THORN

Applications in Focus

Road Lighting

Trust us to save you more

Road lighting trends towards energy saving

We all need to get from here to there and more than ever we need to do so with ease, safely and using less energy. At night our journey becomes more difficult and it is road lighting that transforms our routes. It takes a lot of experience and expertise to provide appropriate lighting that enhances safety yet meets today's demanding energy reduction ambitions. Thorn has been involved in road lighting since the early innovations, we developed and applied many of the light sources and luminaires, consistently driving down energy use each time. You can be sure that today we continue to provide dependable performance and smart solutions in road lighting encompassing the latest changes in technology.

As the trend towards urbanisation continues this energy saving journey involves connecting light with the application; application with time and time with the user. There is a growing demand for better control of energy, reduced light pollution and wider compatibility with diverse digital systems. This can only be achieved when you understand the wider application. This brochure collects together advice on controls, luminaires and creating the right environment, developing the right solutions that save energy.

Globally, there is a trend to use LED and white light that is enabling us to both lower the energy required for lighting and lower the required lighting level. Research proves that we simply see more efficiently in whiter light than under conventional light sources. This combined with LED challenges us to control and dim our street lighting, setting light in the right place and quantity, using Thorn systems or by integrating your preferred controls. Changes in technology and legislation help us to support you with your carbon reduction targets, to control obtrusive light and to reduce energy, all moving you towards achieving tough environmental standards. Switching off is no longer your only choice, dimming positively impacts energy usage and keeps our roads and streets safe for all.

The other significant trend is within outdoor lighting controls. LED means controls are becoming available to all, either by local presence detection, part night dimming, linked groups of fittings responding to a wider influence or through digitally connected cities. The ability to interact with lighting, use data to fine tune the energy and performance profiles is enabling municipalities to react to the needs of the population, to lengthen the life of an installation and to plan for the future. Lighting more than ever can be efficient, respect our need for dark and yet stimulate a truly smart city. To achieve all these aims takes a team working with you that has experience, practice and a heritage of great projects.

To demonstrate this we have included just a small collection of the many projects we have completed showing that at Thorn we have a long heritage of lighting roads, across all applications, proved through reliable solutions and backed up by our customers - a true Thorn Lighting experience.

Trust us to save you more.

Why Thorn Lighting?

As a globally trusted supplier of outdoor and indoor luminaires with integrated controls, we have decades of experience in luminaire development. Leveraging our research and development facilities, we actively work to raise lighting standards and are uniquely placed to combine the latest light source technology with our specialist expertise in optical and luminaire design. Through delivering high performance and sustainable lighting we are able to meet international demands while exceeding the requirements of customers to become the preferred partner for cost-effective lighting solutions.

Spanning a wide range of industries and sectors, our integrated solutions can be found in many different applications such as road, sport, tunnel, office, education or industry lighting, offering energy savings without compromising performance, efficiency and comfort. When lighting smart cities with our products a solution where aesthetics, optical performance, energy consumption and maintenance are all in perfect balance can be achieved.

The Thorn Experience – Durham County Council

A partnership spanning more than 50 years, based on trust and innovation

With a population of more than 500,000, Durham County Council is one of the largest local authorities in England. As with many other UK and Ireland local authorities, it has a long history spanning more than 50 years working with Thorn – a partnership first ignited by the mass production of street lighting.

Today Durham County Council has approximately 86,000 streetlights and illuminated traffic signs throughout the county, contributing to one of the council's biggest energy costs. In line with the Carbon Reduction Commitment Energy Efficiency Scheme (CRCEE) and the Climate Change Act, the council has been working to reduce both its total energy consumption and CO_2 emissions by 40% by 2016.

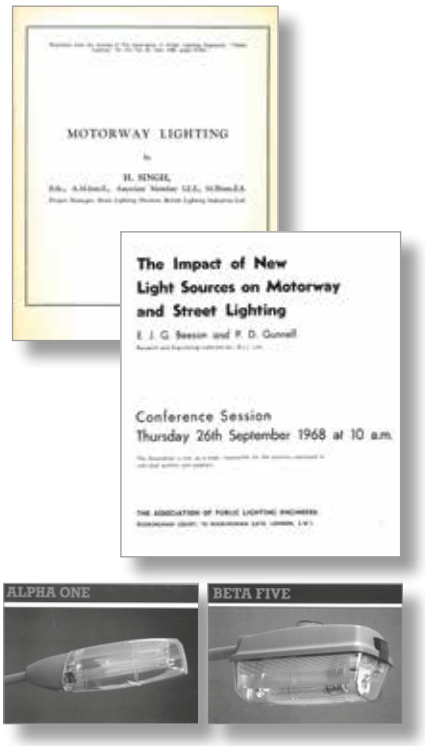
One important part of the initiative is the upgrading of conventional technology to LED. Since 2010 Thorn has supplied more than 14,000 LED road lanterns as part of a major ongoing programme to replace all of the council's inefficient SOX, SON and Cosmo lanterns. In 2010 the luminaire installed was Oracle S as this product was the best fit for the purpose; over 8,000 fittings have been installed. Most recently, in 2013, Thorn won a contract based on the price, photometric performance and efficiency of its lanterns to supply Isaro LED and R2L2 LED lanterns over a 6-year period; over 6,000 of these luminaires have been installed so far.

Darren Hubbard, Senior Street Lighting Engineer, Durham County Council, says: *"Thorn Lighting has been a road lighting partner to Durham County Council since the 1960s. We have found a long-term procurement approach with Thorn to be very beneficial, delivering benefits from continuous product and service improvements."*

"By building on our previous experiences and project successes we can always expect and enjoy more from Thorn. We benefit from faster installation processes and lower energy consumption plus greater service efficiency. Going forward, I expect the products and services provided by Thorn to continue to improve to offer even better quality and performance while still providing excellent value for money".

Before

After



The mass production of street lighting started for Thorn in the 1950s, closely followed in the 1960s with the Alpha One and Beta Five. After that the portfolio of the Alpha and Beta families was enlarged as lamp technology improved through mercury lamps, to low pressure sodium and high pressure sodium.

Thorn held a unique position at that time with high pressure sodium lamps using the Mazda brand. Strong cooperation with local authorities was strengthened through optics that were developed around this lamp and optimised for their needs.

Performance. Efficiency. Comfort.

New lighting technologies and design principles not only improve performance, efficiency and comfort, but serve as the catalyst to sustainable design. Here, we review the most relevant recent advances and highlight their application for smart roads.

Performance

Superior optical control

The optical system of an outdoor luminaire has to be designed to satisfy a number of criteria. The main factors are the type of light distribution required and the choice of light source. Previously the main light sources were traditionally sodium, mercury, ceramic metal halide based discharge and even compact fluorescent (CFL) but these are now surpassed by light emitting diodes (LED).

The size of the light source influences the options open to the designer. The shape of CFL dictates a longer, narrower lantern with little scope for varying the light distribution in the plane of the lamp axis; compact metal halide lamps enable increased options by moving the lamp within the reflector. LEDs due their size and directionality lend themselves to a greater variety of optical arrangements resulting in distributions with excellent control. Thus modern optical designs, materials and techniques can deliver more controlled light distributions and maximise performance. A notable example is EQflux®, an intelligent electronic driver that dims pairs of LEDs in relation to each other and as a result tunes the light distribution of the lantern to the specific road conditions.

Enhanced colour rendering

The greater use of luminaires with "white light" sources (LED, metal halide and compact fluorescent) enhances visual performance due to the output spectrum being more suited to the eyes' own response at low levels of illumination. It allows equivalent recognition at lower light levels.

Efficiency

Greater efficacy, longer life and reduced maintenance

The design of the luminaire, including optics, and the right light source and gear combination, have a direct impact on energy consumption and maintenance costs. Miniature metal halide and LEDs in particular are sources renowned for high quality optical performance with low energy consumption in many applications.

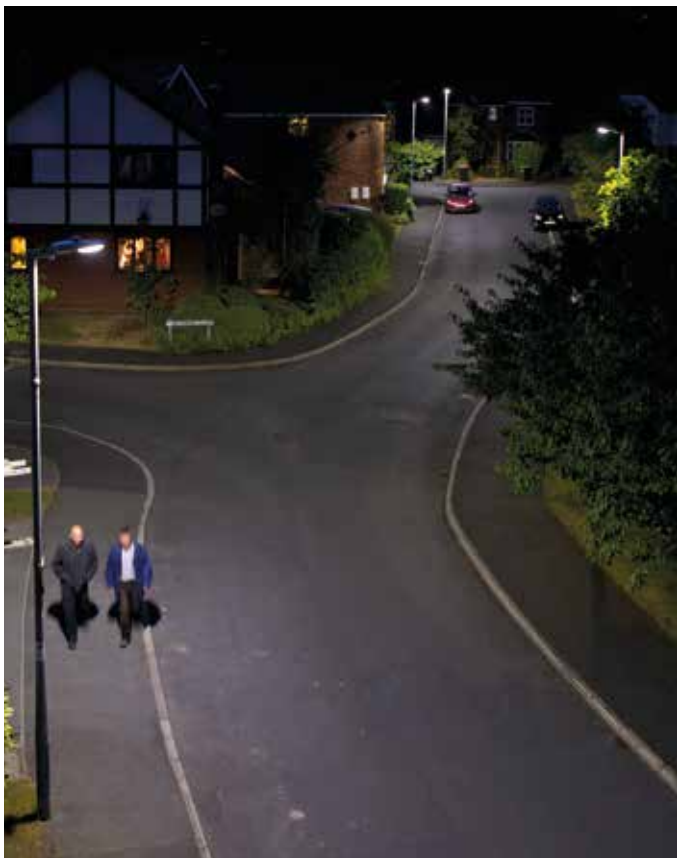
High frequency electronic ballasts have the operational advantage of improved lamp efficacy and life, reduced energy consumption, with the capacity for dimming or power reduction and automatic control, in a lightweight one piece housing. LED drivers can take advantage of flexible drive currents to maximise energy efficiency.

Used to their full potential in well-designed luminaires these technologies can achieve energy savings in excess of 80% on refurbishment projects. In addition, the S/P ratio properties of these white light sources enable lighting levels to be lowered in certain applications and countries, such as residential areas, thus saving further energy and emissions.

With correct thermal management LED can last longer compared to other conventional light sources. When combined with lighting controls that dim and provide feedback as well as the longer life of LED light sources, the impact on maintenance demands and costs can be significant, reducing the need for night-time scouting, and reducing the need to change lamps. Thorn provides a variety of lighting design software, such as ecoCALC, to help calculate savings quickly and assess the life cycle cost of a project.

Environmentally-friendly

At Thorn, we put an emphasis on sustainable practices, such as designing products to last longer, to use materials that can be recycled and easily dismantled at the end of life, and to minimise the use of toxic materials and packaging. Our programme to introduce full Environmental Product Declarations for each new product demonstrates part of our commitment to Corporate and Social Responsibility.



Comfort

Lighting to suit modern transport routes is not just about delivering optimum levels of light for effective performance and energy saving. The right light can generate feelings of safety, reduce stress, increase focus and orientation, improve confidence and provide reassurance. Today's LED luminaires are not limited by the traditional design constraints and with the use of digital technology enable the lighting to be adapted to suit the needs of the user.

Outdoor Lighting Controls

From a single luminaire, through to luminaires grouped into a fully connected network, remote locations or city centres, we can switch, dim, monitor and feedback using proprietary or open protocols, based on wired or wireless technologies with the integration of sensors, energy, data and other digital systems.

All outdoor lighting applications require a control mechanism to enhance energy savings and comfort levels. The most basic is provided by photocells or time controlled switches. The quicker run-up times of modern light sources enables the user to "trim" annual burning hours. Many Thorn luminaires are now available with integral bi-power switches, a flexible device used in conjunction with the power reduction facilities offered by electronic ballasts and LED drivers. Bi-power enables light source power to be varied by switching between power levels controlled by a dedicated control line or standalone device within the luminaire, or by mains bourne digital signals. The ease with which LED can react to changes in power underlines their suitability to this form of control.

A central management system (CMS) offers a different dimension. Utilising either power line or radio frequency data transmission, it allows control of all the light points of a road network from a centralised or decentralised point. CMS functions best with lamps optimised for use with digitally controlled electronic ballasts and LED drivers.

