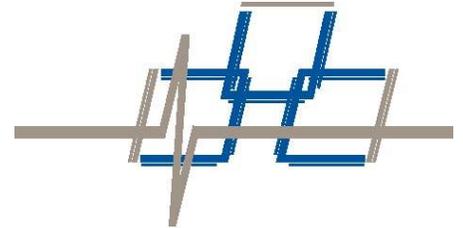


Lighting for Perimeter Security Applications

Application Note



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Fiber SenSys, Inc.
2925 NW Aloclek Drive
Suite 120
Hillsboro, OR 97124
USA

Tel: 1-503-692-4430
Fax: 1-503-692-4410
info@fibersensys.com
www.fibersensys.com

Table of Contents

Introduction	1
Typical Perimeter Lighting Projects	2
Column Placement.....	3
Vertical or Horizontal Plane.....	3
Recommended Lighting Levels	4
Perimeter Lighting Design	4
Light and Camera on Every Column	5
Light for Every Two Cameras or More (Not Recommended)	5
Equipment on Every Other Column	6
Perimeter Lighting Design for Dome Cameras	6
PTZ Lighting for Large Areas.....	7
Lighting the Attack Zone	7
Combined Infra-Red and White-Light	8
Perimeter Lighting Design for General Area Illumination	9
Recommended Lighting Levels	9
Typical White-Light Solution	10
Illuminating the Fence.....	13
FSI Lighting Design Service	14
Perimeter Lighting Solutions Comparison	16
Technology Integration for Smarter Installations	17

Introduction

Fiber SenSys, Inc. (FSI) offers perimeter security lighting as an important part of an outdoor perimeter security intrusion detection system. Illuminating the camera field of view with an Infrared (IR) or white-lighting system significantly improves the performance of the camera.

Ensuring optimum illumination for any perimeter application is crucial for achieving top level security and safety at night. More and more perimeter applications are turning to Infra-Red and White-Light LED lighting solutions instead of traditional lighting technologies such as halogen, sodium or metal halide.

LED lighting offers significant advantages including::

- Optimized Lighting for Best Night-Time CCTV Images
- IR LED - Covert surveillance for long distances
- WL LED - Quick activation for deterrent lighting
- Low power consumption, zero maintenance
- Long life and reliability
- Significant energy, running cost and labour savings

Perimeter applications utilize both IR and White-Light for CCTV purposes, and/or White-Light for general lighting purposes.

Specialized vertical markets, such as military and critical infrastructure facilities have requirements for both IR and White-Light illumination.



Perimeter Security Lighting Using IR



General Area Lighting

Tech Tip: *The design and installation of the lighting determines the overall effectiveness of the solution.*

Typical Perimeter Lighting Projects

Every perimeter lighting application is unique. Whether you are lighting the perimeter of a power station, a prison, or an airport, there are general standards and recommended practices for using the correct lighting solution and the best design approach for sites with typical characteristics.

Most perimeter fence line applications have a “sterile zone” on the inner side of the fence varying from 2m to 5m in width (**Figure 1**). This is the main area of concern for illuminating and monitoring.

Most perimeter projects illuminate the sterile zone up to the inside of the fence line. Some installations will illuminate to a distance beyond the fence line into the “attack zone”. The attack zone is the external public area from which an intruder would approach.

