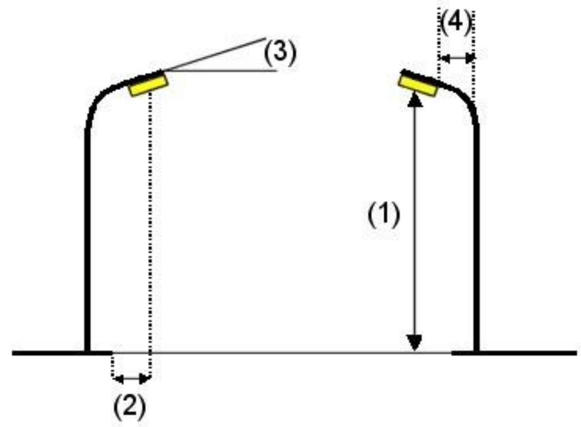
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED150-4S/830 DM10
Luminous flux (Luminaire):	12450 lm
Luminous flux (Lamps):	15000 lm
Luminaire Wattage:	116.0 W
Arrangement:	Double row, with offset
Pole Distance:	28.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	482 cd/klm
at 80°:	84 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

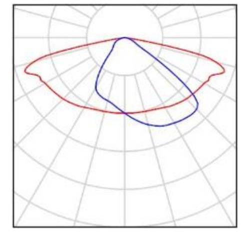
Operator
Telephone

Fax

Street 1 / Luminaire parts list

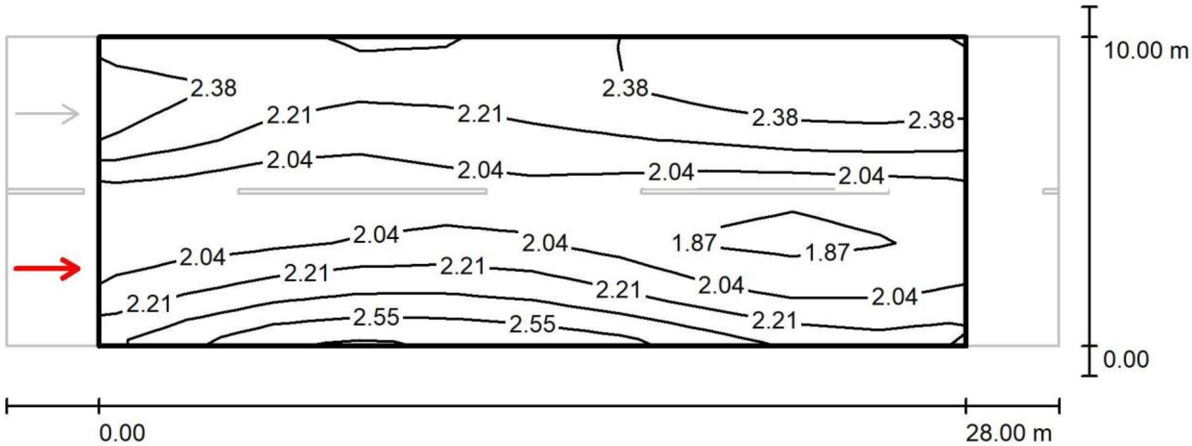
PHILIPS BGP531 T25 1 xLED150-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 12450 lm
Luminous flux (Lamps): 15000 lm
Luminaire Wattage: 116.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED150-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 9 / Isolines (L)

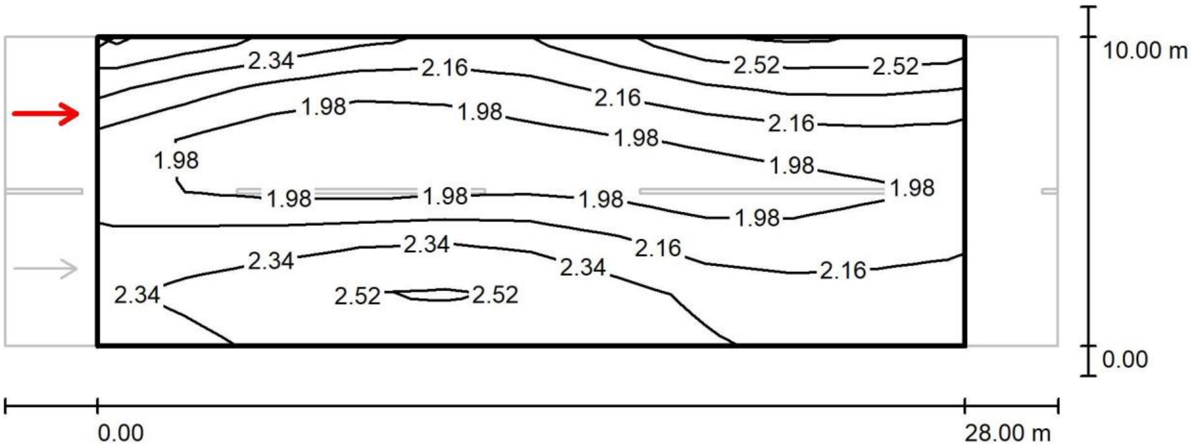


Values in Candela/m², Scale 1 : 244

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.18	0.81	0.83	8
Required values according to class SANS_A1a:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Valuation Field Roadway 1 / Observer 10 / Isolines



Values in Candela/m², Scale 1 : 244

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.18	0.81	0.83	8
Required values according to class SANS_A1a:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

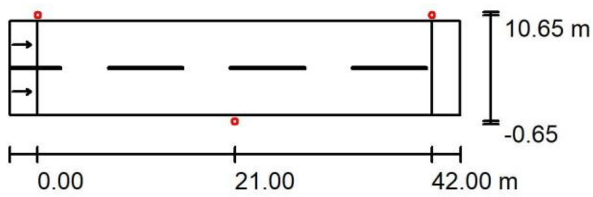
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

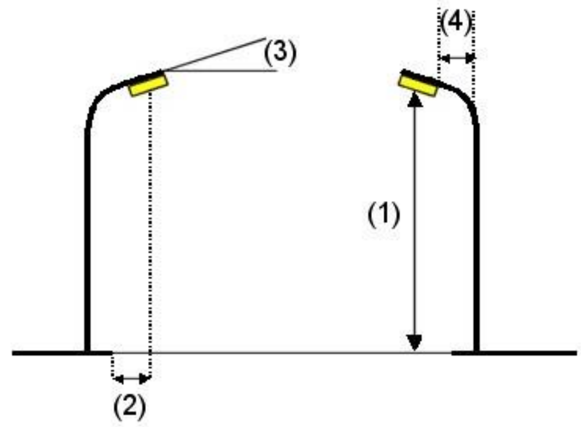
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED150-4S/830 DM10		
Luminous flux (Luminaire):	12450 lm	Maximum luminous intensities	
Luminous flux (Lamps):	15000 lm	at 70°:	482 cd/klm
Luminaire Wattage:	116.0 W	at 80°:	84 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	42.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

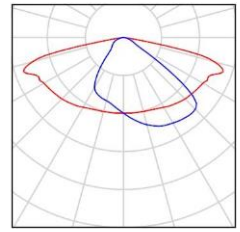
Operator
Telephone

Fax

Street 1 / Luminaire parts list

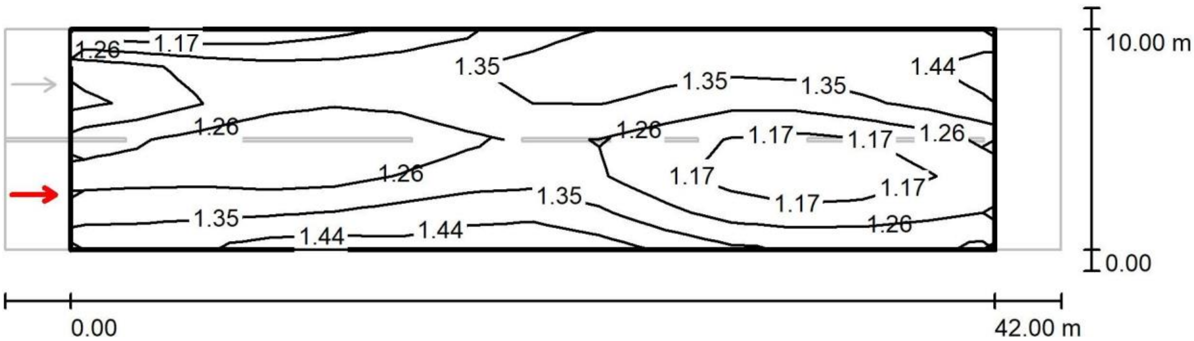
PHILIPS BGP531 T25 1 xLED150-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 12450 lm
Luminous flux (Lamps): 15000 lm
Luminaire Wattage: 116.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED150-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 9 / Isolines (L)



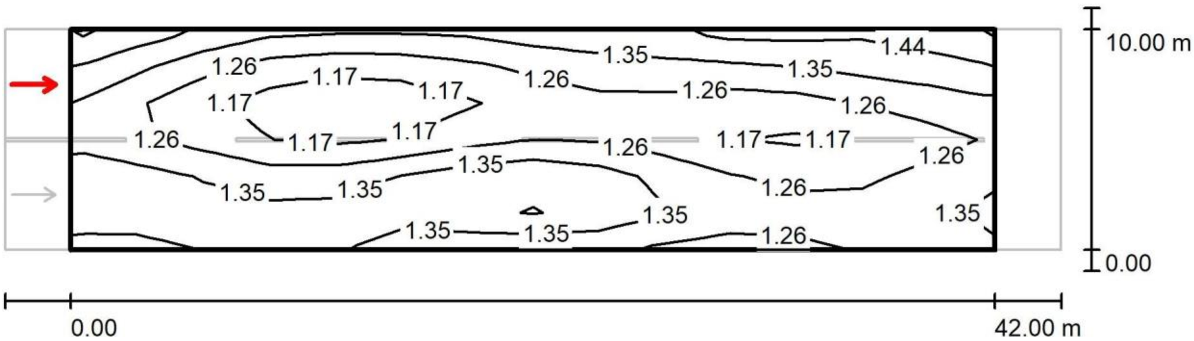
Values in Candela/m², Scale 1 : 344

Grid: 14 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.30	0.83	0.80	7
Required values according to class SANS_A2e:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 10 / Isolines



Values in Candela/m², Scale 1 : 344

Grid: 14 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.30	0.82	0.80	7
Required values according to class SANS_A2e:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

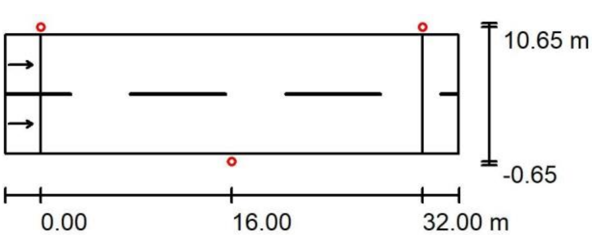
Street 1 / Planning data

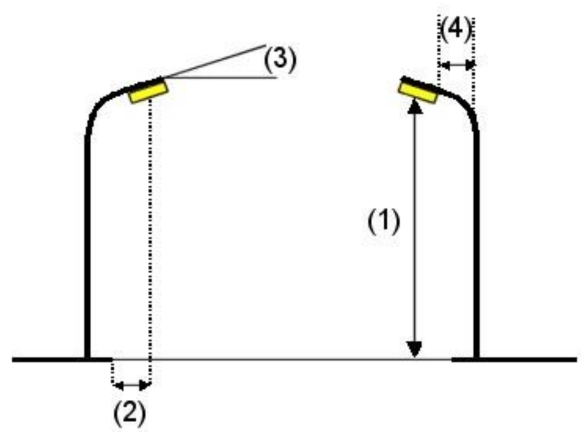
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Operator
Telephone