Benefits include:

- The facility to dim or turn off luminaires at specific times based on pedestrian and traffic flows
- Optimisation of energy use
- Flexibility to adapt to an incident, specific area, event or activity
- Monitoring to report failures and streamline maintenance programmes, CMS is a fundamental step in creating 'intelligent roads" as it can integrate with renewable energy and smart grids

From a standalone lighting point to a local group of luminaires to a remote central management system, Thorn offers support in selecting and implementing the best solution for the project requirements to optimise long-term sustainability.

OLC Single
Standalone control

1

Presence detection, photocells and time switches

These simple controls offer reliable savings without the need for much thought. A photocell fitted to each luminaire can save as much as 50% simply by reacting to the available daylight, potentially presence detectors offer higher savings by switching on the lighting only as needed. Time switches on the other hand are more suited to controlling to a known activity profile, such as switching off the entrance road lighting after a building is closed for business. Most road lanterns from Thorn can be offered with photocell options that require no commissioning. Luminaire

OLC Group
Local control

2

Cabinet control for a group of luminaires, via radio frequency, mains or control line.

Control for a group of luminaires, either cabinet based or within a master luminaire, via radio-frequency, mains or control line. Using a local control cabinet or mounting within a master luminaire, this system allows the dimming of a group of lighting points according to the detection of people and vehicles. Establishing a simple master slave operation by circuit cabling, or by segments via software, the system can control a group of lighting points

OLC Total
Central control

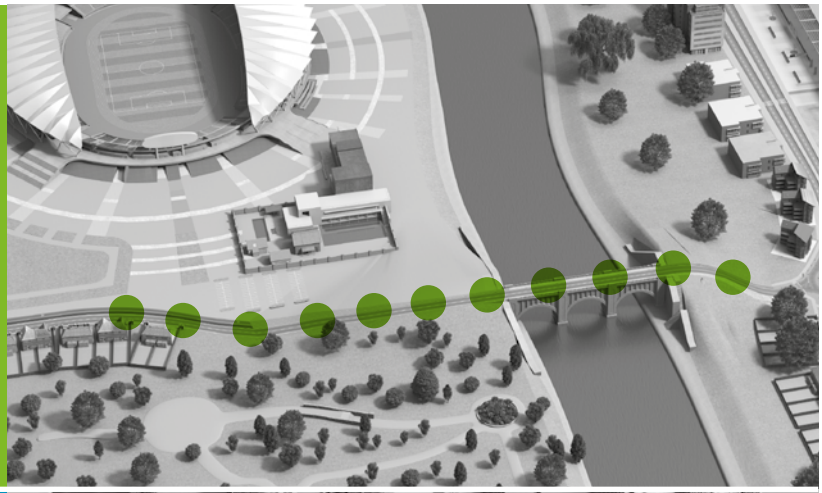
3

Remote central management systems for individual control and monitoring, via power line or radio frequency

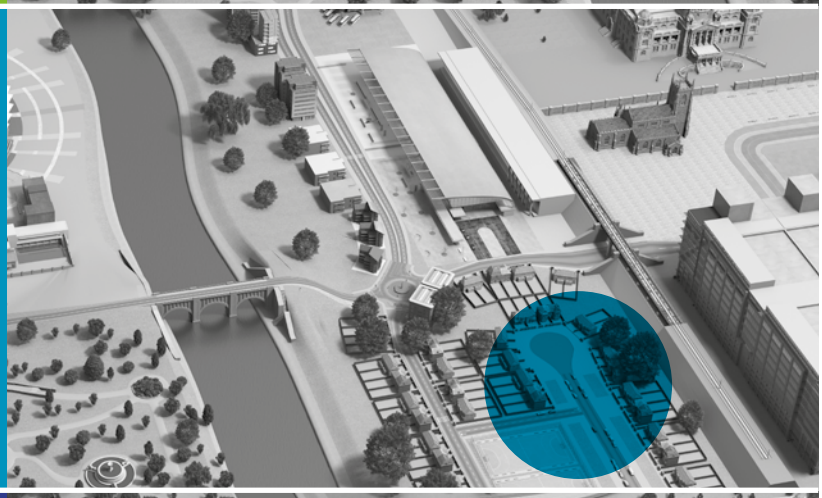
The use of a central management system allows road lanterns to be remotely accessed and viewed in real time. Using power line or radio frequency, remote control of individual lighting points or groups of luminaires can be achieved. These can be switched or dimmed to directly influence energy use and to collect performance data.

With remote central management it is possible to provide operation and maintenance savings through reductions in the need to visit lighting points or scout for failures.

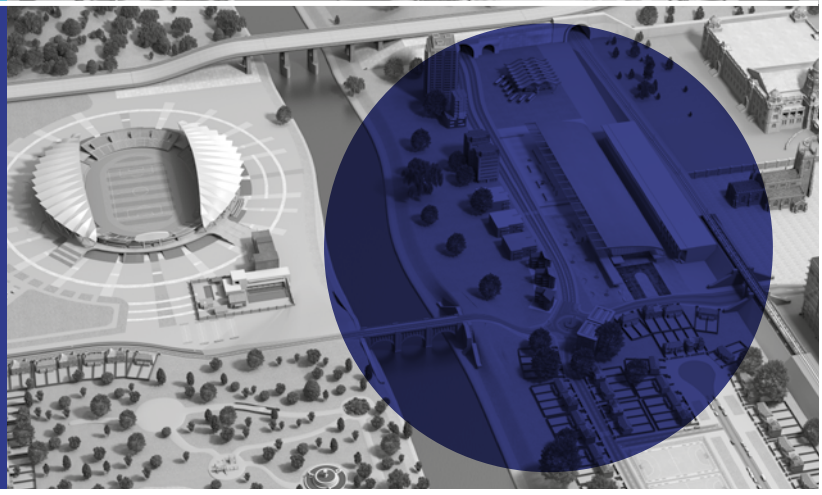
standalone dimming (from 2 levels to several levels) to suit both the user and project profile. Bi-Power gear, standard in many lanterns from Thorn, offers the chance to dim related to the time of night. We know traffic and pedestrian use drops later in the evening and again after midnight. Bi-power options allow the dimming to 50% light output for up to 8 hours of the night. The system requires no commissioning and responds to the changing length of the night throughout the year automatically. Even better it comes as standard in many luminaires, offering an instant 33% energy reduction, with the choice to switch bi-power dimming off where the facility is not required. Programming to specific application needs is also possible.



through one or many inputs, such as radar detectors, to create a corridor of light. Without the need for extensive commissioning this approach offers good energy savings but will provide safety through light on demand or for events in specific zones. For cabinet based versions, measurement and maintenance feedback (by wireless or USB connection) is easily accessible from the local control box reducing the need to visit every luminaire

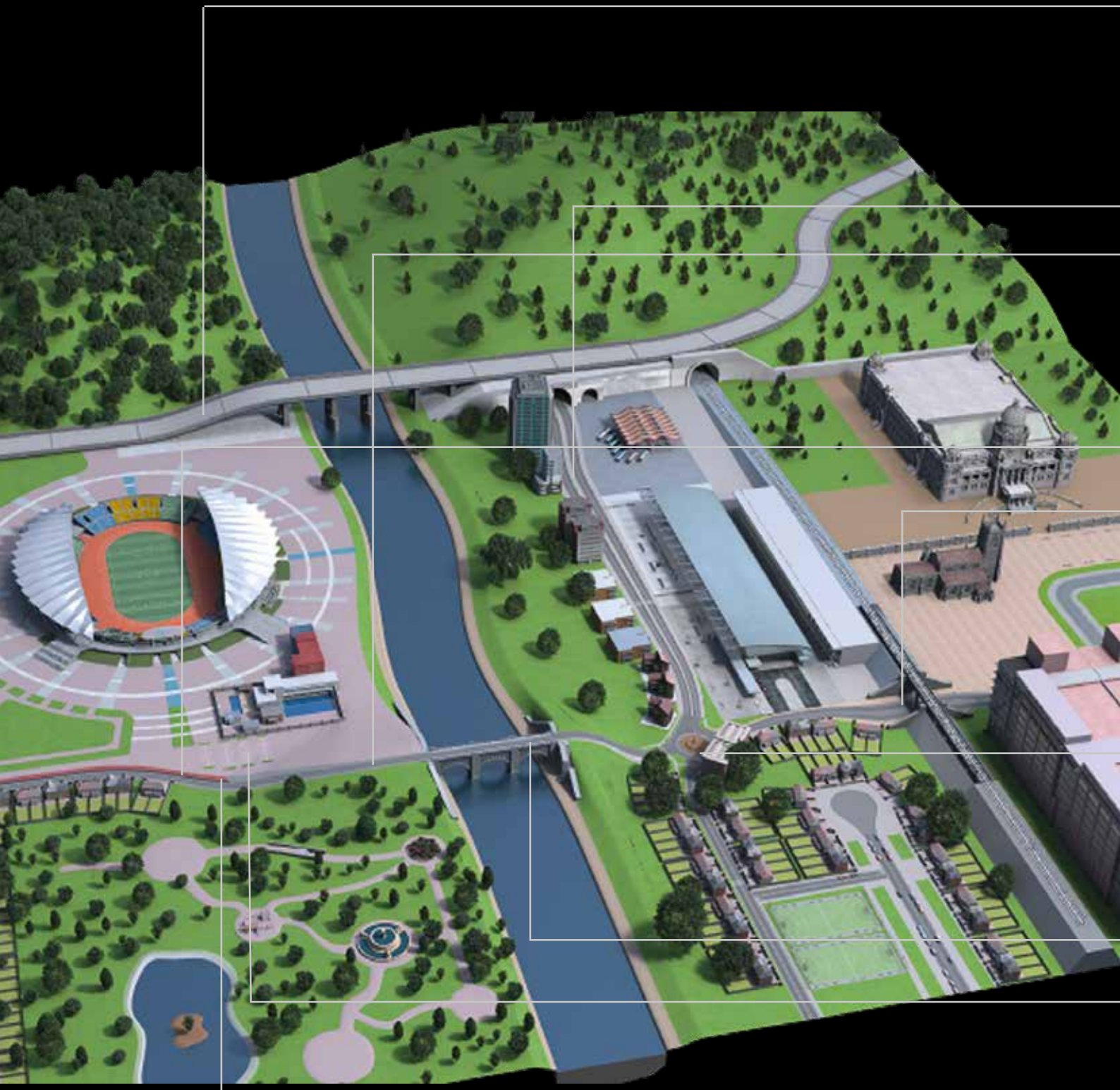


This reduction in demand on resources can be achieved through reduced use of service vehicles as a result of checking failures or adapting lighting remotely to events or weather conditions without the need to attend site. Remote central management can also reduce complaints from the public by providing the right light at the right time and allow dimming according to needs, events, time of year or energy reduction.



Road Lighting

A guide to Thorn products and their applications



Highways/Motorways p12
Gotthard
Oracle
Oxane
R2L2

Main Roads p16

Civic	Orus LED
Dyana LED	Oxane
Isaro LED	R2L2
Krystal	StyLED
Olsys Street	Victor LED
Oracle	Victoria LED

Minor Roads p20

Avenue F LED	Olsys Street
Celest	Oracle
Clan C	Orus LED
Clan O	Oxane
Dyana LED	Plurio LED
Isaro LED	R2L2
Jet	Victor LED

Minor Roads with Cycle Paths p24

Avenue F LED	Olsys Street
Celest	Oracle
Clan C	Orus LED
Clan O	Oxane
Dyana LED	Plurio LED
Isaro LED	R2L2
Jet	Victor LED

Residential Roads p28

Atla LED	Isaro LED
Avenue D	Krystal
Avenue F LED	Olsys Street
Celest	Oracle
Christian IV LED	Oxane
Civic	Plurio LED
Clan C	R2L2
Clan O	Victor LED
Dyana LED	Victoria LED

Pedestrian Crossings p32

Avenue F LED	Oxane
Dyana LED	Plurio LED
Isaro LED	R2L2
IVS	Victor LED
Legend	

Roundabouts p36

Civic	Oxane
Dyana LED	R2L2
Isaro LED	StyLED
Krystal	Victor LED
Oracle	

Bridges p40

Atla LED	Orus LED
Clan C	Oxane
Clan O	R2L2
Dyana LED	Victor LED
Isaro LED	Victoria LED
Oracle	

Car Parks p44

Atla LED	Olsys Street
Avenue D	Oracle
Avenue F LED	Oxane
Christian IV LED	Plurio LED
Civic	R2L2
Clan C	StyLED
Clan O	Victor LED
Dyana LED	Victoria LED
Isaro LED	

Cycle Paths p48

Adelie Bollard	Clan O
Atla LED	Isaro LED
Avenue D	Olsys Street
Avenue F	Oxane S
Christian IV LED	Plurio LED
Civic	R2L2
Clan C	Victoria

Highways/Motorways

Creating the right environment

The lighting should assist the road user to travel to their destination safely and securely at high speed, dependant on the prevailing weather and traffic conditions. Any object at the road edge must be seen without excessive and obtrusive light encroaching on the immediate surroundings. It is important to select an energy efficient, easy to install and maintain luminaire and light source combination. The objective is to meet regulations and standards, such as EN13201, which specify light levels with correct uniformity and glare control, relevant to the conditions and geography.

