

# TUNNEL LIGHTING

# TUNNEL LIGHTING PRINCIPLES

## ZONES TYPES

### 1 - Access Zone

The part of the open road in front of the tunnel portal in the approach direction, covering the distance over which an approaching driver is able to see tunnel entrance. The access zone begins at the stopping distance before of the entrance portal and it ends at the tunnel entrance portal.

### 2 - Threshold Zone

The first part of the tunnel, just after the entrance portal. The threshold zone starts either at the beginning of the tunnel or at the beginning of the daylight sunscreens when occurring. The length of the threshold zone is at least equal to the stopping distance.

### 3 - Transition Zone

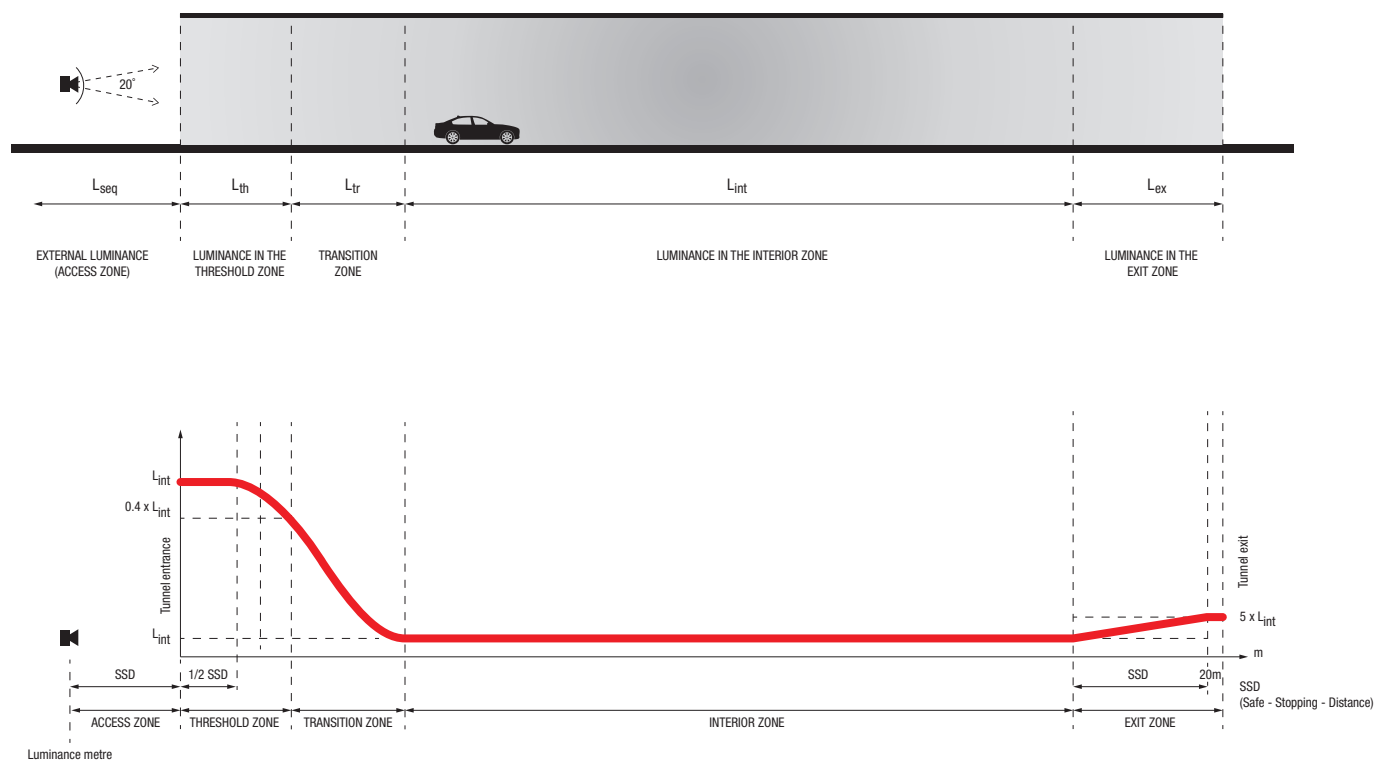
The part of the tunnel starts from just after the threshold zone and ends at the beginning of interior zone. The lighting level in the transition zone is decreasing from the level at the end of the threshold zone to the level of the interior zone. Interior zone: the part of the tunnel after the transition zone till to the beginning of the exit zone.