Fax

Luminaire:	PHILIPS BGP531 T25 1 xLED150-4S/830 DM10		
Luminous flux (Luminaire):	12450 lm	Maximum luminous intensities	
Luminous flux (Lamps):	15000 lm	at 70°:	482 cd/klm
Luminaire Wattage:	116.0 W	at 80°:	84 cd/klm
Arrangement:	Double row, with offset	at 90°:	0.00 cd/klm
Pole Distance:	32.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

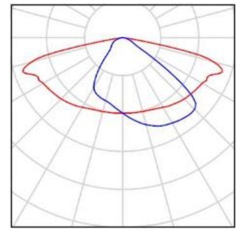
Operator
Telephone

Fax

Street 1 / Luminaire parts list

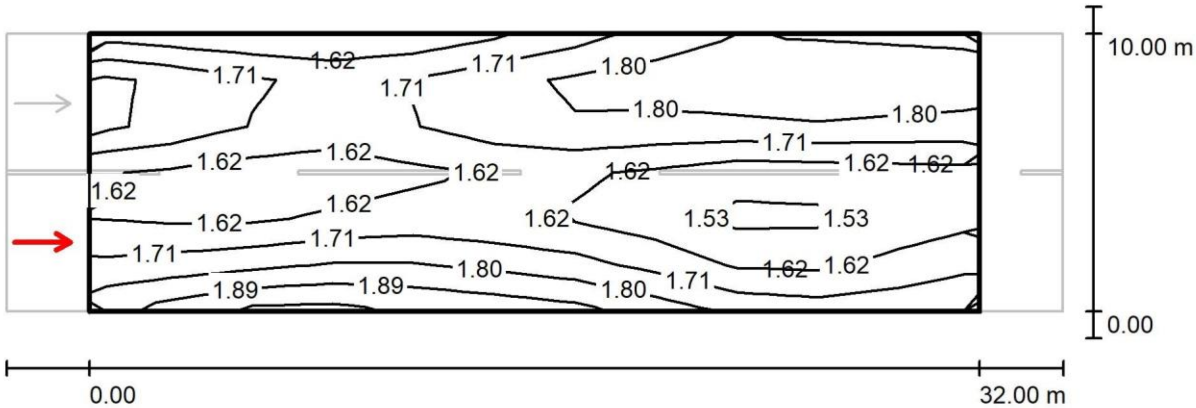
PHILIPS BGP531 T25 1 xLED150-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 12450 lm
Luminous flux (Lamps): 15000 lm
Luminaire Wattage: 116.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED150-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 9 / Isolines (L)



Values in Candela/m², Scale 1 : 272

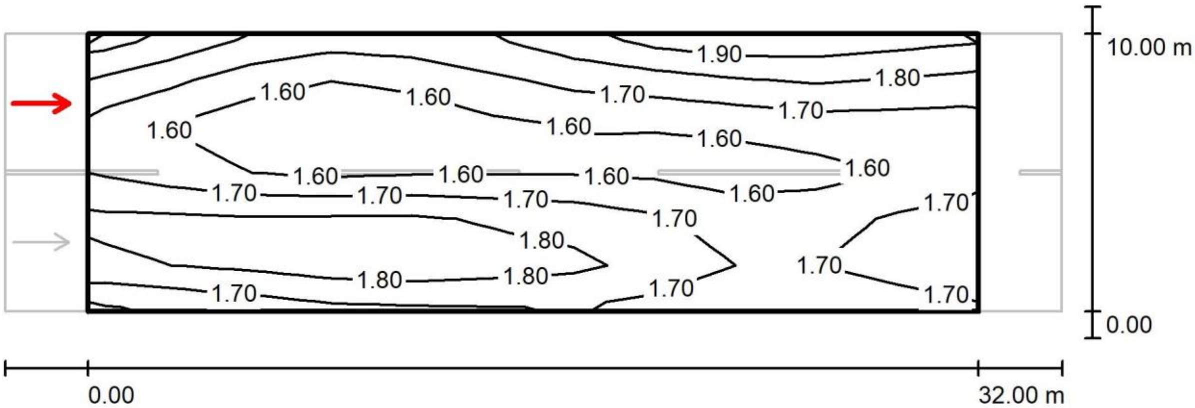
Grid: 11 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.70	0.87	0.86	7
Required values according to class SANS_A1e:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 10 / Isolines



Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	1.70	0.87	0.88	7
Required values according to class SANS_A1e:	≥ 1.50	≥ 0.40	≥ 0.70	≤ 20
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

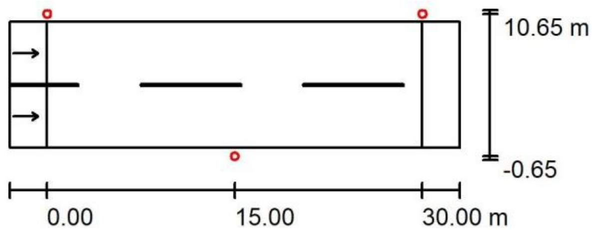
Street Profile

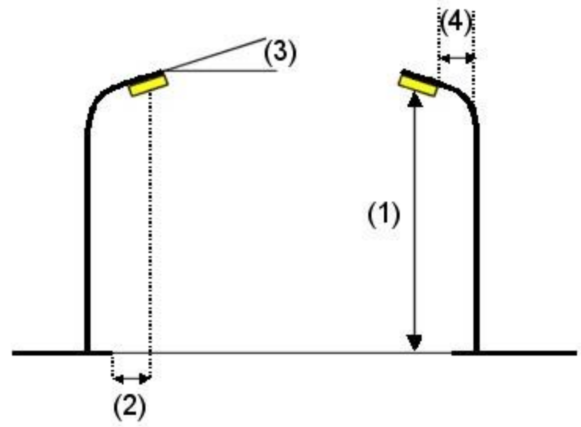
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED170-4S/830 DM10
Luminous flux (Luminaire):	13940 lm
Luminous flux (Lamps):	17000 lm
Luminaire Wattage:	126.0 W
Arrangement:	Double row, with offset
Pole Distance:	30.000 m
Mounting Height (1):	10.000 m
Height:	9.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	477 cd/klm
at 80°:	83 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.5.

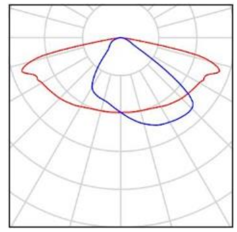
Operator
Telephone

Fax

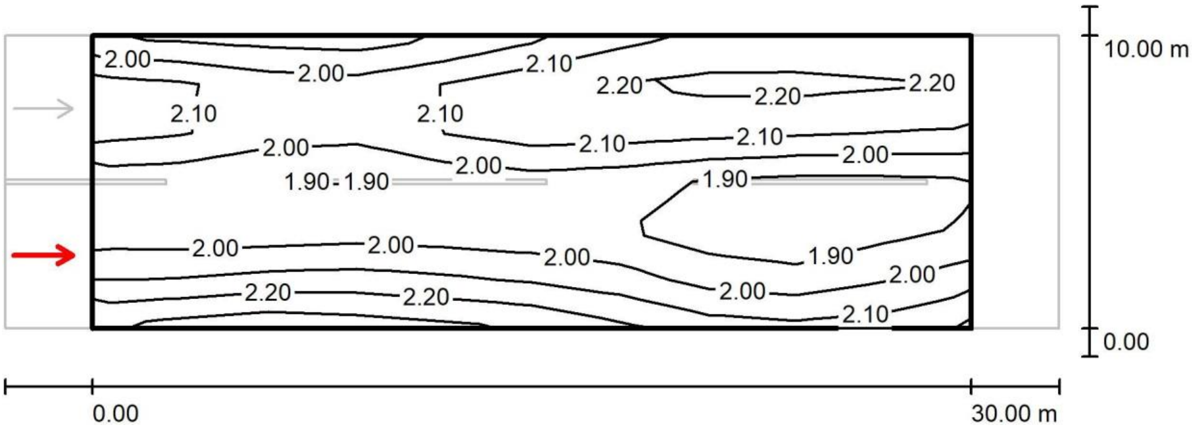
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED170-4S/830 DM10
Article No.:
Luminous flux (Luminaire): 13940 lm
Luminous flux (Lamps): 17000 lm
Luminaire Wattage: 126.0 W
Luminaire classification according to CIE: 100
CIE flux code: 39 73 96 100 83
Fitting: 1 x LED170-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 18 / Isolines



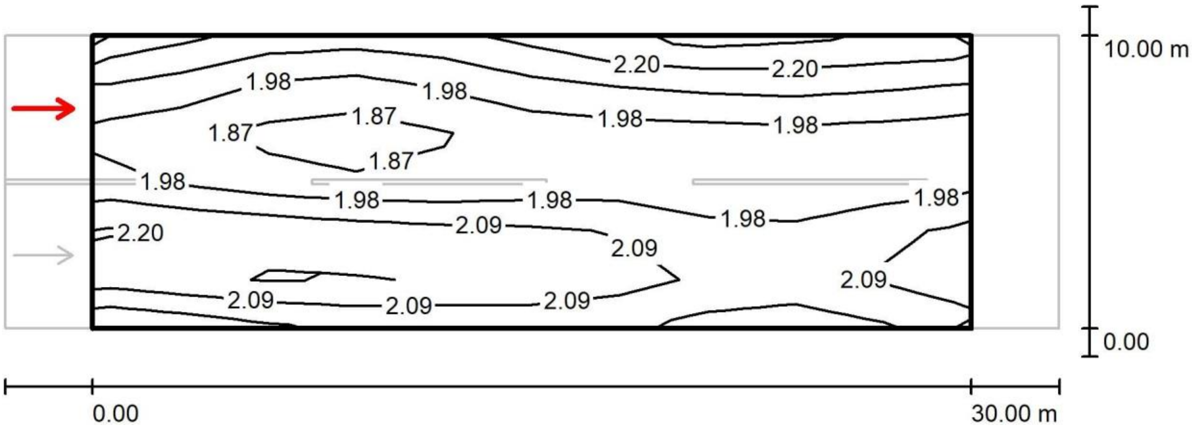
Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.04	0.87	0.89	7
Required values according to class SANS_A1d:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 19 / Isolines



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	2.04	0.87	0.89	7
Required values according to class SANS_A1d:	≥ 2.00	≥ 0.40	≥ 0.70	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

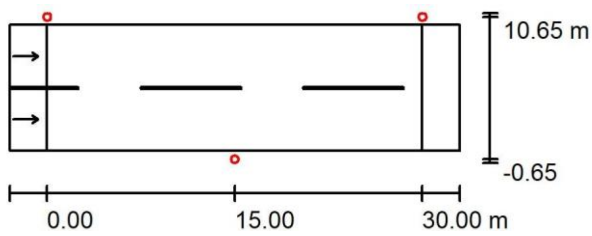
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