Thorn luminaires are designed to meet these standards. With a consistent approach we analyse the trends, application demands and standards that apply before the luminaire design starts. Our luminaires offer a choice of body size, shallow or flat glass enclosures, R-PEC LED optics, post-top or side entry and numerous light source and control options. This means that the luminaire provides the best performance regardless of the road layout. The result is less spill light beyond the road surface with better uniformity and savings in initial expenditure, less energy per metre of road and reduced future maintenance costs. There is always a Thorn road lantern to meet the needs of these high speed roads.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire standalone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

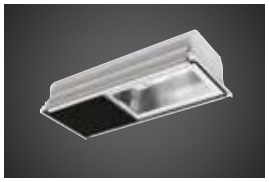
Norrortsleden Highway, Stockholm, Sweden

Good practice

Highways and motorways are designed for high speeds (>60km/h) where no pedestrians, cyclists or slow vehicles are involved. There are no intersections and access is controlled. Lighting class selection is given in PD CEN/ TR 13201-1 with the criteria defined in EN13201-2, ME for dry roads and MEW for wet conditions. Traditional mounting heights are above 12m to correctly light a twin carriageway with 3 or 4 lanes, plus a hard shoulder at either side. Twin-arm brackets should be considered to optimise performance. Although traditionally columns have been installed in a central reservation, an opposite installation with columns behind the hard shoulder can simplify maintenance operations and reduce traffic disruption. Glare is a major concern and an optimally designed optic and/or the use of flat glass enclosures are necessary. The column mounted luminaires should be located to minimise the risk of impact, give visual guidance of the route ahead, for instance curves, junctions and other hazards, yet blend effortlessly with the surrounding landscape.

Product range

Please find below a selection of products especially suited to the application:



Gotthard
www.thornlighting.com/GHSS

Oracle
www.thornlighting.com/ORCL

Oxane
www.thornlighting.com/OXAN

R2L2
www.thornlighting.com/R2L2

Case Study:
Cheung Pei Shan, Hong Kong

Noise barriers at Cheung Pei Shan road fitted with GT7824E

Cheung Pei Shan road is a busy highway in a highly populated residential area near Cheung Pei Shan in Tsuen Wan and Sheung Kwai Chung of Hong Kong. North of the road are resited villages from the old town of Tsuen Wan and Cheung Pei Shan. To its south are three large public housing estates.

To address the traffic noise impact on neighbouring residents, the Highways Department recently undertook the construction of approximately 645 metres of semi-enclosures and 870 metres of cantilevered noise barriers.

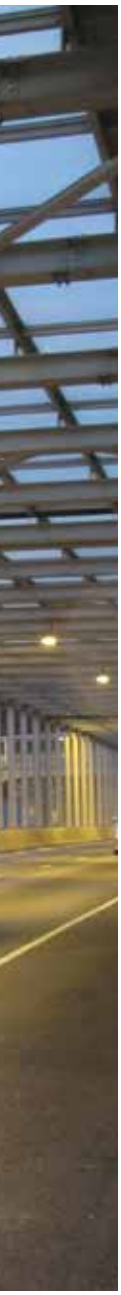
Having worked with Thorn on previous projects, the Highways Department already had a good relationship with Thorn and therefore approached the local team for a lighting solution.

Mr. Roger Leung, Sales Manager explains:
"The noise barriers present a harsh environment and therefore demanded a durable lighting solution. To meet the requirements, we supplied more than 100 GT7824E (400W) tunnel luminaires.

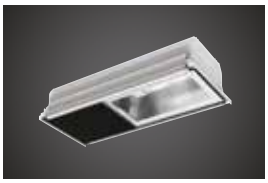
GT7824E is a dedicated tunnel lighting luminaire, perfectly suited to a semi-enclosed road, with robust construction and corrosion protection. Offering a variety of optical systems to suit different lamps and installation geometries, it provides a uniform symmetrical light distribution with excellent glare control.

GT7824E's lightweight construction with continuous closing clips allows seamless continuous mounting for an aesthetically pleasing effect. For ease of maintenance, it also offers front opening without tools, removable gear and easy access to the lamp and connections."

As a result of the installation, the Highways Department benefits from a highly robust and easy to maintain lighting solution.



Product used



Gotthard
www.thornlighting.com/GHSS

Key facts

- IP65 rated for durability
- Variety of fixing points with inclination adjustment from -15°to 65°
- Designed and manufactured to comply with EN60598

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at the Cheung Pei Shan road noise barriers:

Luminaire distribution
Optimised luminaire distribution allows a single row of well-spaced GT7824E luminaires to be used to correctly light the road to the correct standard. In turn, this reduces the quantity of fittings and therefore the overall energy consumption.

Task lighting
Careful design of the lighting installation concentrates light onto the road surface and immediate surrounds. This ensures a well-lit environment and highly efficient use of light.

Waste light
Careful selection of high performance optics and good lighting scheme design minimises spill light onto adjacent areas and into the sky. This reduces waste energy consumption and ecological disturbance in the surrounding area.

Main Roads

Creating the right environment

The essential difference between the lighting requirements for high speed roads and main roads is determined by the element of speed and the type of road users. On a main road there will be a wider variety of road users, increasing the need for visual clarity. Lighting is provided for reasons of safety, to aid navigation and orientation of the user on the road, albeit at a more moderate speed. Roads may not be separated by a central reservation.

Consideration also needs to be given to cost efficiency in terms of installation, energy use and maintenance through life and, from the perspective of the driver, the perception of safety through the correct levels of light, uniformity and low glare.

With "designed for LED" road lanterns Thorn can ease compliance with the demanding standards required for these roads. Using highly engineered heat sinks integrated into the canopy and patented combinations of LED optics we deliver superior optical performance, here for lighting classes up to ME3a, while providing comfort through good glare control as well as energy efficiency and maintenance cost savings.

In most cases it is unsafe to simply switch off the lighting, unless there are times when the roads are completely empty. Our offer therefore extends from full central control to group dimming, and individual mini-photocell and bi-power options to ensure optimum energy management, which is rightly the major aim after safety.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire standalone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Good practice

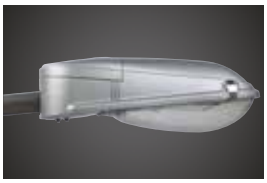
The main use of main roads is for vehicles at high speed (>60km/h) but pedestrians, cyclists or slow vehicles may also be present on footpaths, cycle paths and slow lanes. Intersections can be present and need special attention. The lighting criteria are chosen using the class selection given in PD CEN/TR 13201-1 with the criteria defined in EN13201-2, ME for dry roads and MEW for wet conditions.

A common installation will use columns at around 8-12m high and in an opposite or twin central configuration. Installations always need to be related to the road layout, the number of lanes involved and the lighting criteria. Catenary mounted solutions, where luminaires are mounted over the centre of the road, are popular options in some countries, especially in urban environments. Reducing the number of lighting columns should be balanced with the visual effect of additional suspension wires in architecturally sensitive areas.

As for controls the use of dimming, suited in reaction speed to fast moving vehicles and also to smaller slower pedestrians, will either dim automatically when it is known there are less users, or will react directly to traffic density, time of day and daylight.

Product range

Please find below a selection of products especially suited to the application:



Civic
www.thornlighting.com/CIVC

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

Krystal
www.thornlighting.com/KRYS

Olsys Street
www.thornlighting.com/OSYR

Oracle
www.thornlighting.com/ORCL

Orus LED
www.thornlighting.com/ORUS

Oxane
www.thornlighting.com/OXAL

R2L2
www.thornlighting.com/R2L2

StyLED
www.thornlighting.com/STYL

Victor LED
www.thornlighting.com/VICL

Victoria LED
www.thornlighting.com/VIKL

Case Study:
Polkowice, Poland

Indra LED transforms road lighting in Polish town of Polkowice

Thorn's Indra LED road lanterns have transformed the road loading throughout the town of Polkowice in Poland.

The budget-friendly lanterns were chosen because of their ability to meet and satisfy Polkowice Municipality's growing demand for white light of low glare, good illuminance and uniformity combined with a maintenance-free energy efficient performance.

Designed for use with high-efficacy 4200K LEDs the distinctly shaped lantern incorporates a flat glass optic within a sleek grey canopy and is suitable for use on strategic routes, subsidiary roads and residential streets (up to lighting class ME2 is achieved in Polkowice). The optic eliminates upward light above the horizontal plane and a long life minimises maintenance requirements.

Product used

Indra
www.thornlighting.com/INDR

Key facts

- Light distribution to suit up to ME2 classification
- Meets the growing demand for energy efficient white light
- Zero upward light reduces obtrusive light

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Polkowice:

Luminaire distribution
The lighting distribution provides for good visibility on the roads revealing possible hazards and enhancing safety.

System efficacy
LED combined with the latest lens and a sealed housing with integrated heat sink provides excellent luminaire efficiency.

Waste light
Flat glass optics in the installed position provide zero upward light.

Minor Roads

Creating the right environment

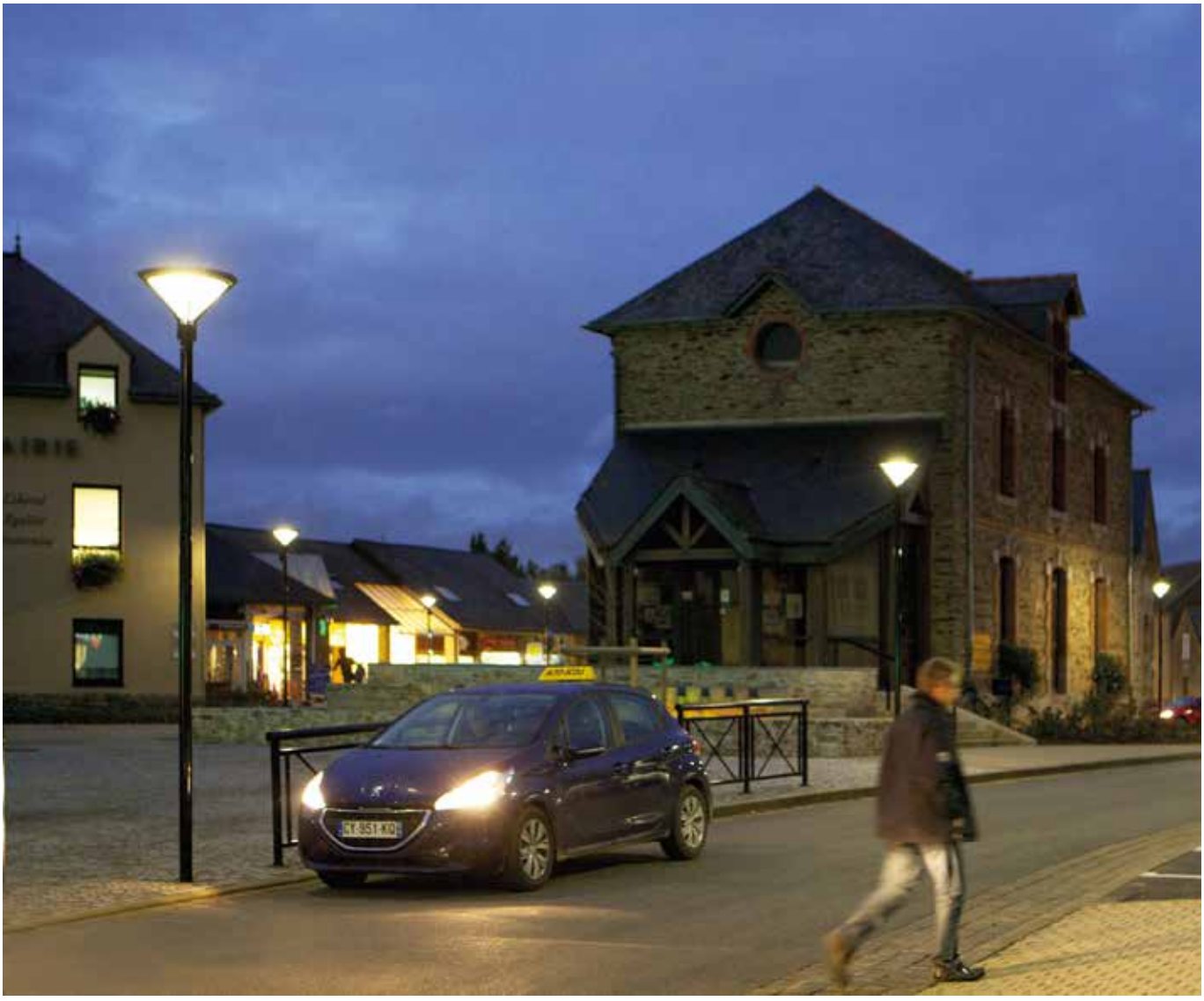
A mix of traffic will be found on minor roads including: motor vehicles, cyclists and pedestrians, all of which should be moving at a slower pace. The lighting levels are generally set at lower levels than for major roads as road users should be more attentive and have a longer time to react. The requirements of pedestrians, who need to see and be seen, particularly at intersections and crossings, now become vitally important and light will need to extend from the road across to cycle paths and footpaths. A good vertical element to the lighting distribution will help with facial recognition, reducing the fear of crime but also allowing drivers to read body language with other road users and predict what they are likely to do. White light is preferable, but use of high colour temperatures should be avoided. The application performance, energy management and glare control requirements will all help in luminaire and controls selection and the aesthetic may have to tie into the surrounding architectural style and feel. Remember that minor roads may sit within urban environments and light spill behind the luminaire should be limited to those surfaces required by the standards with less onto surrounding property.

