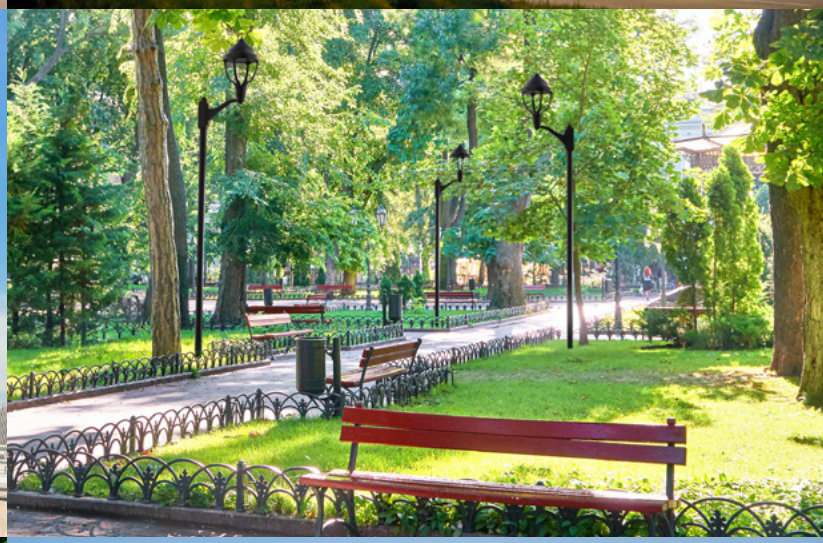
GENLYTE SOLUTIONS



Combining comfort and performance

ComfortEdge™

Lighting technology as a creative tool

Introduction

At Signify, we understand that one of the important factors that shapes the quality and character of outdoor space is lighting. Lighting can enhance the sense of identity, comfort, and security of a space, as well as create different moods and atmospheres. Therefore, lighting is not only a functional element but also a creative tool that can be used to achieve various design goals for outdoor spaces. Research has shown that increased brightness leads people to feel safer when spending time outdoors in their community[1]. Additionally, it enhances the quality and attractiveness of urban public spaces at night[2].

> “Lighting can enhance the sense of identity, comfort, and security of a space, as well as create different moods and atmospheres.”

1. https://www.academia.edu/64776584/Day_for_Night_The_role_of_artificial_lighting_in_returning_people_to_urban_public_spaces.
2. https://link.springer.com/article/10.1057/s41284-021-00296-0.
3. ANSI/IES RP-43-22 Recommended Practice: Lighting Exterior Applications an American National Standard P6. 3.3.

We understand the complexity of lighting and human interactions in outdoor spaces and we are committed to finding innovative lighting solutions.

People within urban and peripheral areas are more susceptible to adapt to different light levels. Low and intermediate light conditions (approximately 1 to 3 lux) or well-lit conditions (4 to 40 lux) impact human vision differently by leveraging different photoreceptors. Some of these photoreceptors are responsible for peripheral vision and are essential at night for people. Consequently, it is important to consider other outdoor lighting factors to provide lighting that enhances and supports the user experience and their visual needs. There are five factors to take into consideration which are highlighted by IES within RP-43:

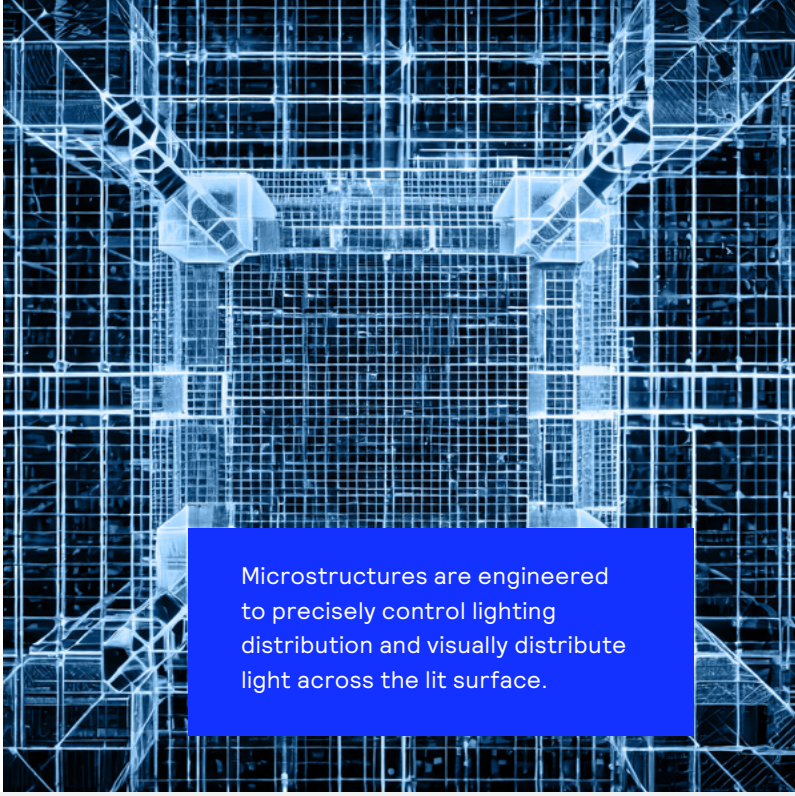
- **Glare:** intense and blinding light can cause discomfort and temporary blindness, according to the International Dark Sky Association (IDA) (darksky.org/resources/glossary/).
- **Illuminance:** a measure of the amount of light that reaches an area of a surface and is measured in lux or foot-candles. A lighting solution that is designed well can also lower the amount of light needed and enhance visibility.
- **Visual adaptation:** the process of adjusting from high to low-light conditions involving photochemical and physiological changes in the eye. Some changes in the eye occur quickly but some could take up to 30 minutes[3]. Adaptation affects visual acuity and people's ability to navigate space. Good lighting design should avoid sudden changes in brightness.
- **Uniformity:** the level of illuminance variation within a lit area. Illuminance variation affects visibility, especially when changes are frequent, abrupt or could cause discomfort[4].
- **Spectrum distribution:** the range of wavelengths of electromagnetic radiation that are visible to the human eye. An adequate light spectrum contributes to the comfort of outdoor spaces by supporting the recognition of colors at night while reducing the potential impact on the surrounding environment[5].

4. ANSI/IES RP-43-22 Recommended Practice: Lighting Exterior Applications an American National Standard P6. 3.4.
5. ANSI/IES RP-43-22 Recommended Practice: Lighting Exterior Applications an American National Standard P6. 3.5.

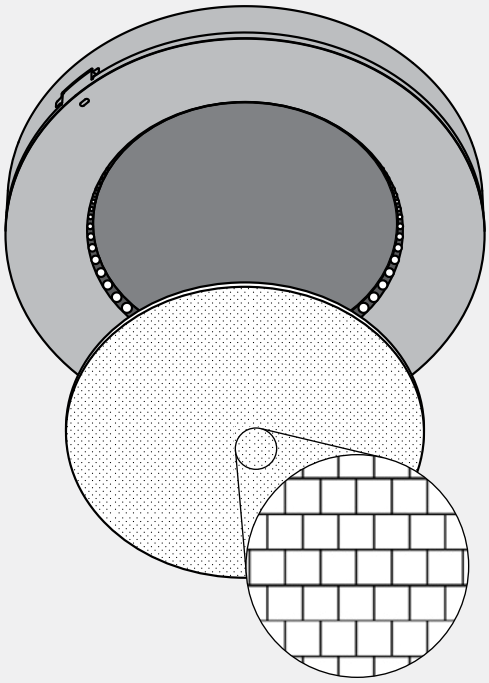
Most direct view LEDs and reduced glare lighting solutions on the market today focus primarily on lighting performance or glare at the expense of photometric performance. A comfortable visual experience for outdoor users goes beyond glare reduction. A range of comfort factors and specific performance metrics must be considered.

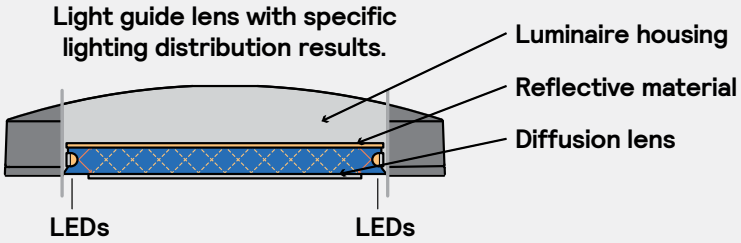
Technology

ComfortEdge™ is designed with comfort in mind, promoting both user comfort and lighting performance. This technology is based on a unique design that reduces glare, improves visual adaptation and uniformity, and is designed to provide the right light level and light spectrum for a well-lit and comfortable environment (see appendix A). Additionally, ComfortEdge™ achieves state of the art performance with excellent photometric control and distribution performances.