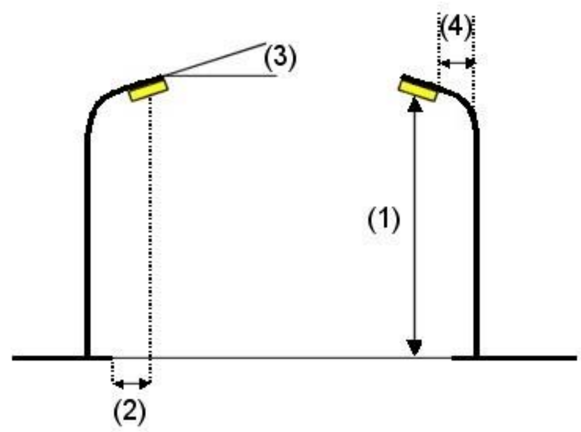
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51		
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities	
Luminous flux (Lamps):	20000 lm	at 70°:	422 cd/klm
Luminaire Wattage:	152.0 W	at 80°:	25 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):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

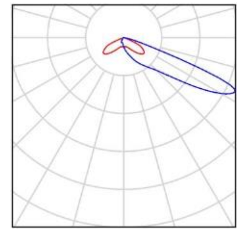
Operator
Telephone

Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

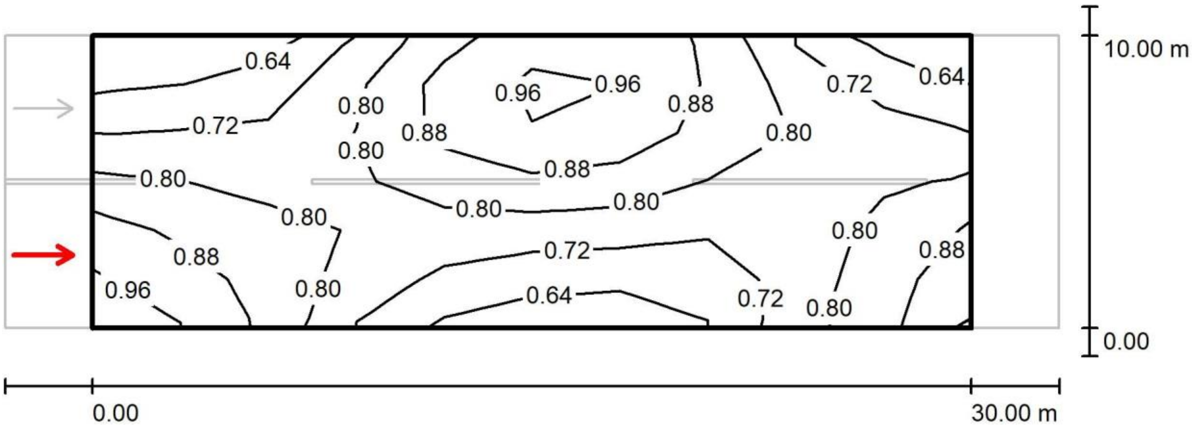
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



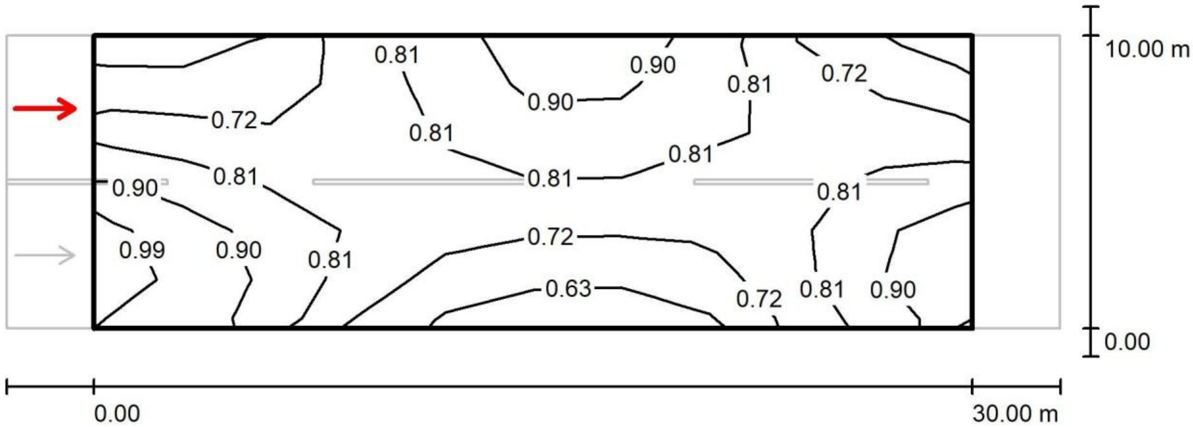
Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.79	0.74	0.75	1
Required values according to class ME4b:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.79	0.75	0.75	1
Required values according to class ME4b:	≥ 0.75	≥ 0.40	≥ 0.50	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

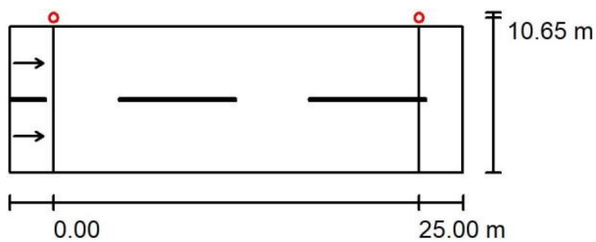
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

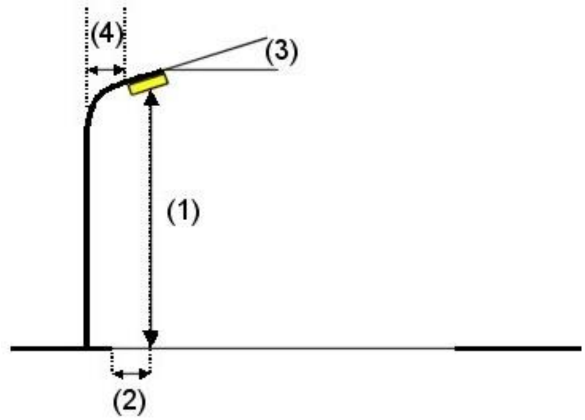
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51		
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities	
Luminous flux (Lamps):	20000 lm	at 70°:	422 cd/klm
Luminaire Wattage:	152.0 W	at 80°:	25 cd/klm
Arrangement:	Single row, top	at 90°:	0.00 cd/klm
Pole Distance:	25.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.Arrangement complies with glare index class D.6.	
Boom Angle (3):	0.0 °		
Boom Length (4):	0.000 m		

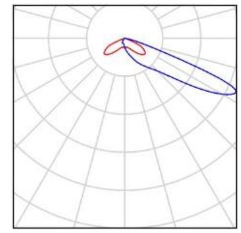
Operator
Telephone

Fax

Street 1 / Luminaire parts list

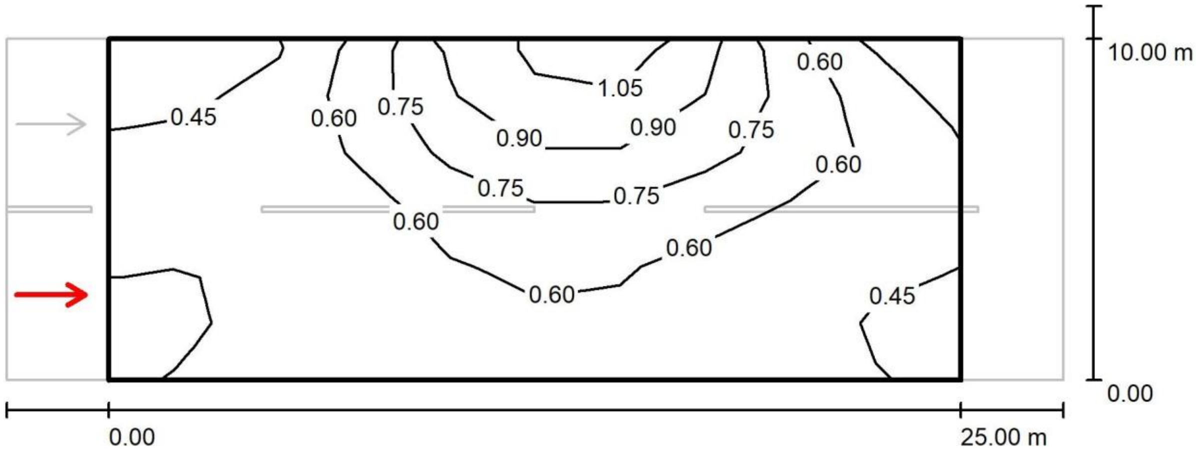
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 222

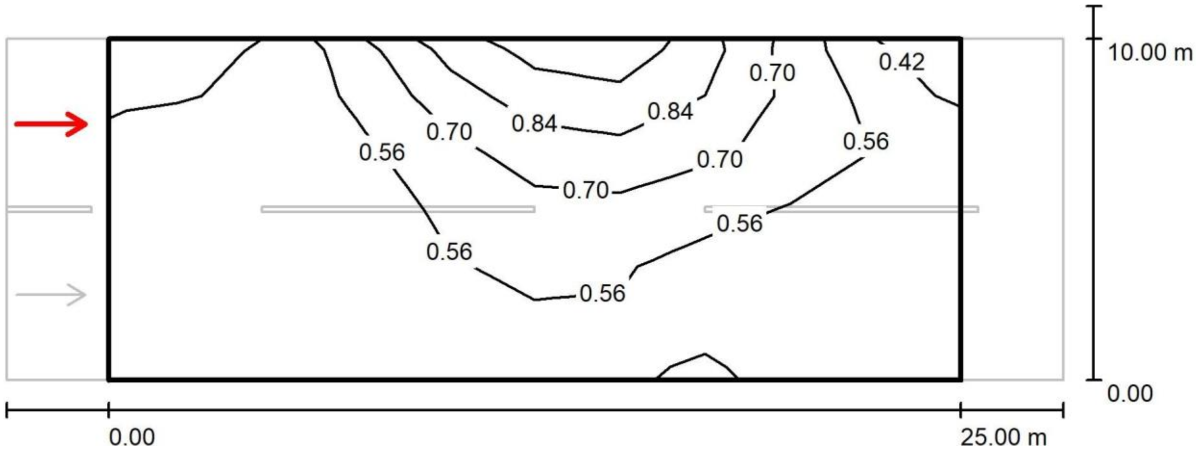
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.60	0.60	0.71	2
Required values according to class ME5:	≥ 0.50	≥ 0.35	≥ 0.40	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 222

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3,
q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.57	0.64	0.50	1
Required values according to class ME5:	≥ 0.50	≥ 0.35	≥ 0.40	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

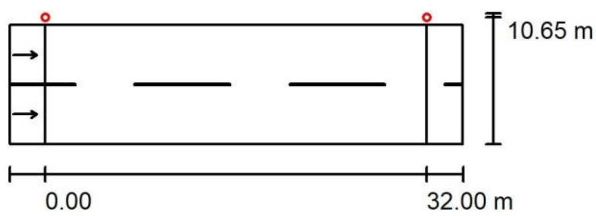
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