Where these roads pass though rural zones they may remain unlit except for safety. In this case linked detection and controls systems can be used to detect oncoming traffic and maximise energy saving while preserving darkness when the road is empty.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency



Holeby, Denmark

Good practice

Minor roads are normally medium to low speed roads with a large number of slow vehicles and pedestrians. Intersections are common. Regional roads and urban roads are mainly part of this group as well as commercial streets. Lighting is generally in accordance with the less onerous ME classes defined in EN13201- 1, but the needs of pedestrians must also be taken into account using the guidance given in PD CEN/TR 13201-1.

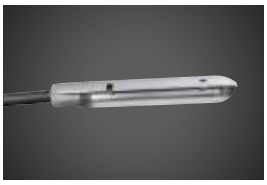
Columns 6-8m high are commonly used in a single sided or staggered layout, although in some commercial streets with wide footpaths an additional column and luminaire may be used to achieve high quality lighting and differentiate areas.

Visual comfort is achieved with good uniformity, low glare and lamps with good colour rendering which will promote a feeling of safety, particularly for pedestrians. The luminaires and support systems, which must be carefully located to minimise potential impact, should be in harmony with their surroundings. This will include the impact of dimming or switching of luminaires on surrounding domestic premises and their occupants.

Product range

Please find below a selection of products especially suited to the application:

Avenue F LED
www.thornlighting.com/AVFL



Celest
www.thornlighting.com/CLST

Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

Jet
www.thornlighting.com/JETA

Olsys Street
www.thornlighting.com/OSYR

Oracle
www.thornlighting.com/ORCL

Orus LED
www.thornlighting.com/ORUS

Oxane
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2

Victor LED
www.thornlighting.com/VICL

Case Study:
Schladming, Austria

International ski resort refurbished and equipped with LEDs

Schladming is one of the leading international ski resorts in Austria. It is part of the Ski Amadé network covering 28 ski areas and towns that make up the largest ski area in Europe. For the second time, Schladming was selected to host the FIS Alpine World Ski Championships, which took place from the 4-17 February 2013.

The goal of this lighting project was to renew the existing luminaires in the inner town and to light the new streets and roundabouts around the venue. Thorn was chosen to design and supply, largely due to the high technical specifications of its LED luminaires, energy efficiency expertise and longstanding reputation.

The Oxane (56W, 84W) road lantern was chosen for lighting the streets in lower ME-categories. Designed to deliver excellent lighting performance and energy efficiency, Oxane is at the forefront of LED technology. With excellent heat control and resistance to outside elements, the self-cleaning shape delivers accurate performance in Schladming's harsh conditions.

The post top Plurio O LED and Avenue F LED lanterns were selected for lighting the footpaths in lower S-categories. Plurio O is part of a large family offering style and performance to minimise obtrusive light. Conforming to the European Standard EN13201, Plurio O meets class G5, corresponding to a full horizontal cut off to prevent upward light. With the ULOR 0% accessory, Plurio even meets the most stringent class G6.

The Avenue F LED lantern features a prismatic crown for reduced glare and a distinctive modern aesthetic. Its state-of-the-art LED system provides performance, comfort and a unique light signature. Avenue F LED is part of an extensive family with coordinated columns and a wall mounted version.

All of the luminaires at Schladming have been installed with Thorn's bi-power dimming. Bi power reduces energy consumption and light output by 50 per cent for eight hours during the night. Bi power also extends the lifetime of the LED and has no effect on colour rendering or colour temperature.

By carefully selecting the right combinations of product, spacing and mounting height, it is ensured that the wide variety of tasks are efficiently and correctly lit with minimal waste light. The use of quality LED lanterns will significantly simplify maintenance requirements and reduce the quantity of spare parts to be held in stock.

Manfred Breitfuß, General Manager at Congress Schladming, says: *"The convergence of different villages into one city over the past few decades led to a few technical problems resulting from the likes of cluttering of different lighting points and extended cables.*

As part of the Schladming 2030 initiative, Thorn has been a competent partner and we look forward to the next steps together to illuminate Schladming more energy efficiently and safely."

As one of the key suppliers to the city of Schladming, Thorn took the opportunity to welcome 50 of its international customers to explore the city and take a tour of the installation while exchanging ideas on sustainable lighting solutions and LED lighting in general

Products used

Plurio LED
www.thornlighting.com/PLRL

Avenue F LED
www.thornlighting.com/AVFL

Oxane
www.thornlighting.com/OXAN

Key facts

- Complete LED migration project
- All of the luminaires at Schladming have been installed with Thorn's bi-power dimming
- Energy consumption and light output have been reduced by 50 per cent for eight hours during the night
- The use of quality LED lanterns will significantly simplify maintenance requirements

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Schladming:

Automatic scene setting
Through bi-power, lanterns can be dimmed to 50% output during the quietest hours of the night, resulting in a significant reduction in energy consumption.

Constant illuminance
Selection of the correct combination of product, spacing and mounting height ensures the wide variety of tasks are efficiently and correctly lit with minimal waste light.

Maintenance
The use of quality LED lanterns simplifies the maintenance requirements and reduces the quantities of spare parts needed to be held in stock.

Minor Roads with Cycle Paths

Creating the right environment

Where roads specifically contain a cycle path with only a white line to separate cyclist from other traffic the lighting needs to minimise potential conflict. In these zones cycle traffic may be considerable and may take priority over motorised vehicles. Cyclists will often have minimal lighting of their own.

Traffic speed will be naturally slower or may be deliberately slowed by traffic calming measures. The lighting needs to enable cyclist and motorist to see hazards in good time and to take avoiding action. Equally, light should allow road users to see and read facial expressions, and to clearly understand signage and road markings.

Control strategies should match those of surrounding roads. Where traffic is combined any sensor based technology should have higher sensitivity, reacting to slower speeds and the smaller trigger offered by a cyclist. The facility to dim luminaires should still be considered, but the lighting levels chosen will need to respect the reduced effectiveness of bicycle lighting.

Where the cycle path is not attached to the road the lighting becomes much simpler and can be mounted with a smaller scale and closer relationship to the line of the path. Here controls may significantly impact energy use with inclusion of detections systems and corridor like functionality.
Please see p. 48 for more information.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency
- Local control, via integrally mounted master and slave, grouping of bollards via high frequency detection of cyclists or pedestrians

Good practice

Where cycle and pedestrian pathways are present the use of luminaires with different light distributions is beneficial to comply with requirements for the road and also to be able to correctly light the pathways without needing to change the pole characteristics.

If cycle paths are set back from a main road or outside built up areas a separate lighting system is required. This can comprise 5-8m high columns with asymmetric post top lanterns or specifically designed bollards that have a wide angled distribution to provide a minimum number of lighting points. The wide beam distribution will also provide a good vertical illuminance, helping guidance along the path.

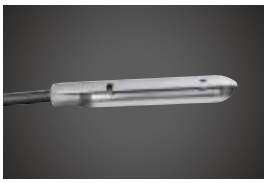
Where cycle lanes are marked out on existing roadways the road lighting classification should comply with S classes defined in EN13201- 1, using the guidance given in PD CEN/TR 13201-1. Where good facial recognition is important
A classes will be more appropriate.

At speeds of up to 40km/h good uniformity of the cycle path surface is paramount to allow early perception of hazards. The use of white light is now the accepted norm.

Product range

Please find below a selection of products especially suited to the application:

Avenue F LED
www.thornlighting.com/AVFL



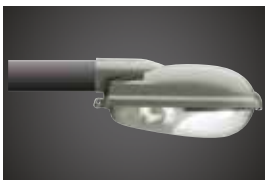
Celest
www.thornlighting.com/CLST

Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL



Jet
www.thornlighting.com/JETA

Olsys Street
www.thornlighting.com/OSYR

Oracle
www.thornlighting.com/ORCL

Orus LED
www.thornlighting.com/ORUS

Oxane
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2

Victor LED
www.thornlighting.com/VICL

Case Study:
Bethoncourt, France

LEDs for Bethoncourt street lighting

Bethoncourt, a small town in eastern France near the Swiss-German border, has just switched on a street lighting scheme in support of an extensive programme of urban renewal.

The new lighting forms part of the modernisation programme to improve travel conditions, mainly for pedestrians and cyclists, and upgrade the main axis of the neighbourhood, making it a more attractive place in which to live, work or visit.

The scheme involves the supply of 30 stylish Thorn Dyana LED* street lanterns – in wattage ratings of 75W and 45W – and 26 Plurio LED 45W decorative lanterns for pedestrian and cycle path lighting.

The improved colour appearance (4200K) and colour rendering is a boon to specifiers who have to take account of the amenity value of street lighting in town centres.

The town also wanted energy-efficient lanterns, with high reliability and limited maintenance.

Besides employing a patented high performance optic to reduce glare, the scheme eliminates light above the horizontal. Overall it demonstrates how the latest lighting equipment uses less energy to enhance task performance and improve both the night-time atmosphere and day-time appearance, thus helping to sustain the social, economic and environmental wellbeing of the community.

Products used

Dyana LED
www.thornlighting.com/DYNL

Plurio LED
www.thornlighting.com/PLRL

Key facts

- Improved colour appearance and rendering suited to public spaces
- Energy-efficient lanterns, with high reliability and limited maintenance
- Patented high performance optic to reduce glare

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Bethoncourt:

Luminaire distribution
Precision luminaire optics are chosen for the application providing light where it is needed and suited to the user with minimal glare.

System efficacy
The latest modular LED construction in a luminaire designed for LED provides maximum energy efficiency.

Waste light
Lanterns with zero upward light or flat glass design minimise light nuisance

Residential Roads

Creating the right environment

Generally residential roads should be lit with light levels and colour rendering that enhances the neighbourhood and encourages people to go out at night without the fear of crime. Luminaires should have a good spacing window to allow for the considerable number of junctions or obstacles to column positioning. They should be easy to install, maintain and be resistant to potential vandalism. The luminaires should be energy efficient and reliable in function with lighting controls monitoring their performance, and when necessary bringing failures to the attention of maintenance teams. Care should be taken to ensure light nuisance is not caused to residential properties, but be aware some residents may be used to light spill providing access and security lighting to their dwelling. Luminaires that accept light guillotines may be necessary where the terrain will cause light through windows.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Presence detection
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Great Lumley, Durham, UK

Good practice

These roads are normally used by low speed mixed traffic where parked vehicles are common and column heights of 6m or less are frequently chosen. Lighting guidance is given in PD CEN/TR 13201-1 from S, A, ES, and EV classes defined in EN13201-2.