Microstructures are engineered to precisely control lighting distribution and visually distribute light across the lit surface.





ComfortEdge™ revolutionizes outdoor lighting by combining cutting-edge LED technology with a sophisticated light guide system. The LEDs are positioned on the edge of the device and shine horizontally on a light guide, which mixes and distributes the light evenly. The light then passes through a specially designed lens that disperses it softly but in a highly controlled way. This ensures that the observer never has a harsh, direct view of the light source but rather enjoys a smooth and comfortable luminous surface.

ComfortEdge™ offers a motion sensor option for additional energy savings. The motion sensor is completely concealed behind the light engine, creating a seamless aesthetic.

> “ComfortEdge™ revolutionizes outdoor lighting by combining cutting-edge LED technology with a sophisticated light guide system.”

Spacing

ComfortEdge™ provides consistent illuminance level across the space, facilitating smooth visual transitions, and it also enhances the visibility of faces and objects across the area, adding to the overall appeal of the space. Moreover, ComfortEdge™ contributes to placemaking for outdoor spaces by highlighting architectural elements, creating focal points, and enhancing a sense of security. The choice between multiple CCTs (2700–4000K) allows lighting to be tailored to the primary uses of the space, whether supporting activities or creating a cozy and reassuring atmosphere. With these qualities, ComfortEdge™ can create warm and inviting ambiances that elevate spaces without harsh contrast.

ComfortEdge™ delivers uniform vertical light and a seamless light distribution overlap. In comparison the direct view light engine is designed for applications that require a sharp light gradient and precise cutoff at the edges of the coverage area.

Aesthetics

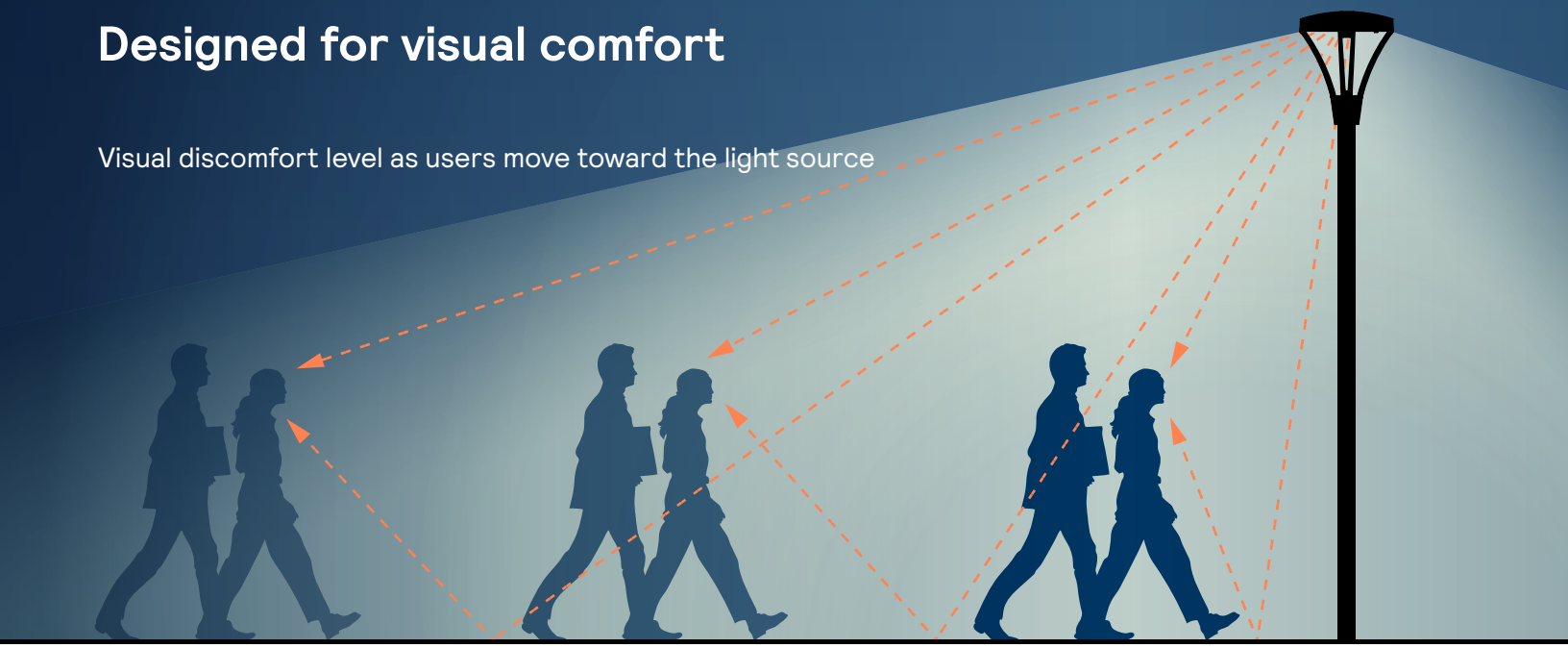
As an edge-lit, indirect light source, the sophisticated and elegant design centers on a large, luminous, uniformly lit surface. ComfortEdge™ creates a warm and soft lighting atmosphere that suits any environment. The light source is concealed from direct view, adding to the aesthetic appeal of the luminaire. The resulting light distribution is smooth and uniform which provides visual comfort and appeal of the space. This feature is consistent across all lumen packages, ensuring a high-quality and seamless light source regardless of the brightness level.