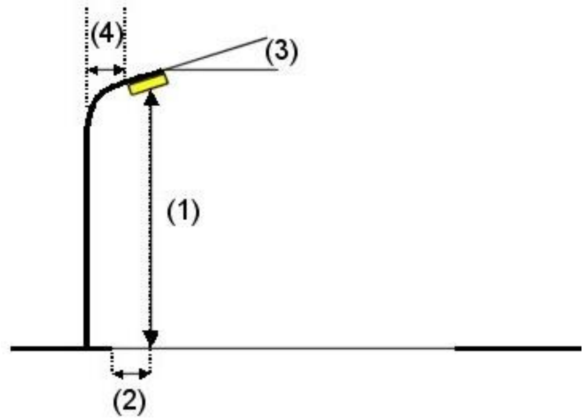
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





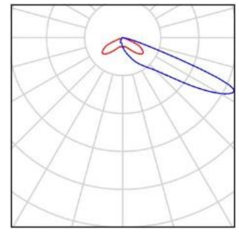
Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51		
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities	
Luminous flux (Lamps):	20000 lm	at 70°:	422 cd/klm
Luminaire Wattage:	152.0 W	at 80°:	25 cd/klm
Arrangement:	Single row, top	at 90°:	0.00 cd/klm
Pole Distance:	32.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.Arrangement complies with glare index class D.6.	
Boom Angle (3):	0.0 °		
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

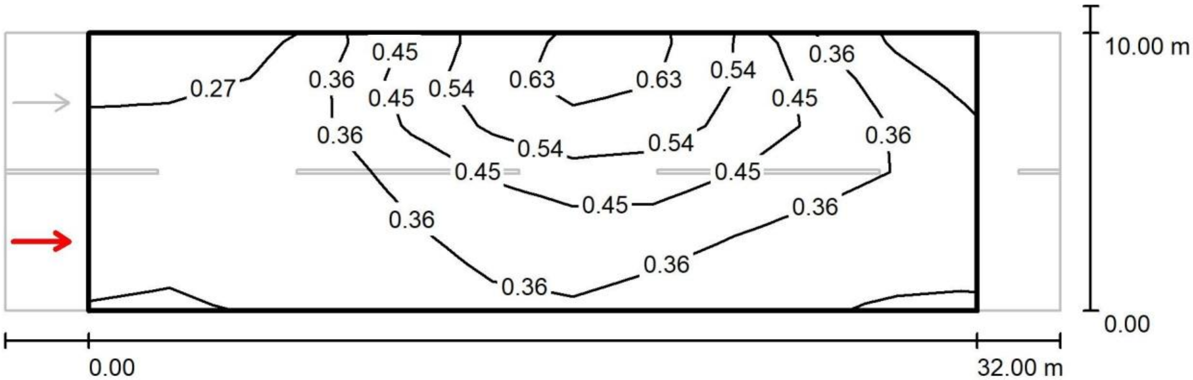
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 272

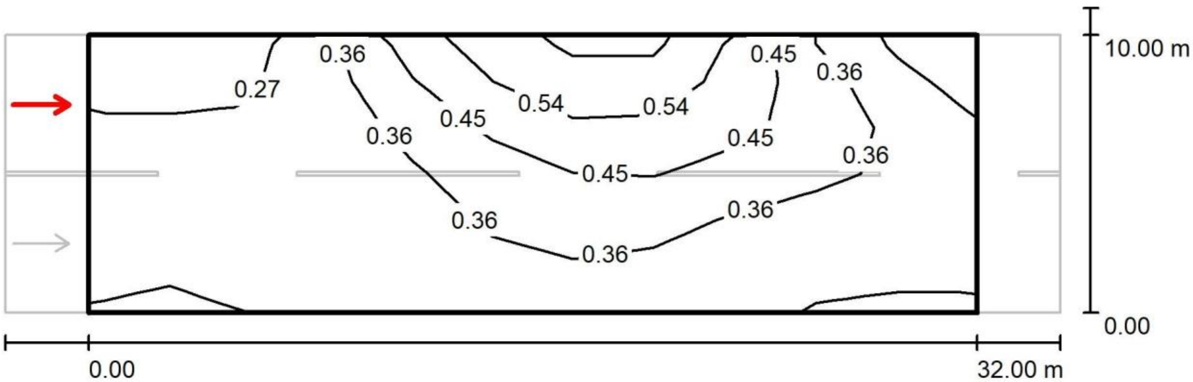
Grid: 11 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.38	0.55	0.70	2
Required values according to class ME6:	≥ 0.30	≥ 0.35	≥ 0.40	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 272

Grid: 11 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m)tarmac: R3, q0: 0.070

	L_{av} [cd/m²]	U0	Ul	TI [%]
Calculated values:	0.36	0.60	0.46	1
Required values according to class ME6:	≥ 0.30	≥ 0.35	≥ 0.40	≤ 15
Fulfilled/Not fulfilled:	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

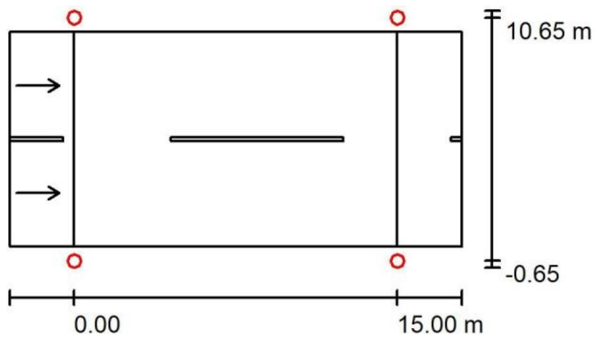
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

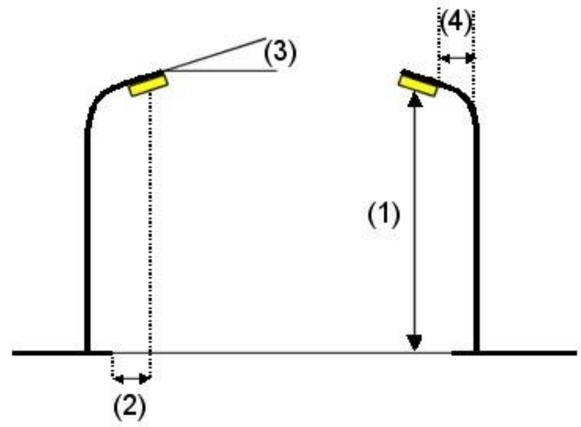
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





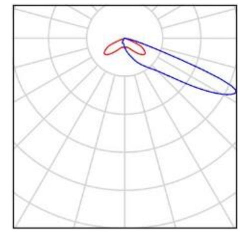
Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities
Luminous flux (Lamps):	20000 lm	at 70°: 422 cd/klm
Luminaire Wattage:	152.0 W	at 80°: 25 cd/klm
Arrangement:	Double row, opposing	at 90°: 0.00 cd/klm
Pole Distance:	15.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.
Mounting Height (1):	8.000 m	
Height:	7.900 m	No luminous intensities above 90°.
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.
Boom Length (4):	0.000 m	

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

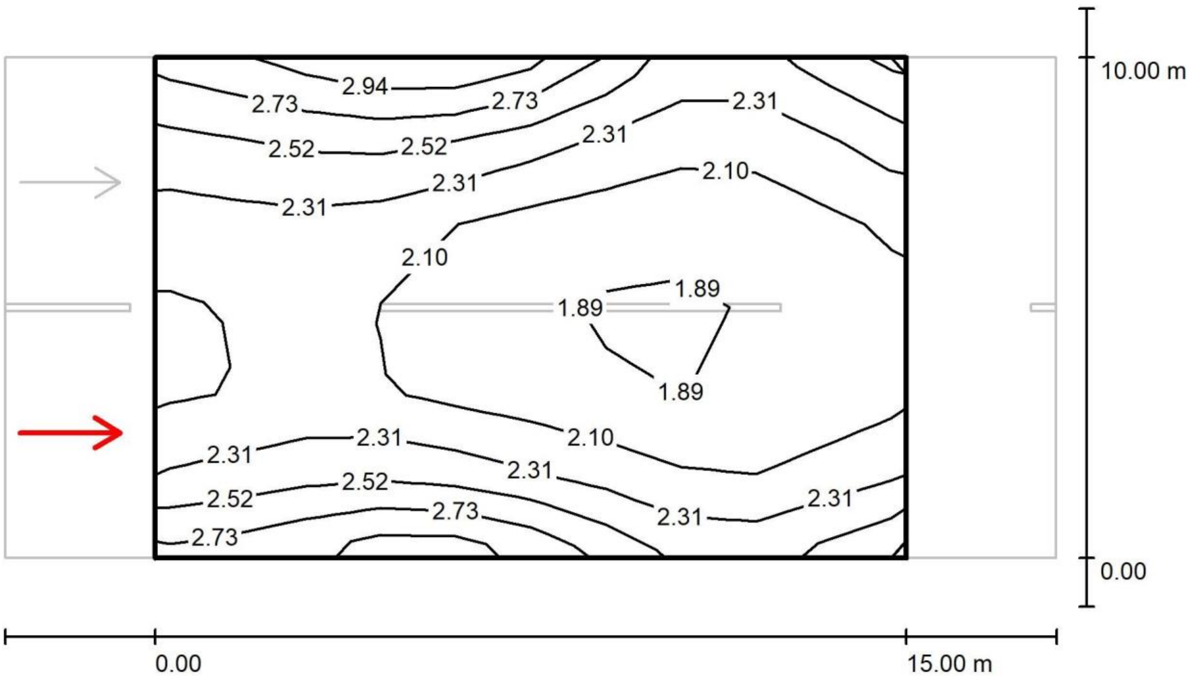
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 151

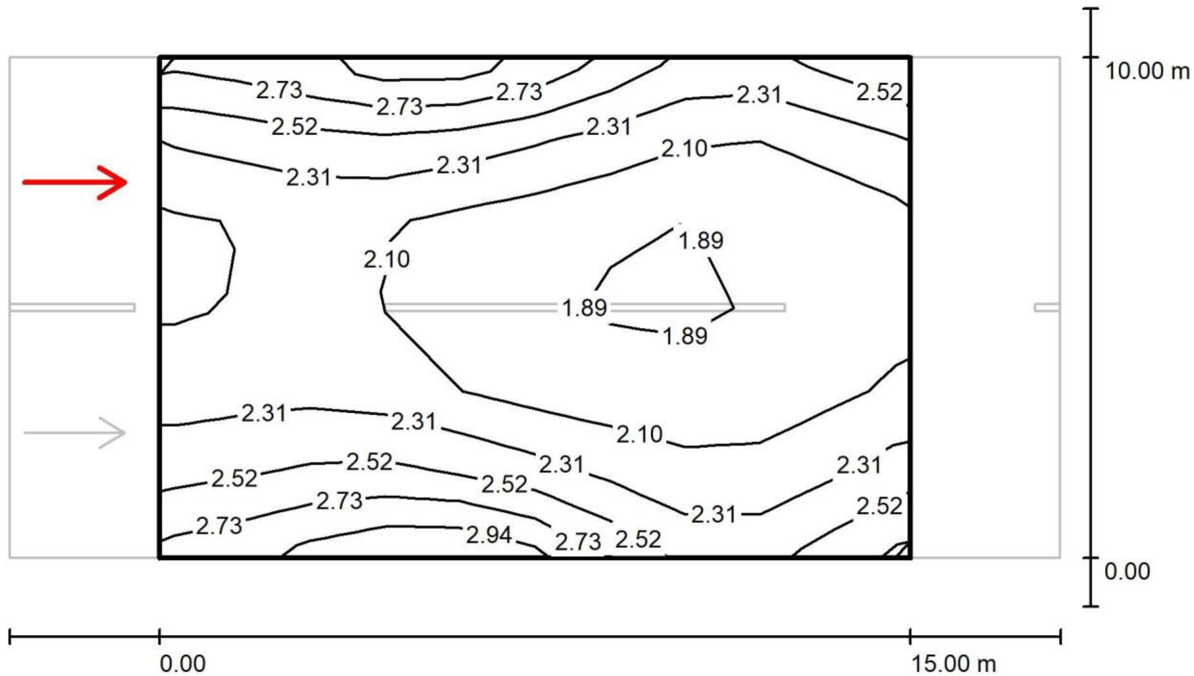
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	2.23	0.81	0.87	1	0.41
Required values according to class MEW1:	≥ 2.00	≥ 0.40	≥ 0.60	≤ 10	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 151