### 4 - Interior Zone

The part of the tunnel after the transition zone till to the beginning of the exit zone.

### 5 - Exit Zone

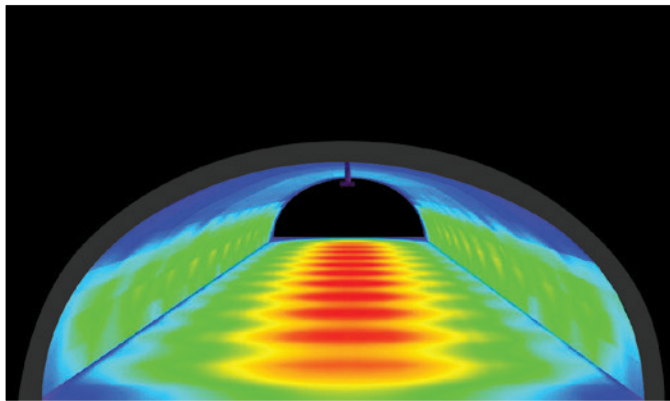
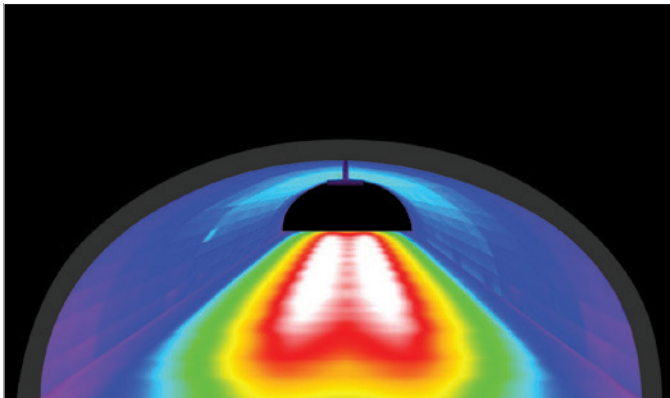
The exit zone begins at the end of the interior zone, ends at the exit portal of the tunnel.



# TUNNEL LIGHTING PRINCIPLES

## DESIGN CRITERIA

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### **Tunnel**

Tunnel is the structure over a roadway that restricts the normal daytime natural illumination of a roadway section such that the driver's visual sensation is diminished. In order to classify changing lighting requirements along with the tunnel length, tunnel is evaluated in the form of sub interior zones: the access zone, the threshold zone, the transition zone, the interior zone, the exit zone and parting zone.

### **Traffic Flow**

The number of vehicles passing a specific point in a stated time in stated direction (s). In tunnel design, peak hour traffic, vehicles per hour per lane, will be used.

### **Design Speed**

The design speed is the speed for which the tunnel is laid out. It is generally accepted that this speed is the maximum speed allowed on the access roads to the tunnel.

### **Reference Point**

The reference point is in principle the point located in the center of the approaching lanes, at a height of 1,5 m and at a distance from the entrance of the tunnel equal to the stopping distance (SD) at the design speed.

### **Stopping Distance**

Stopping distance is the distance necessary to stop the vehicle moving at the speed in question in total safety. It comprises the distance covered during the reaction time and during the braking time.