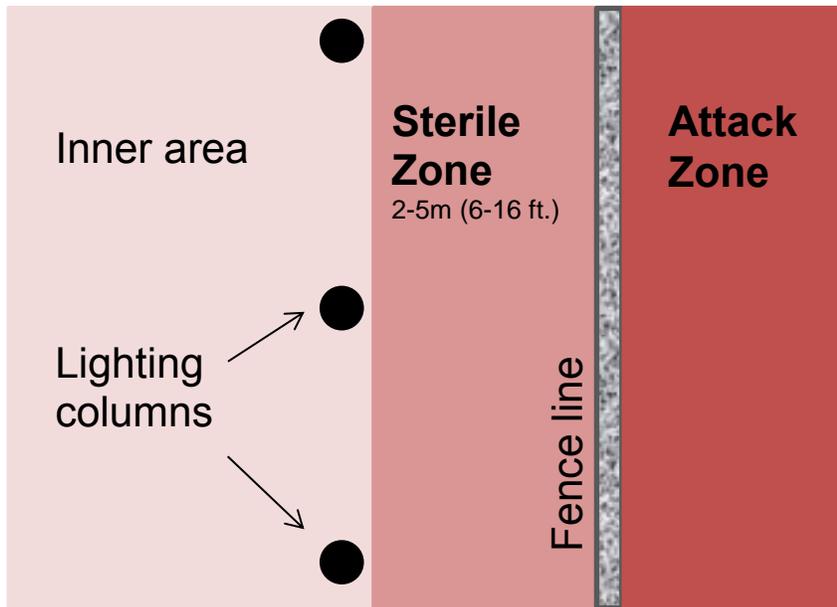


Figure 1: Typical Perimeter Protection Areas

Infra-Red lighting is generally installed on lighting columns alongside CCTV cameras to monitor intruders’ approach covertly.

Where visible White-Light illumination is used on the perimeter columns, it often has a multipurpose function, providing lighting for CCTV to identify intruders, deterrent lighting and for general area illumination for the safety of site personnel.

Column Placement

Columns are typically placed at a minimum distance of 2.5m (8ft) from the fence line in order to prevent intruders from using them to climb the fence structure.

Columns are mostly placed outside of the sterile zone.

- Typical column spacing for CCTV lighting is usually 50m (164ft).
- Between 25m (82ft) and 30m (98ft) for general lighting.

Vertical or Horizontal Plane

There are certain recommended lighting design approaches for different perimeter applications, to ensure the best night time illumination for the safety and security of the site. When designing and installing CCTV lighting, the illumination should be targeted out across a scene to light a subject/object/scene on a vertical plane.

With lighting for general area purposes, e.g. lighting for the safety of people and vehicles on site, the illumination should be targeted down onto a scene to light the ground on a horizontal plane.

Some designs require minimum illumination levels stated within their tender/project specification which must be adhered to.

(Example specification of lighting for general lighting purposes: 5 lux minimum at 300mm (12") from the ground in the sterile zone. Taking an illumination measurement at 300mm (12") allows for any undulations on the ground which may alter the reading).

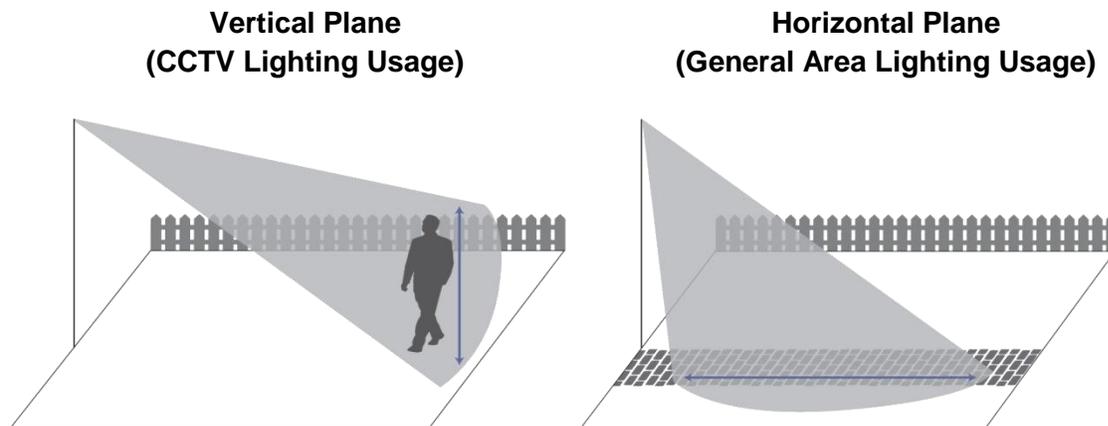


Figure 2: Illuminating on different planes for different purposes significantly alters the amount of light required.

Recommended Lighting Levels

CCTV Lighting:

Recommended level of Infra-Red power on scene = 0.35-0.4 μWcm^2 (microwatts per cm²)
(Recommended practice for a good level of IR on scene for high quality night-time images)

Recommended level of White-Light on scene = 2-3 lux
(BSEN European Standards)

BEWARE – There is currently no standard measurement criteria to compare and rate the performance of IR lighting for CCTV

General Area Lighting:

Recommended levels of visible White-light illumination for general area purposes = 5lux
(BSEN standards)

Perimeter Lighting Design

CCTV lighting design for perimeter applications is generally easier than general area lighting design for perimeters. Most perimeters utilize Infra-Red lighting for CCTV purposes, and the key criteria for design consideration are:

- Distance
- Angle
- Mounting position
- Alignment with camera FOV
- Even illumination
- Photocell following contact to trigger day/night camera switching



Light and Camera on Every Column

Typically, one light should be used with every camera for best CCTV performance, for full and even coverage of the scene which the camera is viewing, with no dark spots.