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	2.23	0.81	0.87	1	0.40
Required values according to class MEW1:	≥ 2.00	≥ 0.40	≥ 0.60	≤ 10	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

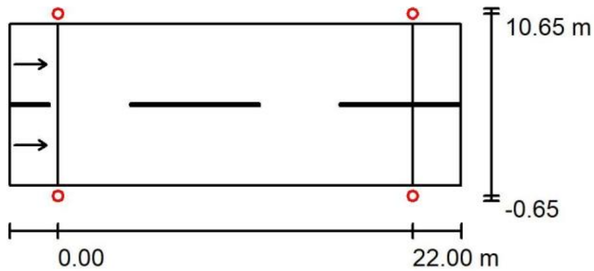
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

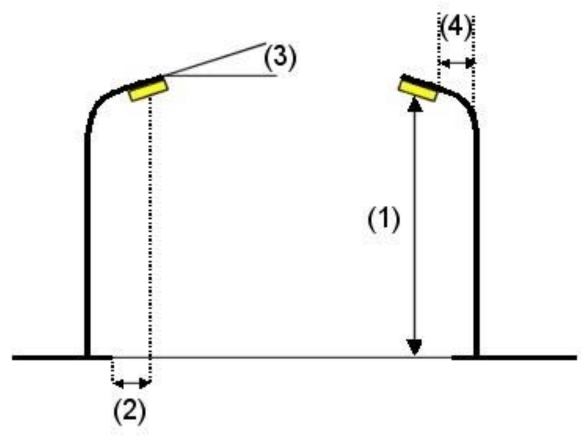
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Luminous flux (Luminaire):	9600 lm
Luminous flux (Lamps):	20000 lm
Luminaire Wattage:	152.0 W
Arrangement:	Double row, opposing
Pole Distance:	22.000 m
Mounting Height (1):	8.000 m
Height:	7.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	422 cd/klm
at 80°:	25 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.

Arrangement complies with luminous intensity class G4.

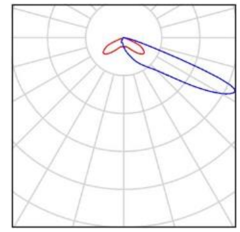
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

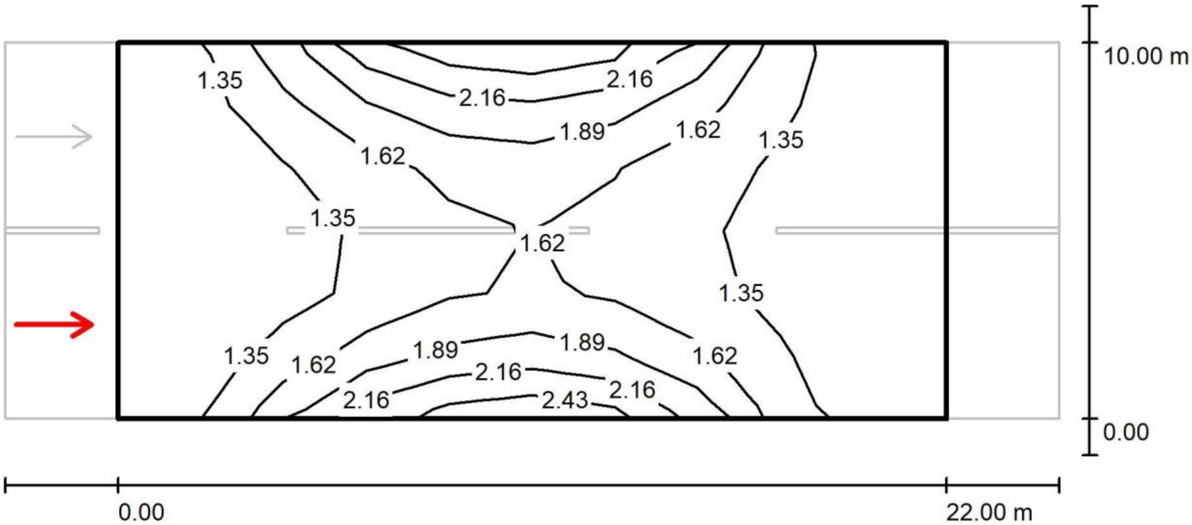
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)

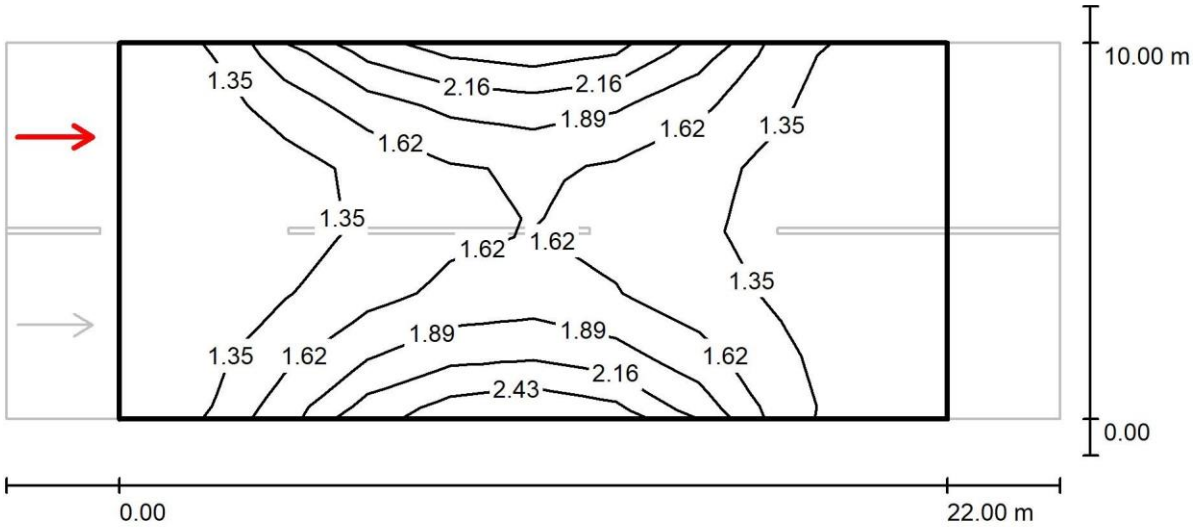


Values in Candela/m², Scale 1 : 201

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	1.52	0.72	0.64	2	0.38
Required values according to class MEW2:	≥ 1.50	≥ 0.40	≥ 0.60	≤ 10	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 201

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	1.52	0.72	0.64	2	0.38
Required values according to class MEW2:	≥ 1.50	≥ 0.40	≥ 0.60	≤ 10	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

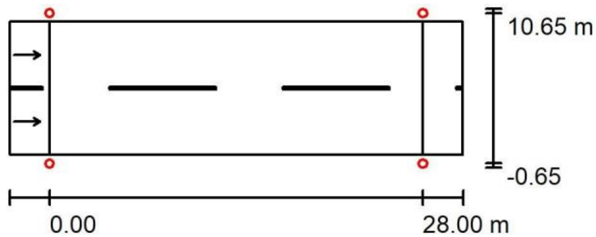
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

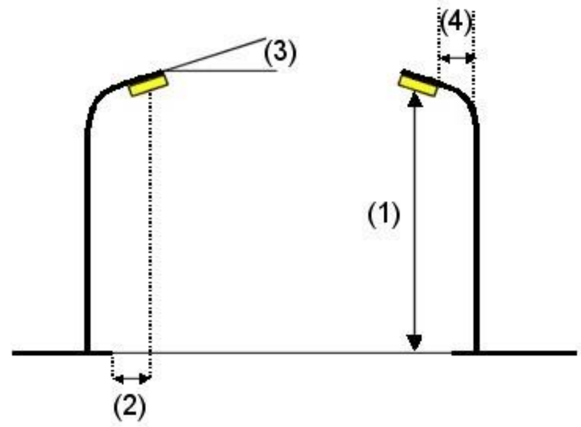
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





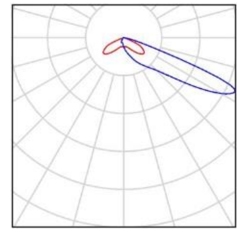
Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51		
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities	
Luminous flux (Lamps):	20000 lm	at 70°:	422 cd/klm
Luminaire Wattage:	152.0 W	at 80°:	25 cd/klm
Arrangement:	Double row, opposing	at 90°:	0.00 cd/klm
Pole Distance:	28.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	8.000 m		
Height:	7.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

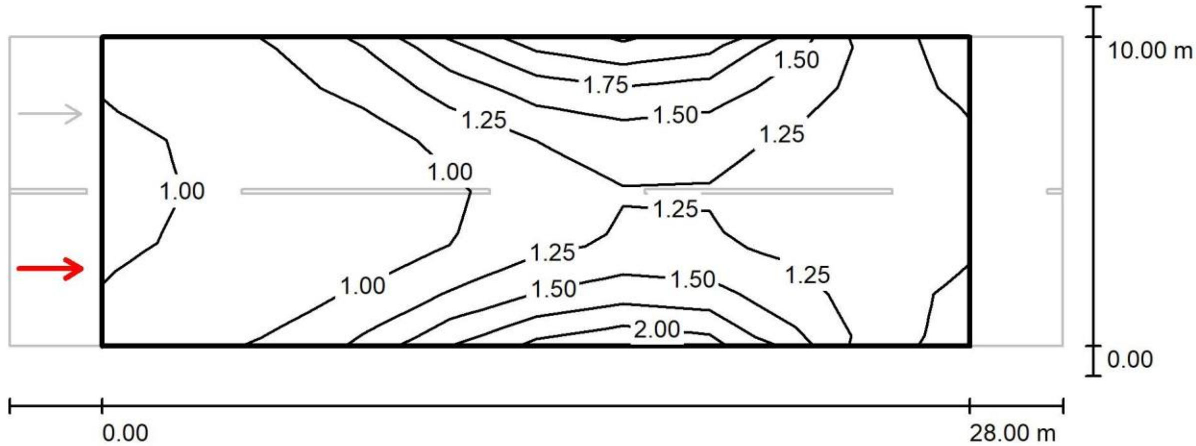
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 244