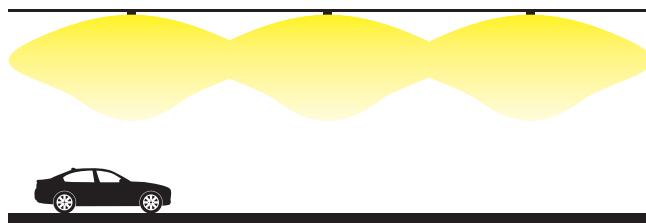
## DESIGN CRITERIA

### TUNNEL LIGHTING DISTRIBUTION TYPES

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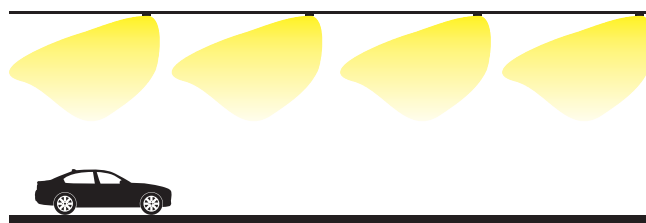
#### Symmetric Lighting

The lighting where the light equally falls on objects in directions with and against the traffic. Symmetric lighting is characterized by using luminaries that show a luminous intensity distribution that is symmetric in relation to the plane normal to the direction of the traffic.



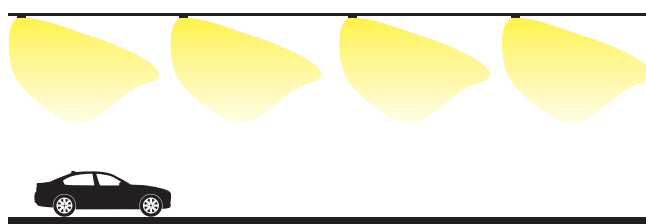
#### Counter-beam Lighting

The lighting where the light falls on objects from an opposite direction to the traffic. Counter - beam lighting is characterized by using luminaries that show a luminous intensity distribution that is asymmetric in relation to the plane normal to the direction of the traffic, where the maximum luminous intensity is aimed against the direction of the traffic. The term refers only to the direction of normal travel.



#### Pro-beam Lighting

The lighting where the light falls on objects in the same direction as the traffic. Pro-beam lighting is characterized by using luminaries that show a luminous intensity distribution that is asymmetric in relation to the 90/270 C - plane (the plane normal to the direction of the traffic), where the maximum luminous intensity is aimed in the same direction as the direction of the traffic.





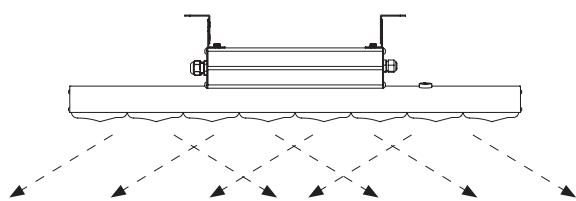
## ADAPTIVE LIGHTING

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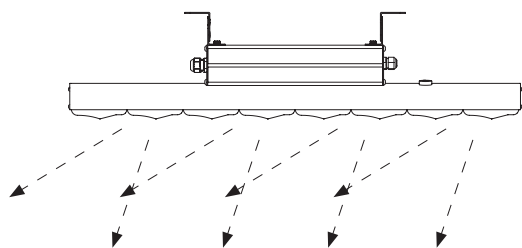
Depending of the design criteria, you would need different light distributions along the tunnel such as Pro-beam, Counter - beam or Symmetrical. Especially in "Transition zone", there is common use of Symmetrical light distribution where the driver would need to see any objects within the stopping distance. In principle, stopping distance is calculated according to traffic flow. But traffic flow is not constant in general, it means there are different times of the day where you'll see high or low traffic.

There are several researches that proves main reason for the accidents in tunnel is not related to seeing any object but the car next to us. When the traffic flow is higher than expected, to be able to see the next car, Pro-beam lighting would be sufficient and even visually more comfortable as the light will only be directed in front of the driver.

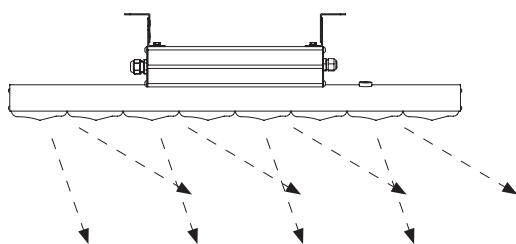
This is where the T-Light concept comes along. T-Light is a unique luminaire that has electronically switchable optical units providing Pro-beam, Counter - beam and Symmetrical light distribution. Thanks to the patented Milestone® technology of Heper, it's possible to control separately two PCB's within the Milestone® module. With a careful planning, it would be possible to have an intelligent approach to the tunnel lighting design. When there is high traffic flow, system can change to Pro-beam light distribution automatically. This means more visual comfort, less accidents.