ComfortEdge™ light engine provides uniform and consistent lighting across the entire luminous surface creating a more overall refined product aesthetic.

Direct view light engine with its standardized form factor, excels in performance, though it may result in a slightly varied lit surface.

Designed for visual comfort

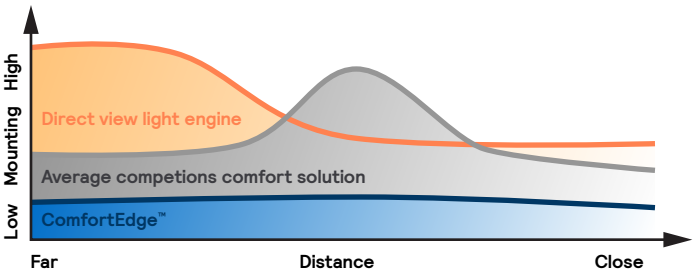
Visual discomfort level as users move toward the light source



ComfortEdge™ end-user experiences

Designed to benefit the user visual experience and comfort by reducing negative effects that can come with direct view light engines, such as discomfort and glare.

Direct view light engines are a quantitative solution for commercial and roadway lighting that require a sharp light gradient and precise cutoff at the edges of the coverage area. While this is useful for lighting applications where the property line is close to residential or other regulated zones that need a quick transition from high to low light levels, it can also cause uneven visual distribution and high candela at higher angles.



In contrast, ComfortEdge™ creates a uniform and soft lighting distribution that spreads the light and color temperature evenly. This creates a welcoming space, ideal for activities within various lighting applications. ComfortEdge™ provides unique, uniform lighting distributions and a smooth transition to lower light levels at the perimeter of the area. This helps to ease visual adaptation and recognition of other users of the space. As a result, people can feel more at ease when enjoying outdoor spaces or moving confidently through a nighttime environment. The ComfortEdge™ solution offers a superior alternative to direct view lighting for applications that require both high performance and high comfort for an improved experience.

Direct view Light Engine

The initial lighting intensity is high, creating glare and eye discomfort. A constant luminance along the progression ensures a smooth transition and no subsequent eyes discomfort.

Average competitions solution

The initial lighting intensity is medium, creating soft glare and eye discomfort. Inconsistency in luminance along the progression creates a harsh transition that increases eyes discomfort.

ComfortEdge™

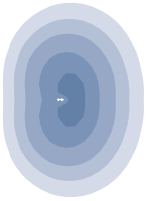
The initial lighting intensity is low, creating minimal glare and eye discomfort. A constant luminance along the progression ensures a smooth transition and no eyes discomfort.

ComfortEdge™ performance

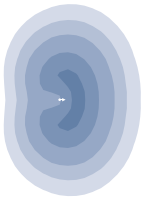
Fixtures create a pleasant and functional environment where pedestrians are present, such as streets or parking lots.

ComfortEdge™ meets RP-8 lighting standard guidance, which is a recommended practice for quality outdoor lighting solutions in various environments where pedestrians are present, such as streets or parking lots. The RP-8 standard provides lighting design techniques and criteria that aim at assuring visibility, comfort, and a sense of security for occupants while supporting various tasks or activities within the space. By meeting the RP-8 guidelines, ComfortEdge™ not only enhances visual conditions compared to direct view solutions (Appendix A) but also creates a pleasant and functional environment that positively impacts the productivity, mood and satisfaction of individuals using the space.