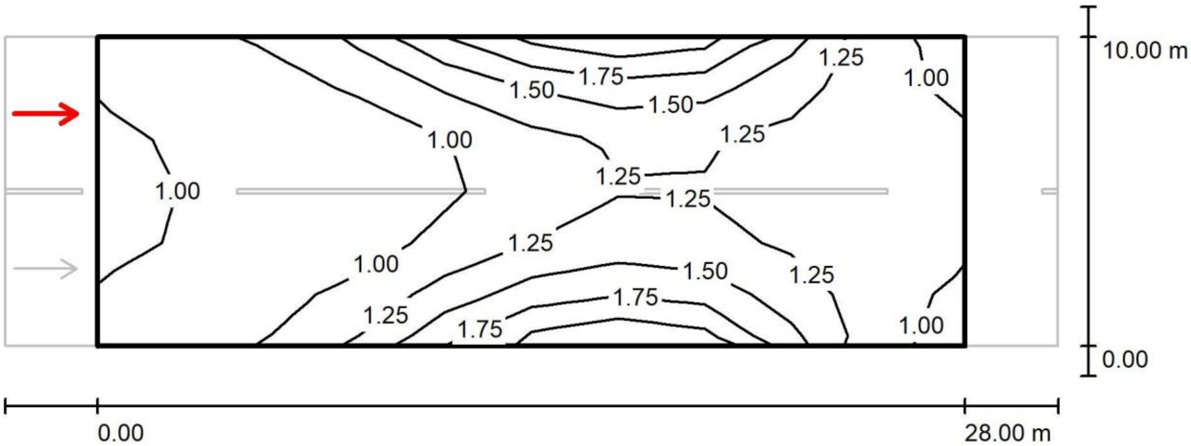
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	1.19	0.67	0.61	2	0.42
Required values according to class MEW3:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 244

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	1.19	0.67	0.61	2	0.42
Required values according to class MEW3:	≥ 1.00	≥ 0.40	≥ 0.60	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Street 1 / Planning data

Street Profile

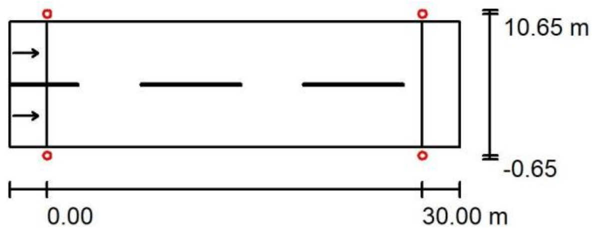
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

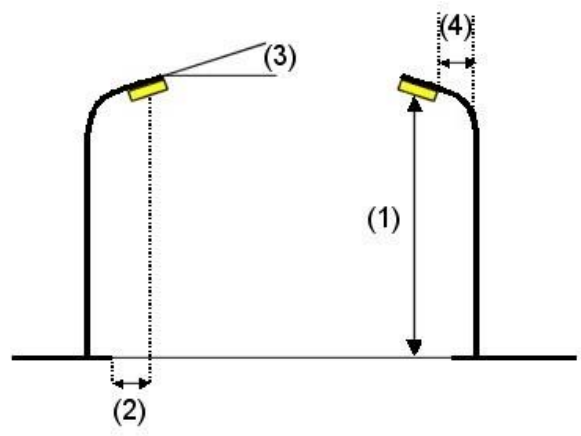
Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone

Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Luminous flux (Luminaire):	9600 lm
Luminous flux (Lamps):	20000 lm
Luminaire Wattage:	152.0 W
Arrangement:	Double row, opposing
Pole Distance:	30.000 m
Mounting Height (1):	10.000 m
Height:	9.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities	
at 70°:	422 cd/klm
at 80°:	25 cd/klm
at 90°:	0.00 cd/klm

Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

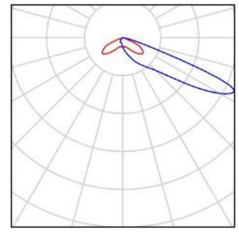
No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Operator
Telephone
Fax

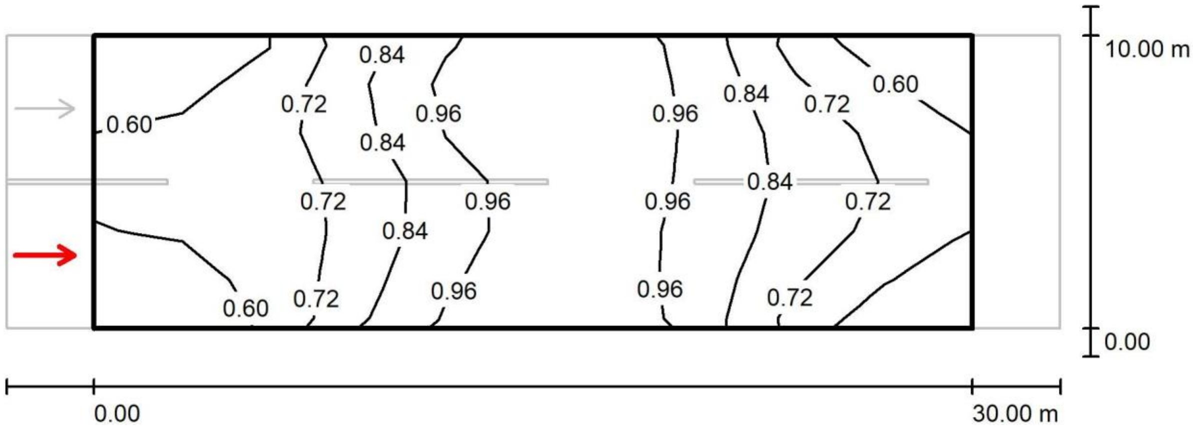
Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 258

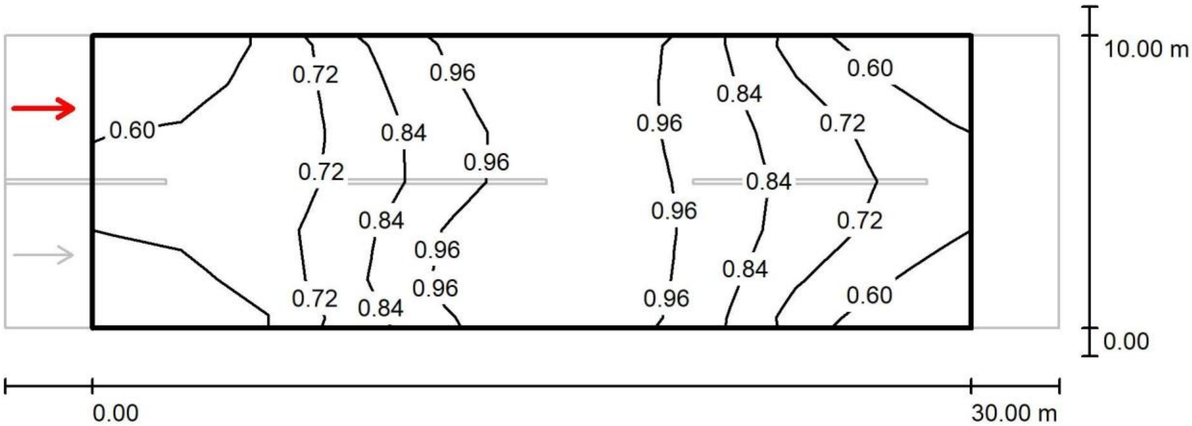
Grid: 10 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.79	0.63	0.56	1	0.45
Required values according to class MEW4:	≥ 0.75	≥ 0.40	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Operator
Telephone

Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 258

Grid: 10 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.79	0.63	0.56	1	0.45
Required values according to class MEW4:	≥ 0.75	≥ 0.40	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Street 1 / Planning data

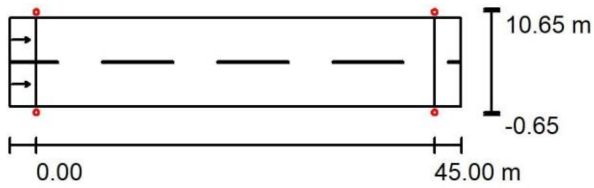
Street Profile

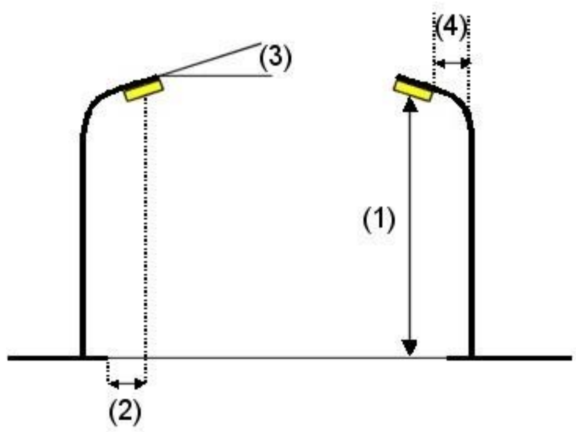
Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements

Operator
Telephone
Fax





Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Luminous flux (Luminaire):	9600 lm
Luminous flux (Lamps):	20000 lm
Luminaire Wattage:	152.0 W
Arrangement:	Double row, opposing
Pole Distance:	45.000 m
Mounting Height (1):	10.000 m
Height:	9.900 m
Overhang (2):	-0.650 m
Boom Angle (3):	0.0 °
Boom Length (4):	0.000 m

Maximum luminous intensities

at 70°:	422 cd/klm
at 80°:	25 cd/klm
at 90°:	0.00 cd/klm

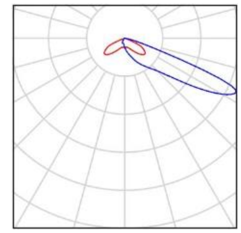
Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.

No luminous intensities above 90°.
Arrangement complies with luminous intensity class G4.
Arrangement complies with glare index class D.6.

Street 1 / Luminaire parts list

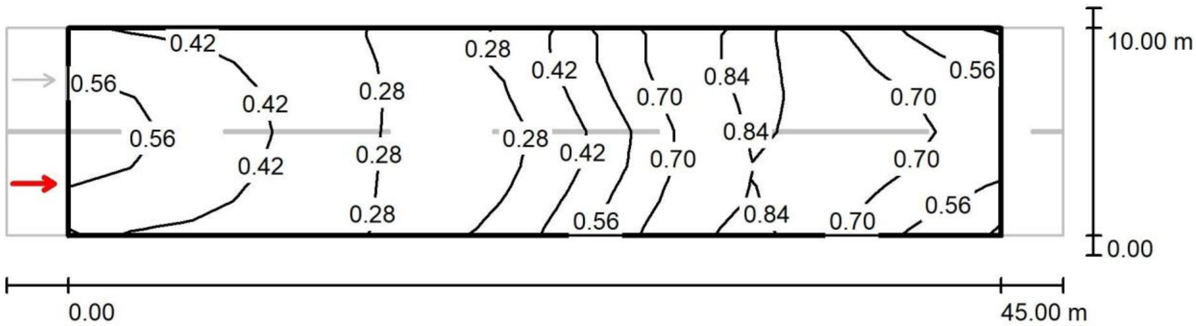
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

See our luminaire catalogfor an image of the luminaire.



Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



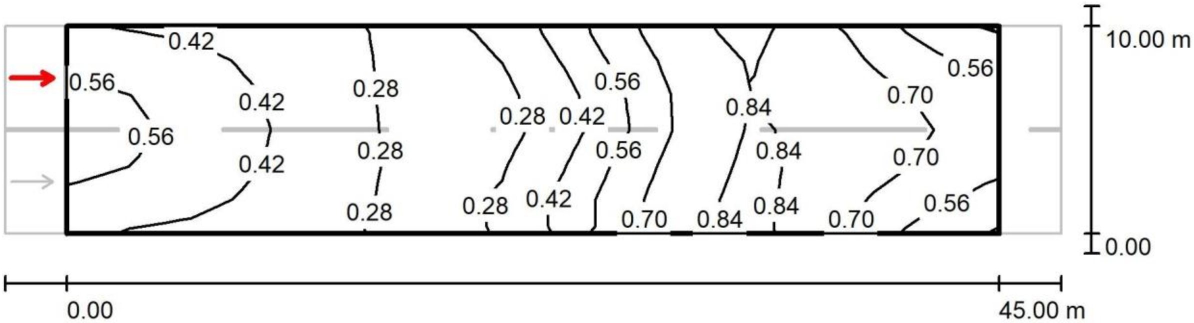
Values in Candela/m², Scale 1 : 365

Grid: 15 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.53	0.36	0.26	2	0.27
Required values according to class MEW5:	≥ 0.50	≥ 0.35	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

Operator
Telephone
Fax

Street 1 / Valuation Field Roadway 1 / Observer 8 / Isolines (L)



Values in Candela/m², Scale 1 : 365

Grid: 15 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.53	0.36	0.26	2	0.27
Required values according to class MEW5:	≥ 0.50	≥ 0.35	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

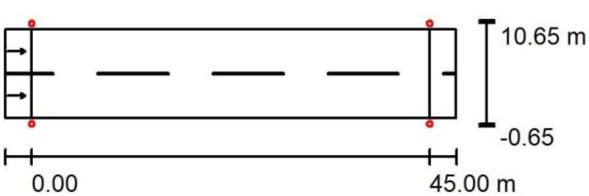
Street 1 / Planning data

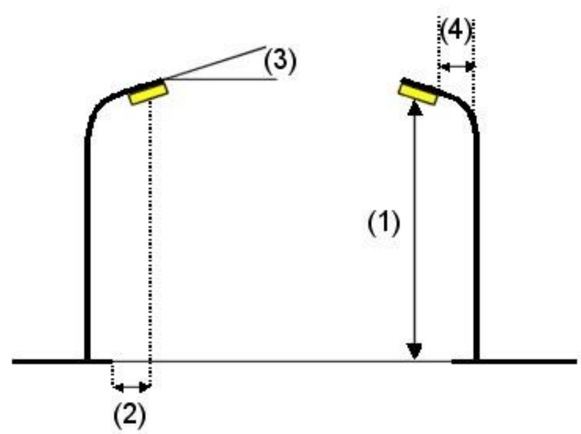
Street Profile

Roadway 1 (Width: 10.000 m, Number of lanes: 2, tarmac: R3, q0: 0.070)

Light loss factor: 0.67

Luminaire Arrangements





Operator
Telephone

Fax

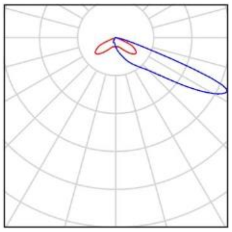
Luminaire:	PHILIPS BGP531 T25 1 xLED200-4S/830 DX51		
Luminous flux (Luminaire):	9600 lm	Maximum luminous intensities	
Luminous flux (Lamps):	20000 lm	at 70°:	422 cd/klm
Luminaire Wattage:	152.0 W	at 80°:	25 cd/klm
Arrangement:	Double row, opposing	at 90°:	0.00 cd/klm
Pole Distance:	45.000 m	Any direction forming the specified angle from the downward vertical, with the luminaire installed for use.	
Mounting Height (1):	10.000 m		
Height:	9.900 m	No luminous intensities above 90°.	
Overhang (2):	-0.650 m	Arrangement complies with luminous intensity class G4.	
Boom Angle (3):	0.0 °	Arrangement complies with glare index class D.6.	
Boom Length (4):	0.000 m		

Operator
Telephone
Fax

Street 1 / Luminaire parts list

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51
Article No.:
Luminous flux (Luminaire): 9600 lm
Luminous flux (Lamps): 20000 lm
Luminaire Wattage: 152.0 W
Luminaire classification according to CIE: 100
CIE flux code: 20 57 97 100 49
Fitting: 1 x LED200-4S/830 (Correction Factor 1.000).

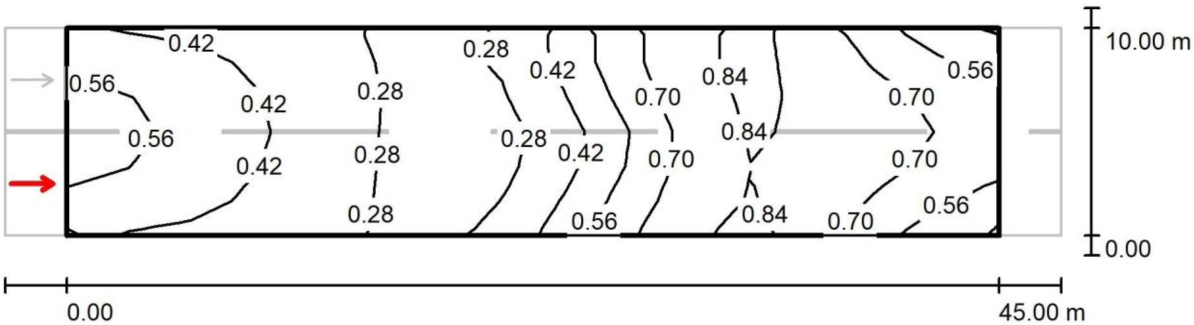
See our luminaire catalogfor an image of the luminaire.



Operator
Telephone

Fax

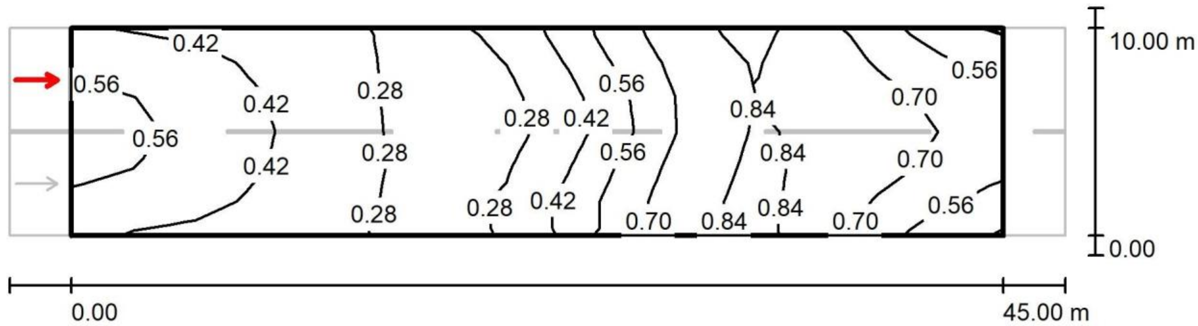
Street 1 / Valuation Field Roadway 1 / Observer 7 / Isolines (L)



Values in Candela/m², Scale 1 : 365

Grid: 15 x 6 Points
Observer Position: (-60.000 m, 2.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.53	0.36	0.26	2	0.27
Required values according to class MEW6:	≥ 0.30	≥ 0.35	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓



Values in Candela/m², Scale 1 : 365

Grid: 15 x 6 Points
Observer Position: (-60.000 m, 7.500 m, 1.500 m) tarmac: R3,
q0: 0.070, tarmac (wet): W3, q0 (wet): 0.200

	L_{av} [cd/m²]	U0	Ul	TI [%]	U0 (wet)
Calculated values:	0.53	0.36	0.26	2	0.27
Required values according to class MEW6:	≥ 0.30	≥ 0.35	/	≤ 15	≥ 0.15
Fulfilled/Not fulfilled:	✓	✓	✓	✓	✓

7.3. tabular form of the results of the different arrangements

Table 7.1. tabular form of the results of the different arrangements.

Luminaire name	Mounting Height (m)	Pole spacing (m)	Arrangements	Lamp_Luminaire specification	Class of road	observer	Lav (Cd/m2)	U0	UI	TI (%)
PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830	8	30	Double row, with offset	Luminous flux (Luminaire): 6800 lm Luminous flux (Lamps): 8000 lm Luminaire Wattage: 60.0 W	SANS_A3a	observer 1	1.11	0.81	0.8	7
						observer 2	1.11	0.81	0.8	7
PHILIPS BGP531 T25 1 xLED80-4S/830 DM10_830	10	35	Double row, with offset	Luminous flux (Luminaire): 6800 lm Luminous flux (Lamps): 8000 lm Luminaire Wattage: 60.0 W	SANS_A3b	observer 1	0.85	0.85	0.84	6

						observer 2	0.85	0.84	0.84	6
PHILIPS BGP530 T25 1 xLED80/830 DK	8	32	Double row, with offset	Luminous flux (Luminaire): 6720 lmLuminous flux (Lamps): 8000 lmLuminaire Wattage: 61.0 W	SANS_A2f	observer 1	0.97	0.8	0.63	4
						observer 2	0.98	0.79	0.63	4
PHILIPS BGP530 T25 1 xLED80/830 DK	8	25	Single row, bottom	Luminous flux (Luminaire): 6720 lm Luminous flux (Lamps): 8000 lm Luminaire Wattage: 61.0 W	SANS_A3c	observer 1	0.6	0.46	0.61	6
						observer 2	0.65	0.43	0.61	3

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	8	35	Double row, with offset	Luminous flux (Luminaire): 8820 lmLuminous flux (Lamps): 10500 lmLuminaire Wattage: 64.0 W	ME3a	observer 1	1.23	0.78	0.74	8
						observer 2	1.23	0.77	0.74	8
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	8	35	Double row, with offset	Luminous flux (Luminaire): 8820 lm Luminous flux (Lamps): 10500 lm Luminaire Wattage: 64.0 W	ME3b	observer 1	1.23	0.78	0.74	8
						observer 2	1.23	0.77	0.74	8

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	8	38	Double row, with offset	Luminous flux (Luminaire): 8820 lmLuminous flux (Lamps): 10500 lmLuminaire Wattage: 64.0 W	ME3c	observer 1	1.13	0.78	0.75	8
						observer 2	1.14	0.73	0.74	8
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	8	35	Double row, with offset	Luminous flux (Luminaire): 8820 lm Luminous flux (Lamps): 10500 lm Luminaire Wattage: 64.0 W	SANS_A1f	observer 1	1.23	0.78	0.74	8
						observer 2	1.23	0.77	0.74	8

PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	8	27	Single row, bottom	Luminous flux (Luminaire): 8820 lmLuminous flux (Lamps): 10500 lmLuminaire Wattage: 64.0 W	SANS_A4e	observer 1	0.75	0.43	0.83	11
						observer 2	0.85	0.4	0.87	6
PHILIPS BGP531 T25 1 xLED105-4S/740 DM10	10	30	Single row, bottom	Luminous flux (Luminaire): 8820 lm Luminous flux (Lamps): 10500 lm Luminaire Wattage: 64.0 W	SANS_A4f	observer 1	0.6	0.54	0.88	8
						observer 2	0.68	0.5	0.9	6

PHILIPS BGP340 1xLED92-3S/740 DM	10	30	Double row, with offset	Luminous flux (Luminaire): 7912 lmLuminous flux (Lamps): 9200 lmLuminaire Wattage: 71.0 W	SANS_A1c	observer 1	1.31	0.91	0.89	6
						observer 2	1.3	0.91	0.89	6
PHILIPS BGP531 T25 1 xLED115-4S/740 DM10	8	25	Double row, with offset	Luminous flux (Luminaire): 9660 lm Luminous flux (Lamps): 11500 lm Luminaire Wattage: 71.0 W	SANS_A1e	observer 1	1.9	0.82	0.87	7
						observer 2	1.89	0.82	0.87	7

PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830	8	25	Single row, bottom	Luminous flux (Luminaire): 8400 lmLuminous flux (Lamps): 10000 lmLuminaire Wattage: 78.0 W	ME4a	observer 1	0.77	0.44	0.86	10
						observer 2	0.88	0.41	0.88	6
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830	8	26	Double row, with offset	Luminous flux (Luminaire): 8400 lm Luminous flux (Lamps): 10000 lm Luminaire Wattage: 78.0 W	SANS_A2a	observer 1	1.58	0.82	0.85	7
						observer 2	1.58	0.82	0.85	7

PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830	8	25	Single row, bottom	Luminous flux (Luminaire): 8400 lmLuminous flux (Lamps): 10000 lmLuminaire Wattage: 78.0 W	SANS_A4b	observer 1	0.77	0.44	0.86	10
						observer 2	0.88	0.41	0.88	6
PHILIPS BGP531 T25 1 xLED100-4S/830 DM10_830	8	25	Single row, bottom	Luminous flux (Luminaire): 8400 lm Luminous flux (Lamps): 10000 lm Luminaire Wattage: 78.0 W	SANS_A4d	observer 1	0.77	0.44	0.86	10
						observer 2	0.88	0.41	0.88	6

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10	8	28	Double row, with offset	Luminous flux (Luminaire): 9240 lmLuminous flux (Lamps): 11000 lmLuminaire Wattage: 81.0 W	ME2	observer 1	1.62	0.81	0.83	7
						observer 2	1.62	0.81	0.83	7
PHILIPS BGP531 T25 1 xLED110-4S/830 DM10	8	25	Double row, with offset	Luminous flux (Luminaire): 9240 lm Luminous flux (Lamps): 11000 lm Luminaire Wattage: 81.0 W	SANS_A1b	observer 1	1.81	0.82	0.87	7
						observer 2	1.81	0.82	0.87	7

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10	10	32	Double row, with offset	Luminous flux (Luminaire): 9240 lmLuminous flux (Lamps): 11000 lmLuminaire Wattage: 81.0 W	SANS_A2b	observer 1	1.26	0.87	0.86	7
						observer 2	1.26	0.87	0.88	6
PHILIPS BGP531 T25 1 xLED110-4S/830 DM10	8	25	Single row, bottom	Luminous flux (Luminaire): 9240 lm Luminous flux (Lamps): 11000 lm Luminaire Wattage: 81.0 W	SANS_A4a	observer 1	0.85	0.44	0.86	10
						observer 2	0.96	0.41	0.88	6

PHILIPS BGP531 T25 1 xLED110-4S/830 DM10	10	35	Single row, bottom	Luminous flux (Luminaire): 9240 lmLuminous flux (Lamps): 11000 lmLuminaire Wattage: 81.0 W	SANS_A4c	observer 1	0.54	0.54	0.79	9
						observer 2	0.61	0.51	0.88	6
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10	8	27	Single row, bottom	Luminous flux (Luminaire): 10080 lm Luminous flux (Lamps): 12000 lm Luminaire Wattage: 89.0 W	DIN5044	observer 1	0.86	0.43	0.83	11
						observer 2	0.97	0.4	0.87	6

PHILIPS BGP531 T25 1 xLED120-4S/830 DM10	8	27	Single row, bottom	Luminous flux (Luminaire): 10080 lmLuminous flux (Lamps): 12000 lmLuminaire Wattage: 89.0 W	ME4b	observer 1	0.86	0.43	0.83	11
						observer 2	0.97	0.4	0.87	6
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10	8	25	Single row, bottom	Luminous flux (Luminaire): 10080 lm Luminous flux (Lamps): 12000 lm Luminaire Wattage: 89.0 W	SANS_A2c	observer 1	0.93	0.44	0.86	11
						observer 2	1.05	0.41	0.88	6

PHILIPS BGP531 T25 1 xLED120-4S/830 DM10	8	25	Single row, bottom	Luminous flux (Luminaire): 10080 lmLuminous flux (Lamps): 12000 lmLuminaire Wattage: 89.0 W	SANS_A2c	observer 1	0.93	0.44	0.86	11
						observer 2	1.05	0.41	0.88	6
PHILIPS BGP531 T25 1 xLED120-4S/830 DM10	8	26	Single row, bottom	Luminous flux (Luminaire): 10080 lm Luminous flux (Lamps): 12000 lm Luminaire Wattage: 89.0 W	SANS_A3f	observer 1	0.89	0.44	0.85	11
						observer 2	1.01	0.44	0.86	6

PHILIPS BGP531 T25 1 xLED165-4S/740 DM10	8	30	Double row, with offset	Luminous flux (Luminaire): 13695 lmLuminous flux (Lamps): 16500 lmLuminaire Wattage: 100.0 W	ME1	observer 1	2.24	0.81	0.8	8
						observer 2	2.24	0.81	0.8	8
PHILIPS BGP531 T25 1 xLED165-4S/740 DM10	10	35	Double row, with offset	Luminous flux (Luminaire): 13695 lm Luminous flux (Lamps): 16500 lm Luminaire Wattage: 100.0 W	SANS_A2d	observer 1	1.71	0.85	0.84	7
						observer 2	1.71	0.84	0.84	7

PHILIPS BGP531 T25 1 xLED165-4S/740 DM10	8	26	Single row, bottom	Luminous flux (Luminaire): 13695 lmLuminous flux (Lamps): 16500 lmLuminaire Wattage: 100.0 W	SANS_A3e	observer 1	1.21	0.44	0.85	12
						observer 2	1.37	0.4	0.86	7
PHILIPS BGP531 T25 1 xLED175-4S/740 DM10	8	26	Single row, bottom	Luminous flux (Luminaire): 14525 lm Luminous flux (Lamps): 17500 lm Luminaire Wattage: 108.0 W	SANS_A2e	observer 1	1.29	0.44	0.85	12
						observer 2	1.46	0.4	0.86	7

PHILIPS BGP531 T25 1 xLED175-4S/740 DM10	8	26	Single row, bottom	Luminous flux (Luminaire): 14525 lmLuminous flux (Lamps): 17500 lmLuminaire Wattage: 108.0 W	SANS_A3d	observer 1	1.29	0.44	0.85	12
						observer 2	1.46	0.4	0.86	7
PHILIPS BGP531 T25 1 xLED150-4S/830 DM10	8	28	Double row, with offset	Luminous flux (Luminaire): 12450 lm Luminous flux (Lamps): 15000 lm Luminaire Wattage: 116.0 W	SANS_A1a	observer 1	2.18	0.81	0.83	8
						observer 2	2.18	0.81	0.83	8

PHILIPS BGP531 T25 1 xLED150-4S/830 DM10	10	42	Double row, with offset	Luminous flux (Luminaire): 12450 lmLuminous flux (Lamps): 15000 lmLuminaire Wattage: 116.0 W	SANS_A2e	observer 1	1.3	0.83	0.8	7
						observer 2	1.3	0.82	0.8	7
PHILIPS BGP531 T25 1 xLED150-4S/830 DM10	10	32	Double row, with offset	Luminous flux (Luminaire): 12450 lm Luminous flux (Lamps): 15000 lm Luminaire Wattage: 116.0 W	SANS_A1e	observer 1	1.7	0.87	0.86	7
						observer 2	1.7	0.87	0.88	7

PHILIPS BGP531 T25 1 xLED170-4S/830 DM10	10	30	Double row, with offset	Luminous flux (Luminaire): 13940 lmLuminous flux (Lamps): 17000 lmLuminaire Wattage: 126.0 W	SANS_A1d	observer 1	2.04	0.87	0.89	7
						observer 2	2.04	0.87	0.89	7
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	10	30	Double row, with offset	Luminous flux (Luminaire): 9600 lm Luminous flux (Lamps): 20000 lm Luminaire Wattage: 152.0 W	ME4b	observer 1	0.79	0.74	0.75	1
						observer 2	0.79	0.75	0.75	1

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	8	25	Single row, top	Luminous flux (Luminaire): 9600 lmLuminous flux (Lamps): 20000 lmLuminaire Wattage: 152.0 W	ME5	observer 1	0.6	0.6	0.71	2
						observer 2	0.57	0.64	0.5	1
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	10	32	Single row, top	Luminous flux (Luminaire): 9600 lm Luminous flux (Lamps): 20000 lm Luminaire Wattage: 152.0 W	ME6	observer 1	0.38	0.55	0.7	2
						observer 2	0.36	0.6	0.46	1

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	8	15	Double row, opposing	Luminous flux (Luminaire): 9600 lmLuminous flux (Lamps): 20000 lmLuminaire Wattage: 152.0 W	MEW1	observer 1	2.23	0.81	0.87	1
						observer 2	2.23	0.81	0.87	1
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	8	22	Double row, opposing	Luminous flux (Luminaire): 9600 lm Luminous flux (Lamps): 20000 lm Luminaire Wattage: 152.0 W	MEW2	observer 1	1.52	0.72	0.64	2
						observer 2	1.52	0.72	0.64	2

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	8	28	Double row, opposing	Luminous flux (Luminaire): 9600 lmLuminous flux (Lamps): 20000 lmLuminaire Wattage: 152.0 W	MEW3	observer 1	1.19	0.67	0.61	2
						observer 2	1.19	0.67	0.61	2
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	10	30	Double row, opposing	Luminous flux (Luminaire): 9600 lm Luminous flux (Lamps): 20000 lm Luminaire Wattage: 152.0 W	MEW4	observer 1	0.79	0.63	0.56	1
						observer 2	0.89	0.63	0.56	1

PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	10	45	Double row, opposing	Luminous flux (Luminaire): 9600 lmLuminous flux (Lamps): 20000 lmLuminaire Wattage: 152.0 W	MEW5	observer 1	0.53	0.36	0.26	2
						observer 2	0.53	0.36	0.26	2
PHILIPS BGP531 T25 1 xLED200-4S/830 DX51	10	45	Double row, opposing	Luminous flux (Luminaire): 9600 lm Luminous flux (Lamps): 20000 lm Luminaire Wattage: 152.0 W	MEW6	observer 1	0.53	0.36	0.26	2
						observer 2	0.53	0.36	0.26	2

7.4. Future Scope of Work:

Lighting, along with architecture, Streets, Highway, Tunnel etc. are improving the world regularly in terms of Visualization. Lighting designers are trying their best to offer a beautiful world to the present & future generation, keeping in mind about energy efficient with smart handling lighting solution.

DALI is a great innovation of new era. By means of DALI complete lighting control can be done such as daylight harvesting, scheduled illumination, occupancy-controlled illumination, etc.

Now a days using Internet Illumination level control, lighting on/off system control, has been discovered so, the effects of the new “IOT (INTERNET OF THINGS)’’ system for Road lighting performance can be investigated in Future.

Light intensity can be controlled based on traffic pressure. Light level can be dimmed in the early morning & evening when daylight level is quite less but not too dark, as well as it can be dimmed in the night-time when pedestrian is very less.

Those features can be investigated in Future for better Road lighting purpose.

7.5. REFERENCES:

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