Symmetrical Light Distribution



Counter-beam Light Distribution



Pro-beam Light Distribution





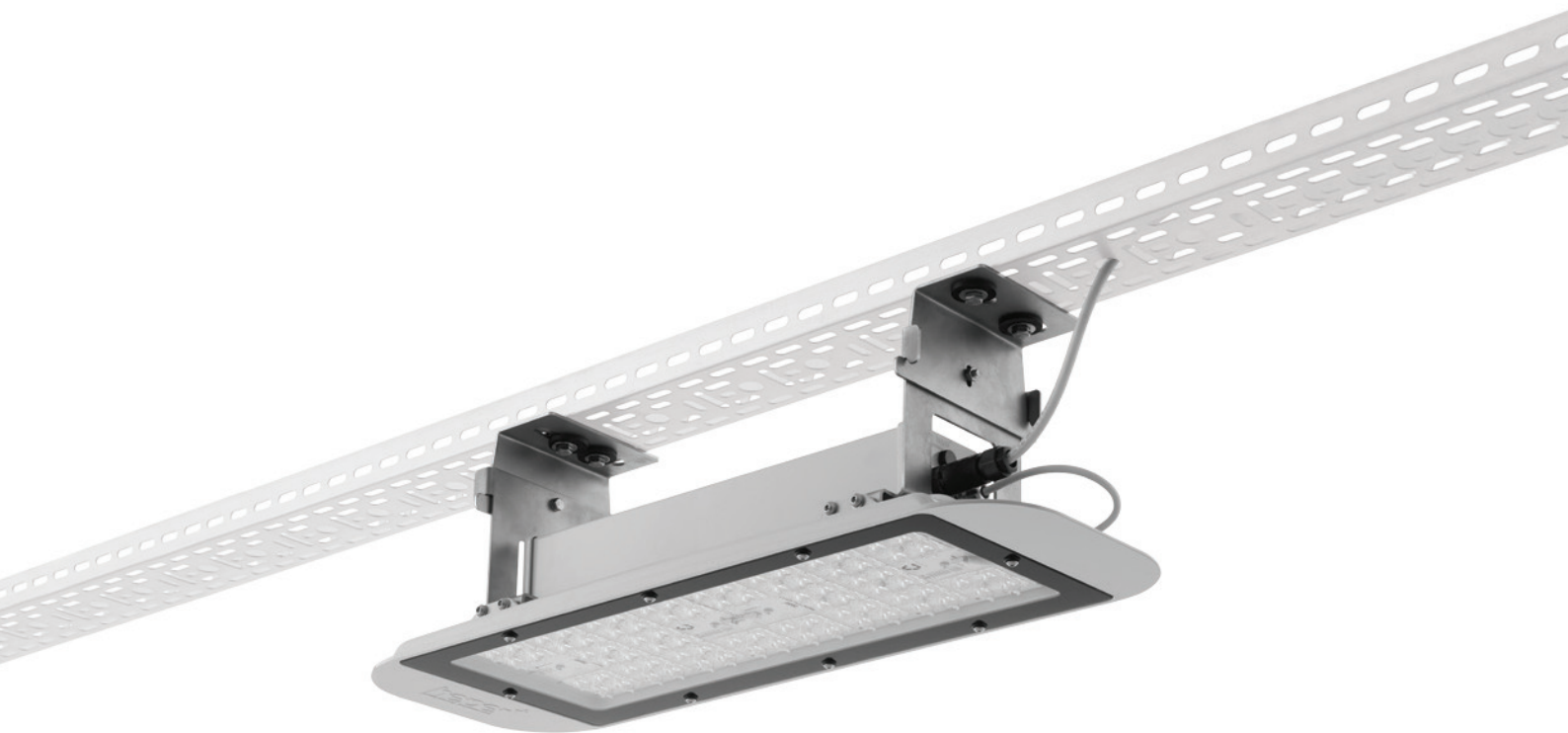
# GOLEDO

**STATE OF THE ART TUNNEL LIGHTING LUMINAIRE**



With dozens of optical distribution options, there is no tunnel out there that our Goledo cannot thrive in.