Single sided layouts may be used to reduce installation costs although layouts may vary due to multiple access points to private car parks or properties. It is more common to light from back of path, allowing free movement to pedestrians, etc. The use of staggered layouts is common when parking lanes and wide footpaths are present.

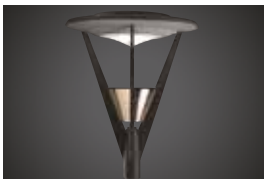
In applications where crime ratios are high and facial recognition is required, vertical and semi-cylindrical illuminance classes should be applied and the use of good colour rendering lamps to improve perception is recommended.

Low glare lanterns should be considered to reduce light trespass onto adjacent residential housing. Vandal and impact resistant luminaires may be required. Lanterns can be themed or styled to suit the neighbourhood road and architectural layout. Lighting controls should dim slowly and avoid nuisance switching.

Product range

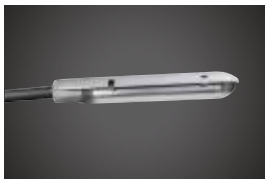
Please find below a selection of products especially suited to the application:

Atla LED
www.thornlighting.com/ATLA



Avenue D
www.thornlighting.com/AVD2

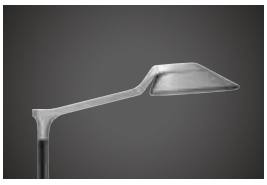
Avenue F LED
www.thornlighting.com/AVFL



Celest
www.thornlighting.com/CLST

Christian IV LED
www.thornlighting.com/CHIV

Civic
www.thornlighting.com/CIVC



Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

Krystal
www.thornlighting.com/KRYS

Olsys Street
www.thornlighting.com/OSYR

Oracle
www.thornlighting.com/ORCL

Oxane
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2

Victor LED
www.thornlighting.com/VICL

Victoria LED
www.thornlighting.com/VIKL

Case Study:
Salford, UK

Salford City Council delivers LED street lighting retrofits for residential areas with Thorn Lighting

Salford City Council upgrades more than 10 000 streetlights and achieves energy savings of 60% with Urban Vision Partnership and Thorn Lighting.

To achieve energy efficiency, Salford City Council embarked on a major project to replace around 11 500 residential street lights. The previous lamps, which were based on high and low pressure sodium technology, were difficult and costly to maintain, and consumed more power than modern LED equivalents.

The organisation tasked with updating Salford's street lights is Urban Vision, a joint venture between Salford City Council, leading professional services firm Capita, and construction expert Galliford Try.

After evaluating proposals from a number of leading lighting companies, Urban Vision chose Thorn Lighting to deliver Salford's streetlight upgrade. *"Our request for proposal was heavily weighted on quality, energy consumption and delivery capability"* says Evan Westby, project manager at Urban Vision/Galliford Try. *"There was also the fact that Thorn is a proven supplier that has successfully delivered large LED street lighting projects around the UK."*

To meet Urban Vision's requirements, Thorn designed a solution based on its Isaro LED lanterns, which can be configured with either 12, 24, or 36 LEDs. The drive current can be adjusted to meet brightness requirements, dimming hours are programmed according to the council's requirements, and an intelligent photocell turns lamps off automatically during daylight hours.

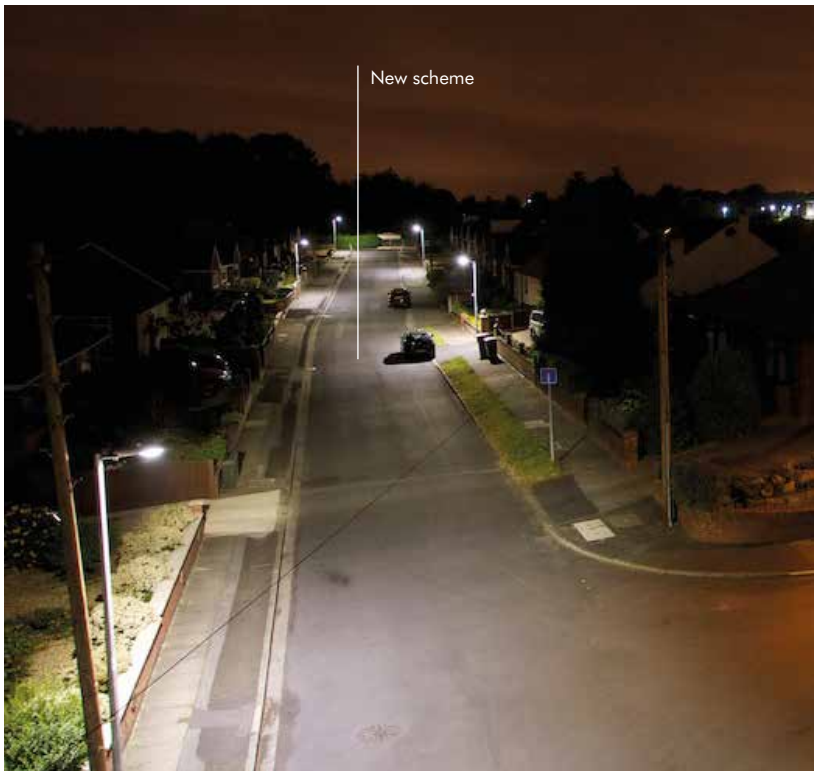
To configure each luminaire correctly based on the width of the road, the height of the column, the distance between columns and the correct lighting and glare levels, Thorn and Urban Vision design teams worked closely together.

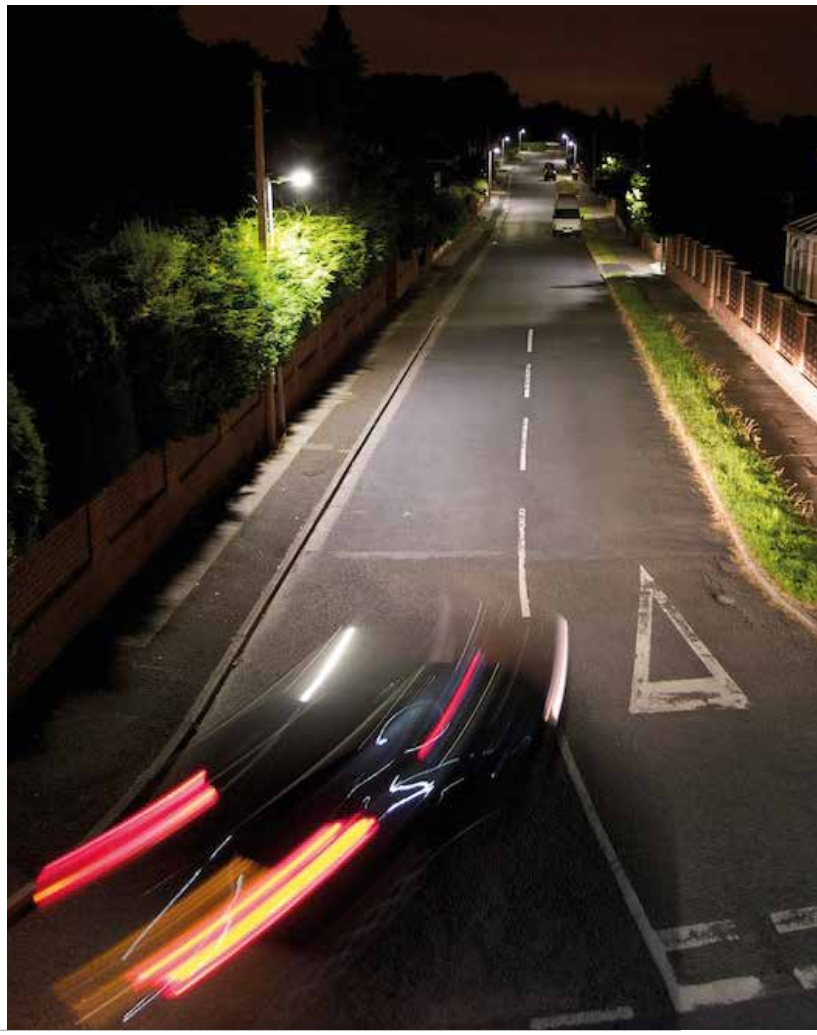
Thorn delivered up to 500 luminaires weekly to Urban Vision, meeting the challenging project schedule. *"We entered into a complex weekly cycle of design, ordering and shipping, and we were consistently impressed with Thorn's flexibility, responsiveness and ability to deliver on time,"* says Evan Westby. *"We have successfully deployed all 9 000 luminaires that were part of the original tender and, based on the success of the project, we are now working with Thorn to deploy an additional 1 500 to 2 000 units around Salford."*

In partnership with Thorn, Urban Vision has helped Salford City Council reduce energy consumption across its street light estate by around 60%.

The maintenance savings delivered by the reliable, durable Thorn luminaires will ultimately be equal to or greater than the council's savings on energy costs.

With integrated 'drivers' to control drive current, dimming hours and more, Thorn streetlights can be reprogrammed, making them completely future-proof. *"We can reprogramme the Thorn fittings easily to make them brighter or dimmer, or to come on and off at different times,"* says Evan. *"That way, if a bus route is changed and more light is needed on a certain street, the light output can be easily adapted to meet those needs."*





Product used

Isaro LED
www.thornlighting.com/ISRL

Key facts

- 60% energy savings - 10% more than the original target
- Major maintenance savings
- Future-proofed streetlights that can be easily reprogrammed to meet the council's future needs

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Salford:

System efficacy
The Thorn Isaro LED luminaires combine optical and thermal controls to maximise efficiency and lumens per watt and optimise energy savings for Salford City Council.

Waste light
Thorn's LED luminaires allow light to be directed in an optimal way. Public areas are illuminated efficiently, with no unnecessary light directed towards residents' gardens or houses.

Maintenance schedule
By significantly reducing maintenance requirements, the Thorn streetlights will deliver impressive cost savings for the council over the next 20 years.