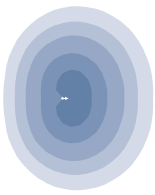
Arm Mount ComfortEdge™ optics



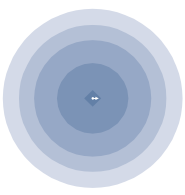
Comfort Type II



Comfort Type III

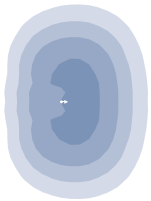


Comfort Type IV

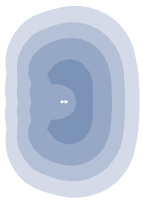


Comfort Type V

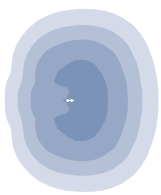
Post Top ComfortEdge™ optics



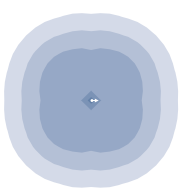
Comfort Type II



Comfort Type III



Comfort Type IV



Comfort Type V

ComfortEdge™ flexibility

ComfortEdge™ allows for ultra-efficient lighting control that can adapt to different lighting needs – whereas currently, most competitors only offer asymmetrical or symmetrical distributions.

ComfortEdge™ enables flexibility in achieving specific IES lighting distributions, such as IES type 2-3-4-5, which are usually only available with direct view solutions. Low lumen packages in direct view solutions also often result in a reduced number of LED boards, which creates a punctual light source within a large opening that can increase the perceived glare[6]. With the ComfortEdge™ solution, the entire surface remains luminous even with the lowest lumen package, which reduces the perceived glare. Moreover, ComfortEdge™ provides best-in-class distribution, allowing it to meet most application lighting requirements at a lower light level than less controlled options from competitors.

ComfortEdge™ solution

The ComfortEdge™ LED light engine is a revolutionary product, encompassing various dimensions of visual comfort.

Unlike conventional direct view LED solutions or other comfort solutions in the market, ComfortEdge™ achieves excellent photometric control and distribution performance while creating a comfortable and reassuring environment for people to enjoy outdoor spaces. The technology delivers uniform vertical light and seamless light distribution overlap, resulting in consistent lighting with minimal contrast that facilitates smooth visual transitions. It also enhances the visibility of faces and objects across an area, adding to the overall appeal of the space (see vertical illuminance comparison Appendix A). ComfortEdge™ technology is the perfect solution for creating a pleasant and relaxing outdoor atmosphere.

6. CIE 232:2019, Discomfort Caused by Glare from Luminaires with a Non-Uniform Source Luminance. 1 Commission Internationale de l'Éclairage (CIE), 2019. DOI: 10.25039/TR.232.2019.

Appendix A

Photometric comparison between direct view LED and ComfortEdge OmniScape luminaires.

	Direct view OmniScape	ComfortEdge OmniScape
Description Roadway Standard	ANSI-IES RP-8-18 Roadway (lum-illum-lv)	ANSI-IES RP-8-18 Roadway (lum-illum-lv)
R-Table	R3	R3
Actual Q0 Value	0.07	0.07
Layout Type	1RNS	1RNS
Road Width	30	30
Median Width	N.A.	N.A.
Number Lanes	2	2
Number Lanes Opposite	0	0
Drivers Side	Right	Right
Calc Area	Bottom	Bottom
Photometric file	S-OSAx-20W40LED-740-G1-2	S-OSAx-C-25W-740-G1-2
S/P Ratio 1	1	1
MH - Row 1	20	20
Setback - Row 1	3	3
+-Orient - Row 1	0	0
Tilt - Row 1	0	0
Spin - Row 1	0	0
Spacing - Row 1	140	140
Luminance (Cd/SqM)		
Average	0.33	0.27
Maximum	0.88	0.89
Minimum	0.12	0.09
Avg/Min (ratio)	2.75	3.00
Max/Min (ratio)	7.33	9.89
Max/Avg (ratio)	2.67	3.30
Illuminance	(Fc)	
Average	0.45	0.38
Maximum	1.57	0.79
Minimum	0.15	0.09
Avg/Min (ratio)	3.00	4.22
Max/Min (ratio)	10.47	8.78
Max/Avg (ratio)	3.49	2.08
Veilling_Luminance (Cd/SqM)		
Average	0.06	0.06
Maximum	0.22	0.18
Minimum	0.00	0.01
Avg/Min (ratio)	N.A.	6.00
Max/Min (ratio)	N.A.	18.00
Max/Avg (ratio)	3.67	3.00
MaxLV (ratio)	0.67	0.67
Threshold Incr. (TI)	34.72	33.35

GENLYTE SOLUTIONS

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