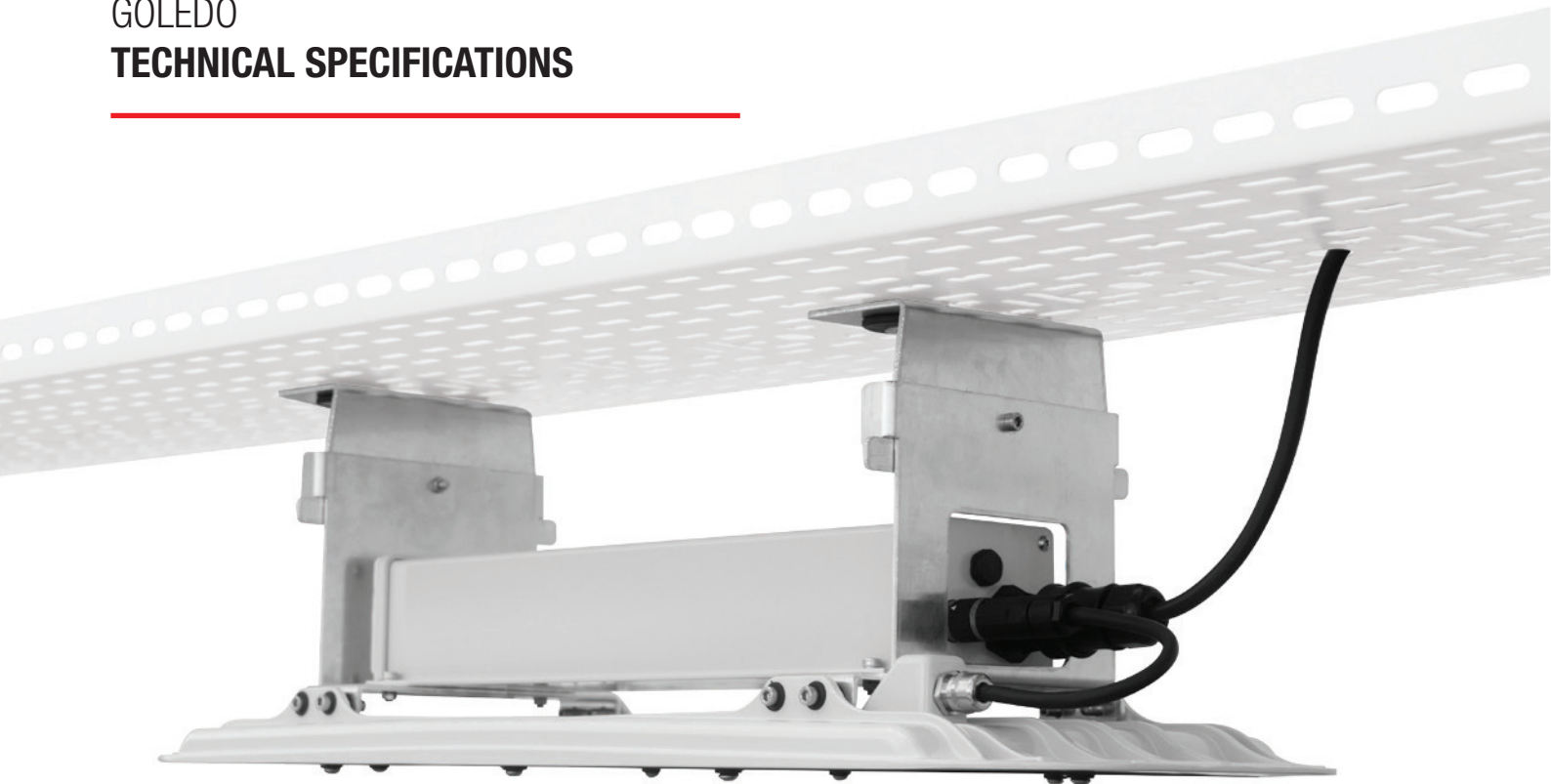




## GOLEDO

### TECHNICAL SPECIFICATIONS

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#### GENERAL HIGHLIGHTS

- Various optics for different tunnel and underpass applications
- Operating temperature: -40°C / +55°C
- Easy installation and maintenance
- Direct cable tray mountable
- Halogen free cabling
- Silicon gasket
- Unique no-carry mounting and maintenance system
- Exceptional thermal characteristics
- In compliance with EN 60598, EN 62722
- ENEC and UL certified

#### ELECTRICAL PROPERTIES

- Drive current: 350mA, 525mA, 700mA
- Optimized PCB design
- Insulation class: CLASS I, CLASS II
- Energy class: A+
- Power factor > 0.95
- Input Voltage: 220V - 240V / 110V - 120V (optional) at 50Hz /60Hz
- Control Type: 1-10V, DALI, StepDIM, AstroDIM