Pedestrian Crossings

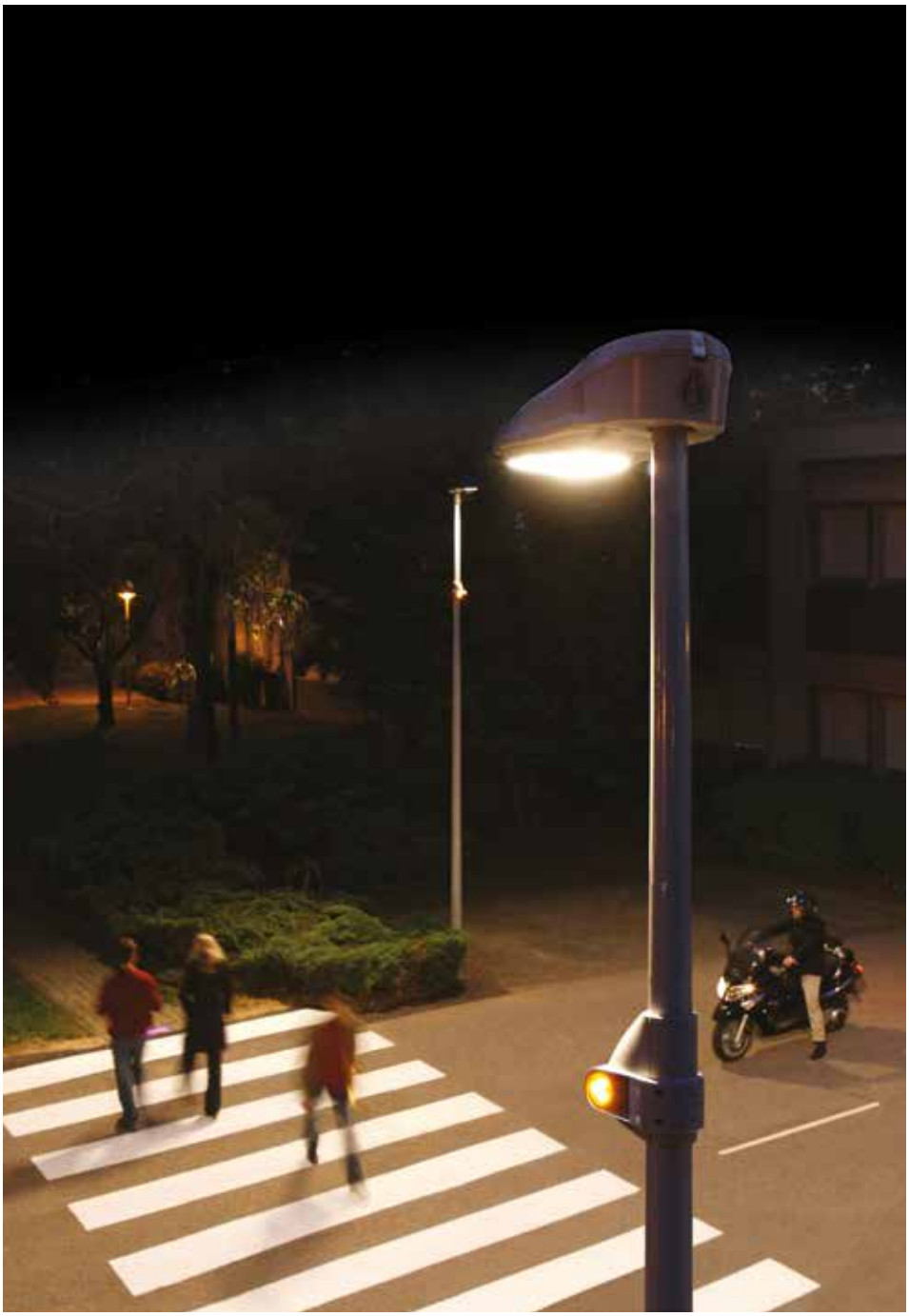
Creating the right environment

It is important to ensure that all pedestrian crossings are lit to provide a safe route to users across all traffic routes, whether they are routes with heavy volumes of traffic, or relatively rural areas where traffic density is much lower. Specific lighting is recommended to the crossing zone and pedestrian routes leading to the crossing as well as warning signals appropriate to the type of crossing. Lighting levels should generally be increased compared to those of the approach road. Dimming or switching the crossing lighting may be inappropriate.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches



Good practice

Pedestrian crossings must be as safe in the dark as during the daytime. Safety can be provided by the use of additional signalling and the use of a separate lighting system.

Lanterns are normally mounted between 5-6m and require an asymmetric light distribution spreading light from the direction of the approaching traffic over the marked crossing and surrounding area without leaving areas of shadow and dazzling drivers.

Care should be taken where traffic can approach from multiple directions. Vertical illuminance should be generous – highlighting pedestrians on and around the crossing. By positioning lighting columns at a distance of 0.5-1.0 times the mounting height from each side of the pedestrian crossing, good positive contrast is achieved in the zone. This will help motorists quickly see pedestrians. Light sources with a different colour temperature to the general road lighting will create additional alertness or signalling effects.

Product range

Please find below a selection of products especially suited to the application:

Avenue F LED
www.thornlighting.com/AVFL

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

IVS
www.thornlighting.com/IVS0

Legend
www.thornlighting.com/LGNC

Oxane
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2

Victor LED
www.thornlighting.com/VICL

Case Study:
Olivet, France

Legend LED luminaires improve high street lighting and energy efficiency

Olivet is a commune located in the Loiret department in central France. It lies on the edge of the Loire Valley, a natural area designated as a UNESCO world heritage site.

Its main thoroughfare, a former national highway, is now a busy shopping including many pedestrian crossings. Lighting was provided by 38 translucent facetted wall mounted units fitted with 250W mercury vapour lamps. The luminaires were of poor colour rendering qualities and very low lumen/watt energy efficiency.

The criteria for Olivet's high street energy improvement programme took into consideration the main shopping thoroughfare, energy savings, a good colour rendering level and instant light, but with the provision that the existing installation points were to be retained.

Legend LED was selected by the mayor of Olivet due its ancient yet modern aesthetics which blend perfectly into the urban landscape.

Legend LED white light and high colour rendition makes it particularly suitable for lighting for a busy shopping area. The lantern's design together with its street lighting photometrics also eliminates obtrusive light, thus providing residents with a comfortable visual environment. The use of LED brings a significant reduction in maintenance frequency with no more lamps to be changed and only the lantern's glass to be cleaned.

Legend LED luminaires have also been installed elsewhere in the commune, including Poutyl Park and other locations.

Product used

Legend
www.thornlighting.com/LGNC

Key facts

- 38 Legend LED 58W lanterns installed
- Energy saving: 60%
- Obtrusive light reduced to zero
- White light and high colour rendition are particularly suitable for lighting a shopping area

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Olivet:

Lamp efficacy
Modern LED light sources in a modern but classical design provide excellent efficacy.

Maintenance schedule
Long life light sources replace old technology increasing the time between maintenance calls and reducing light lost through lamp depreciation.

Waste light
Flat glass optics limit the majority of the light to the street scene, with only a limited upward aesthetic effect.

Roundabouts

Creating the right environment

At roundabouts vehicles converge from many directions. Lighting therefore has to increase awareness and provide guidance to drivers, cyclists and motorcyclists in relation to the geometry of the area and the position of oncoming users. Strategic positioning of luminaires will increase visual guidance as well as safety and highlight upcoming changes in road layout in time for traffic to slow down and navigate the turns safely.

Positioning and height should minimise glare, whilst an increase in lighting level, mounting height, a change in light source or colour temperature, can aid early awareness of a change in road layout.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Orly Airport, France

Le Giratoire Des Bambous, Pont-Audemer, France

Good practice

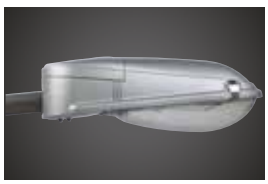
The highest applicable CE class should be used on roundabouts, based upon the highest class of the incoming roads. Access and exit lanes should be highlighted, including a short section of these lanes away from the roundabout.

This is to ensure that any obstacles and approaching vehicles are visible. A common technique is to place columns and luminaires around the outside of the roundabout, at spacing no greater to that used for the approaches.

Columns can also give guidance to the geometry of the area. For instance, different heights of columns and increased light levels can provide advanced notice for those approaching the area. Lanterns should be easy to install, maintain and clean. They should also be well sealed to maximise their effective life.

Product range

Please find below a selection of products especially suited to the application:



Civic
www.thornlighting.com/CIVC

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

Krystal LED
www.thornlighting.com/KRYS

Oracle
www.thornlighting.com/ORCL

Oxane
www.thornlighting.com/OXAN

R2L2
www.thornlighting.com/R2L2

StyLED
www.thornlighting.com/STYL

Victor LED
www.thornlighting.com/VICL

Case Study:
Corigliano Calabro, Italy

StyLED illuminates Corigliano Calabro roundabout

To meet new roundabout regulations, the lighting at the Frassa crossing roundabout in Corigliano Calabro has been updated and improved with Thorn's StyLED road lantern.

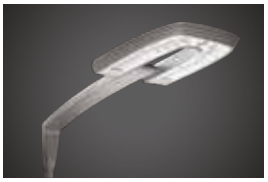
This compact roundabout has an outer diameter of 25 meters and a circular central island and is partially passible for heavy goods vehicles. The refurbishment therefore had to take into account the feasibility for large commercial vehicles and road type 'C', as well as highway secondary subtype 'D'.

The new lighting system comprises four columns fitted with StyLED, all 6 meters high and placed along the central ring circumference of the central island. StyLED is a versatile, durable LED lantern for major and minor roads. It benefits from the EQFlux® optical system, which offers 15 pre-set light distributions to suit differing applications.

With StyLED now in place, the maintained average luminance had been improved to a fully compliant 37 lux with good uniformity and glare control. StyLED's light engine and controller are also housed in two separate IP66 rated compartments for optimised thermal management and in turn longer life.

©Arch. Natale Avolio, Natale Avolio Architetto

Product used



StyLED
www.thornlighting.com/STYL

Key facts

- Power: 129W
- Luminaire output: 9 500lm
- Average luminance: 37 lux

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at the Corigliano Calabro roundabout:

Luminaire distribution
Precise patented optics allow the light distribution to be chosen exactly for the scheme and road conditions.

System efficacy
Designed for LED luminaires with precision optics and cooling combine to provide great luminaire efficacy.

Task lighting
Increased emphasis on the roundabout provides excellent task visibility from a reduced number of fittings.

Bridges

Creating the right environment

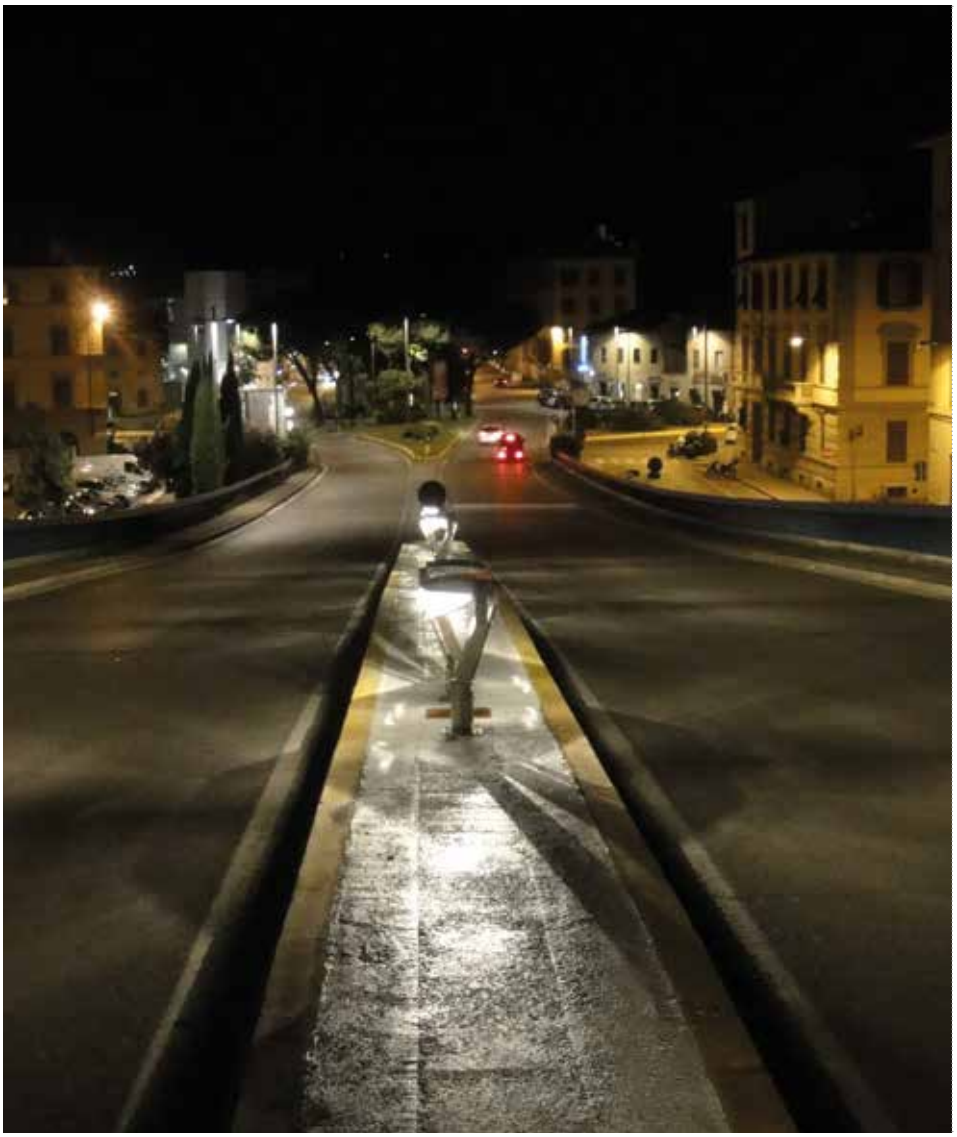
Bridge lighting may impact the surrounding area or traffic underneath the bridge widely, depending on what the bridge crosses. The lighting should highlight the direction and form of the bridge and clearly identify the limits of width or any height restrictions. Where the bridge is historical in nature care should be taken to choose a sympathetically designed lantern, but this should still contain a light source and optics suited to the road deck and traffic type. Particular problems may be encountered with wind loading and the strength of the mounting positions. This coupled with often increased risk for maintenance workers may call for low mounted solutions to be used, typically at less than 0.8m above the deck level to avoid glare to drivers. Entrance roads leading to the bridge itself should be lit accordingly for some distance to enable drivers to see any hazards or restrictions and safely navigate across. Where pedestrian access is mixed with vehicles, care should be taken to light the pathway but also to provide sufficient light to head height for drivers to predict movement onto or across the road.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Cabinet control for a group of luminaires, via mains or control line
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Öresund Bridge, Copenhagen, Denmark



Alessandria Bridge, Alessandria, Italy

Good practice

The main objective is to provide a safe environment for traffic and/or pedestrians. At the design stage consideration should be given to the structure of the bridge and the surrounding area, especially landscaped features, approach routes and the proximity of other forms of transport. As the lighting equipment should be sympathetic to the structure the designer needs to consider the common viewing directions before selecting the most suitable system: columns, floodlighting, catenary or low-level lighting.