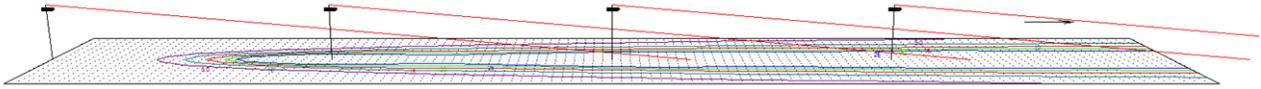


Figure 3: Perimeter CCTV lighting design example showing 1 light and camera per column. 6m (19ft) mounting height, / 50m (164ft) column spacing.

The red line represents the beam pattern

Light for Every Two Cameras or More (Not Recommended)

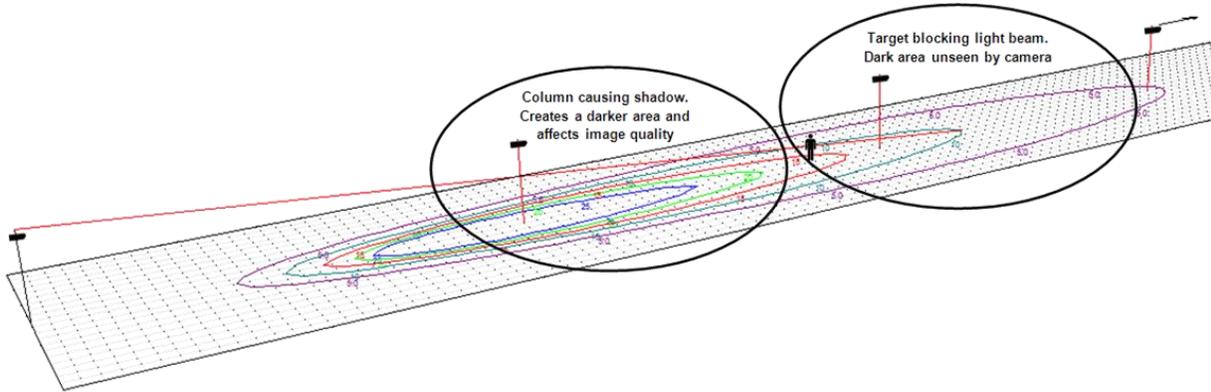


Figure 4: Example showing 1 light covering multiple cameras over 150m (492ft) 6m (19ft) mounting height.

The red line represents the beam pattern

Equipment on Every Other Column

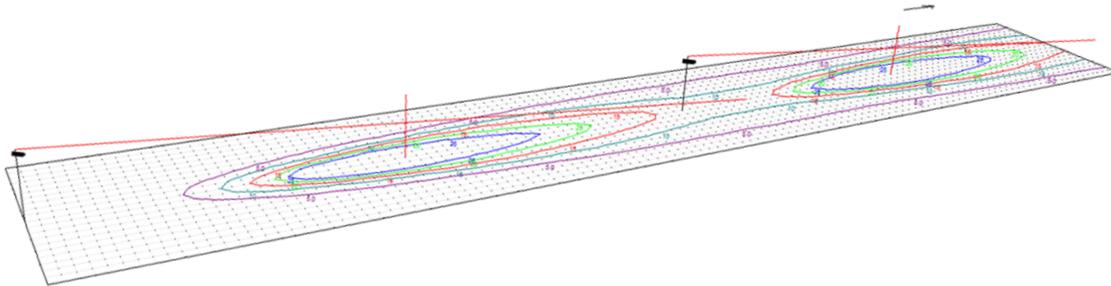


Figure 5: Example showing 1 light and camera every 2nd column
6m (19ft) mounting height / 100m (328ft) column spacing

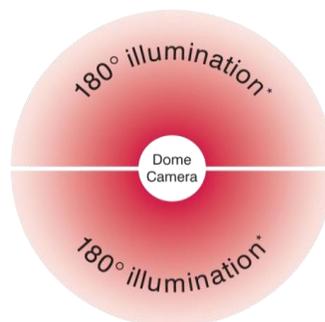
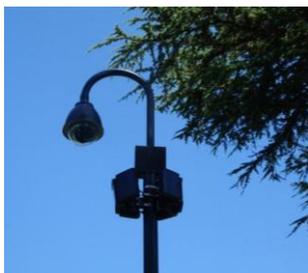
The red line represents the beam pattern

It is possible to install lighting and cameras on every other column to save on installation costs and capital outlay. However, FSI does **not** usually recommend this technique.