#### OPTICAL PROPERTIES

- Various lens arrangements for different zones and different installation areas
- Homogenous light distribution
- Reduced glare with special lenses with transmission > 95%
- Power Chips
- MacAdam Ellipse 3
- Lumen output (absolute photometry): 7200lm - 21500lm
- Color Temperature: 3000K, 3500K, 4000K
- CRI > 70 (4000K), CRI > 70 (3500K) CRI > 80 (3000K)
- Lumen depreciation: L90B10 > 118000h
- Photobiological safety: Risk Group 1
- Efficacy (absolute photometry): 127 lm/W for 4000K at 700mA

#### BODY HOUSING & FINISH

- Corrosion resistant die-cast aluminum housing
- Electrostatic powder coating
- RAL 7035 standard color with optional RAL codes
- Ingress protection: IP66
- Impact protection: IK08

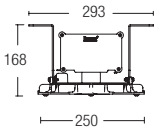
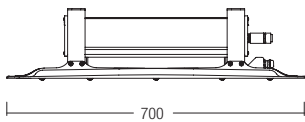
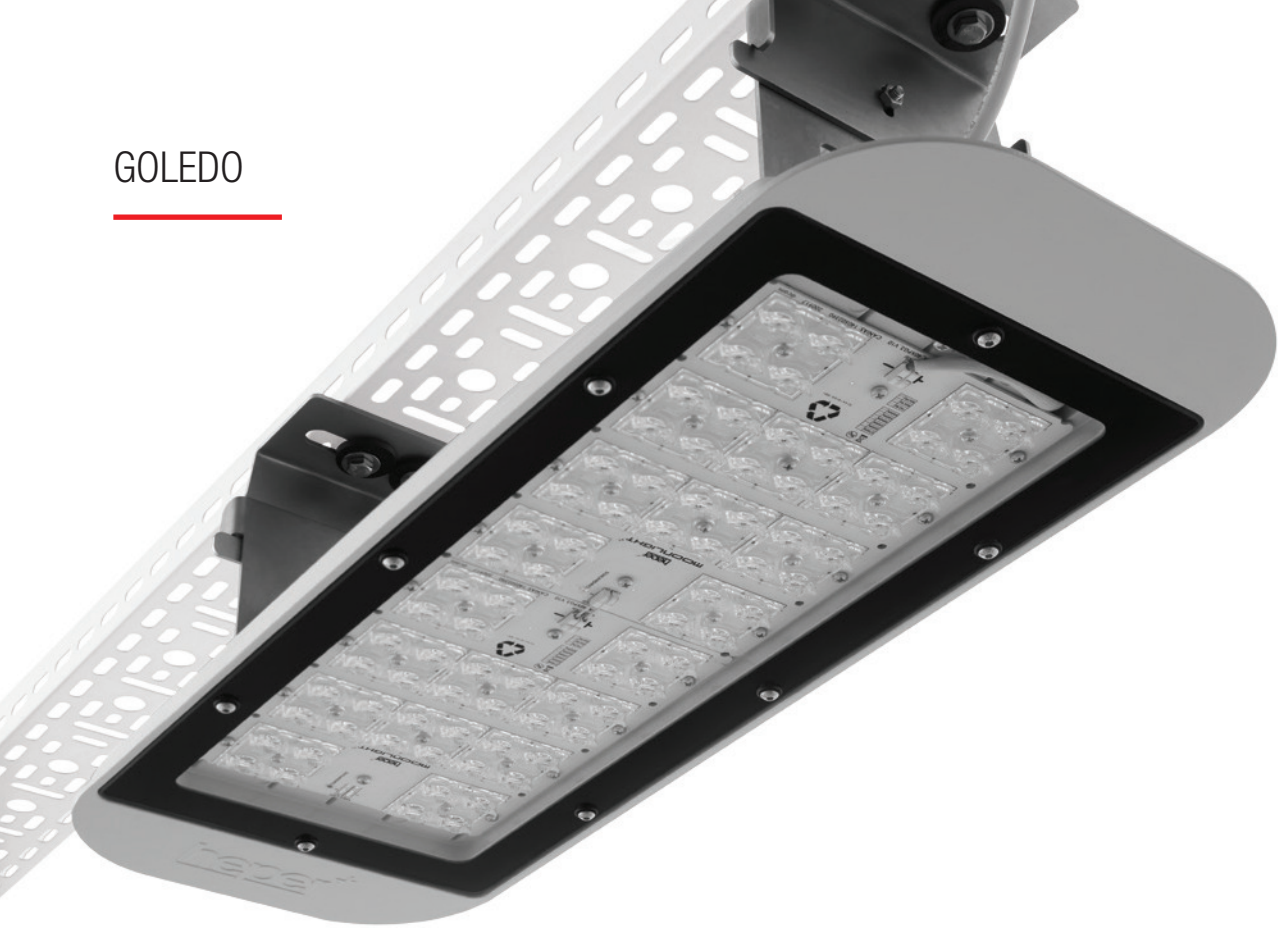
#### EXTRAS