It is also important to recognise that lighting not only illuminates the task, but can contribute aesthetically. Colour should be used with care, but can be effective. Luminaires should be suitable for the environmental conditions as well as the maintenance programmes employed and should be positioned to ease maintenance access.

Fixing positions and environmental impact are also important considerations. Occasionally additional navigation and air obstruction lights are required. Lighting of the bridge should connect aesthetically with the surrounding area.

Product range

Please find below a selection of products especially suited to the application:

Atla LED
www.thornlighting.com/ATLA

Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

Oracle
www.thornlighting.com/ORCL

Orus LED
www.thornlighting.com/ORUS

Oxane
www.thornlighting.com/OXAN

R2L2
www.thornlighting.com/R2L2

Victor LED
www.thornlighting.com/VICL

Victoria LED
www.thornlighting.com/VIKL

Case Study:
Tianjin, China

Orus' FlatBeam® technology transforms Chifeng Bridge

Located in the central business district of Tianjin Downtown, across the Hai River, Chifeng Bridge is the only inclined pylon double plane harp cable-stayed bridge in China. With a unique shape and complex twists and turns, it's Tianjin's landmark. Yet, despite its aspirational design, Chifeng Bridge was experiencing several lighting issues.

These included difficulties in maintaining and replacing lamps, high levels of light pollution and waste, low lighting uniformity and disabling glare. Visually, the bridge also appeared messy with traditionally styled pole luminaires employing high energy 250W-400W lamps.

Low mounting height improves comfort and access

Following extensive field research to explore and demonstrate a series of lighting solutions, Thorn's Orus luminaire with its patented FlatBeam® technology was chosen to refurbish Chifeng Bridge's lighting.

Orus has a special bi-directional optic, resulting in a unique light distribution which projects light transversally to the road. With a 35W HIT-CE lamp, it also offers excellent uniformity with no glare and low energy consumption. Above all, Orus has a mounting height of 0.9m to ensure no direct light enters vehicles, and access and maintenance is significantly easier. The low mounting height also complements the bridge's extravagant design.

For low maintenance, Orus is constructed from high quality vandal resistant materials and engineered for a long operating life. The use of an electronic ballast further enhances energy savings and increases lamp life expectancy.

Michael Han, Lighting Designer at Thorn, says: *"Orus offered the ideal lighting solution for Chifeng Bridge. As well as providing an ideal mounting height, the optical system offers a very sharp and controlled light distribution while optimising the efficiency of the lamp. The use of ceramic metal halide lamps with 35W was the best choice in terms of light control, driver comfort and power consumption."*

Product used

Orus
www.thornlighting.com/ORUS

Key facts

- Total energy saving per annum: 71%
- CO_2 saving per annum: 138 837 tonnes
- Lighting level before: MEa4 Standard
- Lighting level after: ME2 Standard

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Chifeng Bridge:

Luminaire distribution
Orus' unique patented optic controls the light emission bending and shaping the light directly and efficiently onto the road. Using only a 35W the light distribution in this example provides the perfect substitute for 250-400W traditional road lighting.

Task lighting
Ensuring light is concentrated on the road provides the required high levels of illuminance while using minimal energy.

Waste light
Orus' FlatBeam® technology helps to cast more than 93% luminous flux to the road. The other 7% light the surrounds to increase visibility. Precise optical control and luminaire aiming eliminates upward light and ensures no energy is wasted lighting the wrong area. By eliminating upward light, ecological disturbance is also minimised.

Car Parks

Creating the right environment

In terms of lighting design, car parks present a particularly challenging brief – finding the acceptable balance between safety issues, security, reduced energy consumption and obtrusive light. White light is generally preferred and specified by many safer car parking schemes. Care should be taken to provide lighting at an appropriate height and spacing to enable drivers to safely navigate congested routes or tightly parked vehicles, and at the same time avoid glare. Lighting should be chosen carefully to work with CCTV and other security systems, to minimise dark areas, especially when obstructed by vehicles. It should highlight areas with particular driving hazards or provide vertical emphasis, for example entrance areas, ramps, ticket machine and emergency exit routes. Particular care should be taken over obtrusive light where car parks are multi-storey or in sensitive environmental zones. Lighting levels should be suited to vehicles as well as pedestrians and may need to be increased in areas designed for the disabled.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Presence detection.
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Good practice

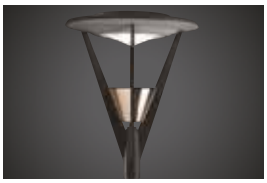
Lighting should be designed in accordance with EN12464-2 and with safety and security being the prime objectives. The speed and direction of the movement of users within the space is an important consideration. A common approach is to use 6-12m lighting columns, either on the edge of the car park or centrally mounted to provide a good level of horizontal and vertical illuminance at ground level. Care must be taken to avoid spill light onto adjacent housing or transportation routes. Supplementary lighting at entrance barriers and exits can help aid colour and perception.

All lighting equipment should be IP and IK rated for environmental conditions and vandal resistance. Units should also utilise lighting controls to conserve energy. Mounting and maintenance access should be carefully considered where parking is multi-storey.

Product range

Please find below a selection of products especially suited to the application:

Atla LED
www.thornlighting.com/ATLA



Avenue D
www.thornlighting.com/AVD2

Avenue F LED
www.thornlighting.com/AVFL

Christian IV LED
www.thornlighting.com/CHIV

Civic
www.thornlighting.com/CIVC

Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Dyana LED
www.thornlighting.com/DYNL

Isaro LED
www.thornlighting.com/ISRL

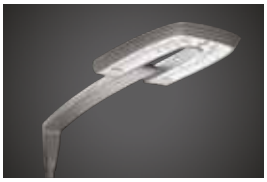
Olsys Street
www.thornlighting.com/OSYR

Oracle
www.thornlighting.com/ORCL

Oxane
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2



StyLED
www.thornlighting.com/STYL

Victor LED
www.thornlighting.com/VICL

Victoria LED
www.thornlighting.com/VIKL

Case Study:
Capodichino Airport, Italy

Clan C reduces energy consumption by 75% for outdoor areas at Capodichino Airport

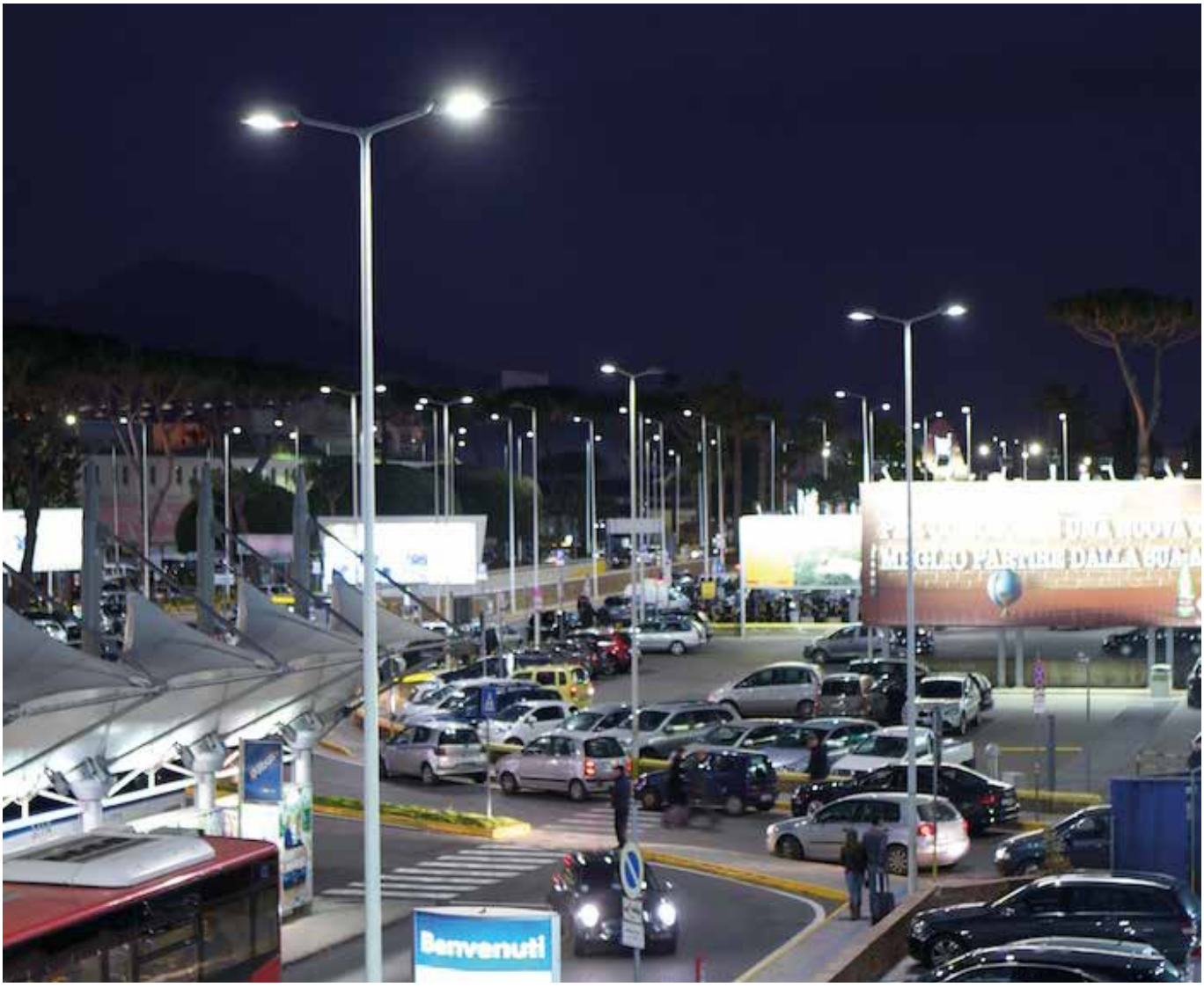
Following a refurbishment project to improve the energy efficiency at Capodichino Airport, Italy, Thorn's Clan C luminaires have reduced the airport's annual light energy consumption by 75% for the outdoor areas.

The outdoor refurbishment, which covered areas including the main access road, car park and apron area, involved replacing HST 150W street lanterns with Clan C 58W fittings.

The refurbishment has also increased the lighting level in the outdoor public spaces by over 60%. The lighting was previously 12 lux with a uniformity of 0.5, achieving a CE4 class with yellow light. After the new luminaires had been installed, lux levels have been increased to 20 lux with the same uniformity and high rendering white light. This has achieved an increase in two lighting classes to an increase in two lighting class to CE2.

For maximum energy savings, Clan C features Thorn's bi-power system, which facilities nighttime dimming through an easy to use on/off switch.

The apron area, which is lit by Champion and Mundial floodlights mounted on a high mast, is now compliant with the International Civil Aviation Organization (ICAO) standard. Some of the floodlights are hot restrike versions to cater for emergency situations.



Product used

Clan C
www.thornlighting.com/CLNC

Key facts

- Energy consumption reduced by 75% for outdoor areas
- Lighting level increased from 12 lux to 20 lux
* Bi-power to facilitate night time dimming

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at Capodichino Airport:

System efficacy
Modular LED construction in a high quality aluminium housing provides excellent efficiency.

Task lighting
Light is provided precisely where needed and to the right level for the task, reducing energy.

Waste light
Flat glass optics, essential for airport use, eliminate obtrusive light to aircraft.

Cycle Paths

Creating the right environment

Rising fuel costs combined with greater environmental and fitness awareness are increasing the popularity of non-motorised method of travel. Much like road lighting, the issues of safety, security, reduced energy consumption and obtrusive light all still apply, perhaps more so as cycle routes can often pass through less busy spaces. White light is preferred with good control of both glare and light spill, especially in residential zones. Care should be taken to provide lighting at an appropriate height and spacing to enable both cyclists and pedestrians to safely pass, and to provide good levels of facial recognition. Lighting should be either well above eye level to maximise column spacing and reduce glare or kept below eye level with excellent optical control to eliminate glare and better indicate direction. Here some care should be taken to choose a luminaire appropriate for this type of application, with an optic suited to traffic routes and with options to react to local movement.

Taking control

Use one or more of the following control mechanisms (for a full explanation of each control mechanism, please refer to p. 08 and 09):

- Photocells and time switches
- Presence detection
- Luminaire stand alone dimming (from 2 to several levels) to suit both the user and project profile
- Remote central management systems for individual control and monitoring, via powerline or radio frequency

Good practice

Cycle paths are normally used by low speed pedestrian and cycle traffic so column heights of 6m or less are suitable.

Lighting guidance is given in PD CEN/ TR 13201-1 from S, A, ES, and EV classes defined in EN13201-2. Single sided layouts are most appropriate to reduce installation costs and to provide an element of route guidance, although layouts may vary as the path approaches other road networks or simply to match the aesthetic of the surrounding area.

In applications where crime rates are high and facial recognition is required, vertical and semi-cylindrical illuminance classes should be applied. The use of good colour rendering white light to improve perception is recommended. Low glare lanterns should be considered with street optics that reduce light trespass onto adjacent residential housing. Vandal and impact resistant luminaires may be required.

Lanterns can be themed or styled to suit the neighbourhood road and architectural layout. Lighting controls should dim slowly and avoid nuisance switching.

Product range

Please find below a selection of products especially suited to the application:

Adelie Bollard
www.thornlighting.com/ADLB

Atla LED
www.thornlighting.com/ATLA

Avenue D
www.thornlighting.com/AVD2

Avenue F
www.thornlighting.com/AVFN

Christian IV LED
www.thornlighting.com/CHIV

Civic
www.thornlighting.com/CIVC

Clan C
www.thornlighting.com/CLNC

Clan O
www.thornlighting.com/CLNO

Isaro LED
www.thornlighting.com/ISRL

Olsys Street
www.thornlighting.com/OSYR

Oxane S
www.thornlighting.com/OXAN

Plurio LED
www.thornlighting.com/PLRL

R2L2
www.thornlighting.com/R2L2

Victoria
www.thornlighting.com/VICA

Case Study:
Farsund by-pass, Norway

Working in association with Otera Samferdsel AS, lighting the new Farsund city by-pass

Working in association with Otera Samferdsel AS, Thorn's Gotthard and Civic luminaires are lighting the way across the new Farsund city by-pass, which includes three roundabouts, a 2,3km road, a 350m tunnel and a 1,6km walking and cycling path. The new by-pass was built to relieve the city of the constant flow of heavy north and south bound through-traffic.

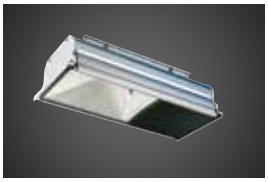
Additional the aim was to provide a safer, quieter and more relaxed environment for residents, as well as reducing the carbon emissions in the city centre.

More than 230 luminaires have been installed, with Gotthard being selected for the tunnel and Civic for the roads and the cycle path. The luminaires also have stand alone control with bi-power functionality to make them economical to run and achieve energy savings.

Kim Holteberg, Project Leader at Otera Samferdsel AS, says: *"The solution Thorn presented was to our exact requirements and I am very pleased with the results. I was impressed by the way Thorn managed the installation and the service as a whole".*

Products used

Civic
www.thornlighting.com/CIVC



Gotthard
www.thornlighting.com/GHSS

Key facts

- 2.3km road, a 350m tunnel and a 1.6km walking and cycling path
- Stand alone control with bi-power functionality makes the scheme economical to run and achieve energy savings
- 230 luminaires installed in total

eControl

From Thorn's 15 ways to save energy, the following are key to minimising energy consumption at the Farsund by-pass:

Luminaire distribution
Precision optics focus light onto the road surface with minimum waste and reduced glare.

System efficacy
Modular LED construction in high quality, sealed luminaires maximise performance.

Task lighting
Luminaire and optic are selected specifically for the application

15 ways to make energy efficient lighting easy

When considering energy efficiency and lighting it is important that it is not considered in isolation. A lighting installation has a basic requirement to provide a sufficient amount of light to allow a task to be performed efficiently and safely. Requirements for this are given in standards such as EN 13201 (road lighting), EN 12464 (lighting of workplaces), EN 12193 (sports lighting), CIE 88 (tunnel lighting) and EN 1838 (emergency lighting). As well as providing good task illumination, the lighting installation should provide light of a good enough quality to provide a pleasant and fulfilling environment for the occupants of a space. The ideal is to provide good task illumination and comfort as energy efficiently as possible.

Energy efficiency is a complex set of interactions and relationships linked to technology, physical environment, social behaviour and work requirements. However we can consider energy efficiency may generally be split into four main areas: technology, control, application and environment.

Thorn's '15 ways to make energy efficient lighting easy' framework is based on the principles that implementing one or more of the following guidelines will help generate significant energy savings.

Technology

Lamp efficacy
How efficiently a lamp converts electricity into light (lm/W)

Ballast classification
Controls the electricity supply to the lamp (Energy Efficiency Index EEI)

Luminaire distribution
Light is controlled and emitted from a luminaire using optics which bend and shape the light to the correct location

System efficacy
The combination of optical and thermal control within the luminaire (luminaire lm/W)

Application

Task lighting
Lighting the task areas with the correct amount of light

Zoning of lighting
Lighting is zoned according to area use

Maintenance schedule
Maintenance must be performed in response to product age, performance and environment

Waste light
Any light which does not hit the intended target is waste light

Control

Presence/Absence
Presence: Lights automatically turn on and off with movement.
Absence: Lights automatically turn off and have to be manually switched on.

Daylight
Artificial lighting responds to the natural light conditions

Constant illuminance
A function designed to produce correct lighting levels for the duration of the maintenance period

Task/Scene setting
Allows the user to set scenes and adapt the lighting to different tasks

Timed off
Automatic cut-off can be installed to turn all lights off during unoccupied hours

Environment

Reflectance
Light is reflected from the surfaces within the area

Visible smart metering
Results of actions can be quickly seen as increased or decreased energy use

Jargon Buster:

CARRIAGEWAY (UNIT: METRES)

Overall width across all lanes of the roadway under consideration.

CUT OFF ANGLE (UNIT: DEGREES)

The total angle, including both above and below the peak intensity, over which the luminous intensity drops to 1% of the peak intensity value.

CONFLICT AREA

Area where motorised traffic intersects or overlaps with other road users e.g. roundabouts, crossings.

DESIGN SPACING (UNIT: METRES)

Required distance between the centre of optical compartments of adjacent road lighting luminaires on a straight section of road.

DESIGN ATTITUDE (UNIT: DEGREES) ALSO KNOWN AS DESIGN TILT

The angle of displacement of a luminaire from the horizontal.

ENVIRONMENTAL ZONES

Defined zones indicating the level of surrounding light – from E1 which is natural surroundings to E4 which is urban surroundings.

FLICKER

The variation in light output of a light source or luminaire through time. This is generally measured using the Percent Flicker which is the ratio of the difference between the maximum and minimum light output over time.

HIGH MAST LIGHTING

System of lighting for large areas with columns carrying multiple luminaires typically at heights greater than 18m.

ILLUMINANCE (UNIT: LUX, SYMBOL: E)

This is the quantity of light falling onto a surface. It has a number of variations normally as given below;

Cylindrical illuminance (symbol: E_z)
the average quantity of light falling onto the surface of a vertical cylinder

Hemispherical illuminance (symbol: E_{hs})
the average quantity of light falling onto a half sphere, e.g. half of a ball placed upon a surface.

Horizontal illuminance
the quantity of light falling onto a horizontal surface, such as the ground.

Semi-cylindrical illuminance (symbol: E_{sz})
the average quantity of light falling onto half of the surface of a vertical cylinder, i.e. 180° of the surface.

Vertical illuminance (symbol: E_v)
the quantity of light falling onto a vertical surface, such as a wall.

LOW LEVEL LIGHTING

Lighting system with mounting heights typically less than 1m.

LUMINANCE (UNIT: CD/M², SYMBOL: L)

This is the quantity of light reflected from a surface to the eye.

LUMINOUS FLUX (UNIT: LUMENS (SYMBOL: Φ))

This is the total quantity of light emitted by a light source. Also known as lamp lumens.

LONGITUDINAL UNIFORMITY (SYMBOL: U_L)

Ratio of minimum to maximum luminance along the centre line of a driving lane.

MESOPIC VISION

The operation of the eye under intermediate ambient light conditions (10-2 cd/m² <mesopic < 10 cd/m²).

LUMINOUS INTENSITY (UNIT: CANDELAS, SYMBOL: I)

This is the quantity of light emitted by a light source in a specific direction.

MOUNTING HEIGHT (UNIT: METRES, SYMBOL: H)

The distance between the centre of the optical compartment of a luminaire to the surface of the carriageway.

OBTRUSIVE LIGHT

This is spill light that creates annoyance, discomfort, distraction or a reduction in the ability to see essential information. It comprises three main components;

Sky glow – light that contributes to the brightening of the sky.

Light trespass – light that spills onto surrounding properties causing annoyance, distraction or discomfort.

Spill light – light that falls outside the boundaries of the intended target area.

SCOTOPIC VISION

The operation of the eye under low ambient light conditions (< 10-2 cd/m²). The scotopic eye response curve is the V'(λ) curve.

OVERHANG (UNIT: METRES, SYMBOL: A

The horizontal distance between the centre of the luminaire optical compartment and the edge of the carriageway. The overhang is positive if the luminaire is in front of and negative if it is behind the edge of the carriageway.

PHOTOPIC VISION

The operation of the eye under high ambient light conditions (> 10 cd/m²). The photopic eye response curve is the V(λ).

SURROUND RATIO

Average illuminance on strips just outside the edges of the carriageway in proportion to the average illuminance on strips just inside the edges.

S/P RATIO

The ratio of scotopic lamp lumens to photopic lamp lumens for a light source.

MAINTE-NANCE FACTOR

(UNIT: PERCENTAGE, SYMBOL: MF)

This indicates the loss of light within a space when the luminaires, light sources and reflecting surfaces within the space are in their worst condition (e.g. oldest or dirtiest). It comprises 4 components;

Lamp lumen maintenance factor (unit: percentage, symbol: F_{LLM}) – the loss in lumen output of a light source after a given number of hours operation compared to the lumen output when new.

Lamp survival factor (unit: percentage, symbol: F_{LS}) – the number of light sources which will have completely failed after a given number of hours of operation compared to the total number of light sources of that type. In road lighting this factor is frequently taken as 1.

Luminaire maintenance factor (unit: percentage, symbol: F_{LM}) – the loss in light output from a luminaire due to dirt and ageing of materials compared to the light output when new.

Room surface maintenance factor (unit: percentage, symbol: F_{RSM}) – the loss in reflectance of primary surfaces within a space due to dirt, etc. compared to the reflectance as new. In road lighting this is normally ignored but is relevant in some circumstances.

OVERALL UNIFORMITY (SYMBOL: U_O)

Ratio of minimum to average luminance or minimum to average illuminance on/of a surface.

SETBACK

(UNIT: METRES) The horizontal distance from the forward face of a column to the edge of the carriageway.

RESIDENTIAL ROAD

Road that carries little vehicular traffic other than generated by residents.

THRESHOLD INCREMENT (SYMBOL: TI)

A measure of glare sensation used mainly in road lighting applications.

THORN
LIGHTING PEOPLE

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