- Constant Light Output
- Programmable driver for different scenarios
- Marine grade coating
- Different light distribution options
- Chromate coating prior to paint

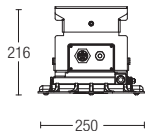
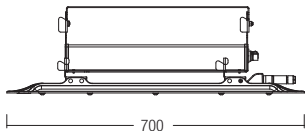
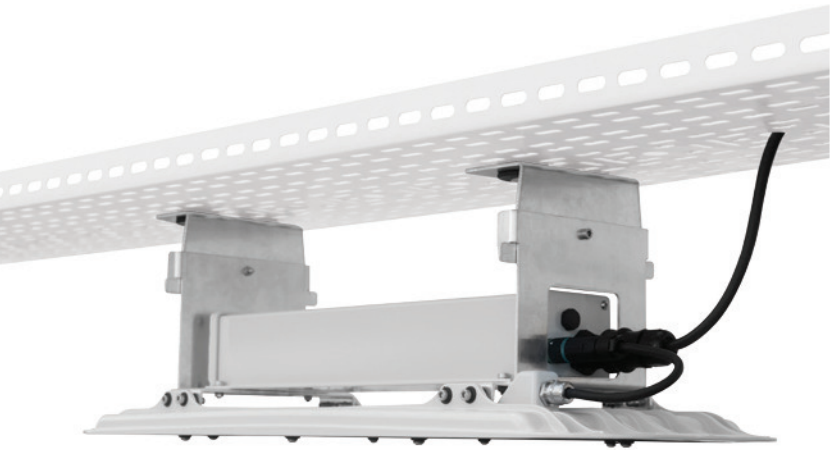




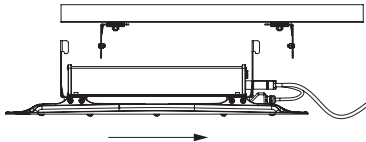
GOLEDO



Standard bracket

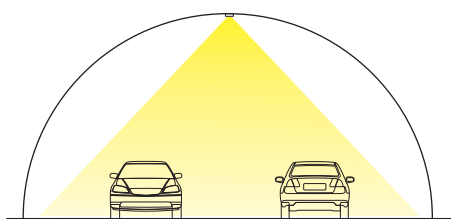


Slide mount bracket

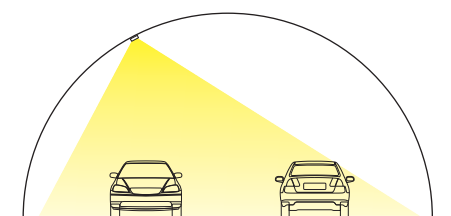


No-carry slide mount system





Goledo Sym



Goledo Asym

### Symmetric Distribution

SYM-XX-(W) – Longitudinal spread 75° and wide symmetric spread 45°

SYM-XX-(M) – Longitudinal spread 75° and wide symmetric spread 50°

### Asymmetric Distribution

ASYM-YY-(W) – Longitudinal spread 75° and narrow transverse spread 30°

ASYM-YY-(M) – Longitudinal spread 75° and wide transverse spread 60°

### Counter Beam Distribution

CB-YY – Asymmetric Throw 50°

CB-182 – Asymmetric Throw 45° and narrow symmetric spread 25°

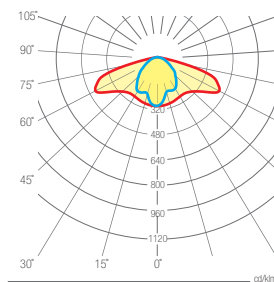
CB-164 – Asymmetric Throw 45° and narrow symmetric spread 30°

### \* Light Distribution options for Goledo Sym and Asym (XX);

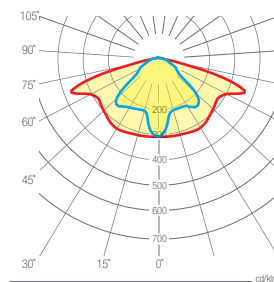
- 44 for 32 LED
- 55 for 40 LED
- 88 for 64 LED
- 1010 for 80 LED

### \* Light Distribution options for Goledo CB (YY);

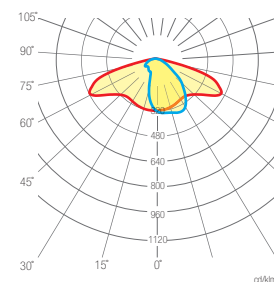
- 80 for 32 LED
- 100 for 40 LED
- 160 for 64 LED
- 200 for 80 LED



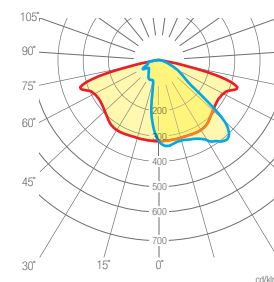
Goledo Sym W



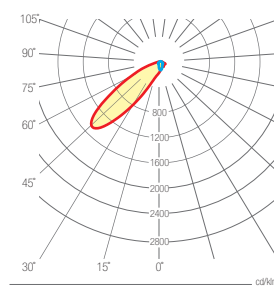
Goledo Sym M



Goledo Asym W



Goledo Asym 80 M



Goledo CB

### Mounting options



Standard bracket



Slide mount bracket



Tunnels



Underpasses



LUMINAIRE				
CODE	DESCRIPTION	POWER (700 mA)	LUMEN	COLOR TEMPERATURE
LT2037.761	GOLEDO T 32 LED	70W	7200lm - 8000lm - 8500lm	3000K - 3500K - 4000K
LT2037.765	GOLEDO T 40 LED	90W	8600lm - 9600lm - 10250lm	3000K - 3500K - 4000K
LT2037.767	GOLEDO T 64 LED	136W	14400lm - 16000lm - 17000lm	3000K - 3500K - 4000K
LT2037.766	GOLEDO T 80 LED	170W	18100lm - 20200lm - 21500lm	3000K - 3500K - 4000K

### Mounting options

Standard bracket: 110819035  
Slide mount bracket: 120162103

Ordering guide : **Product Code - Light Distribution - Mounting option**  
i.e. LT2037.765 - CB80 - 120162103