Again, the columns without a light can cause shadowing and impair the camera vision and image quality. For most CCTV lighting perimeter applications, when using lighting and cameras on every other column, it comes down to reduced costs vs image quality and security.

Perimeter Lighting Design for Dome Cameras

Pan-Tilt-Zoom (PTZ) domes typically utilize lights either side of camera to deliver full 360° coverage, illuminating distances up to 100m (328ft). Typical products used for 360° dome lighting would be wide angle illuminators. Sometimes it may be necessary to use a small illuminator looking down a column if it is a little dark and exposed due to perimeter layout and lighting pattern.



PTZ Lighting for Large Areas

PTZ cameras on pan/tilt housings are often used on the perimeter or in the inner site area, with spot and flood lighting for covering large areas. PTZ cameras mainly utilise Infra-Red lighting, with one long distance, narrow angle light (usually with a 10 degree beam spread) so that the camera can zoom in at subjects/objects which are far away, and one wider angle, shorter distance light (usually with a 30 or 50 degree beam spread) to cover the majority of the foreground area.

Lighting is usually fixed to the PTZ housing, so that the beam moves with the camera as it moves and surveys the site. White-Light illumination is generally not used with PTZ cameras, as the moving, visible illumination would create a disturbance and cause significant light pollution; almost like a search light.

Crucially the lighting has to be of a high enough quality for a good level of detail when the PTZ camera zooms in on a subject/object.

Tech Tip: Ensuring recommended light levels on scene delivers high quality illumination and high quality CCTV images.

Lighting the Attack Zone

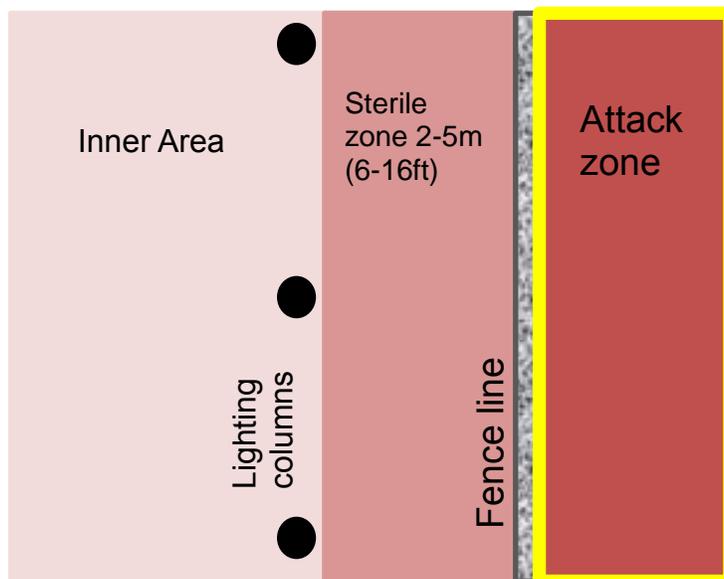


Figure 6: Attack Zone Highlighted

IR lighting can be placed alongside cameras to look out through the fence line to covertly monitor intruders' approach in the attack zone over a long distance area.

Most visible White-Light illumination stops at the fence line. In some cases the project specification may require the illumination to go slightly beyond into the attack zone.

Combined Infra-Red and White-Light

The benefit of White-Light LED illumination is that it is quick to start. It can be activated instantly on demand. For this reason, Infra-Red illumination is often used in conjunction with White-Light illumination.

IR can be used continuously to covertly monitor a scene, and WL only activated when needed (e.g. general lighting for a patrol or deterrent lighting to warn off an intruder).

External triggers such as a PIR detector, motion detection software in camera or fibre optic fence line cable for example, can trigger the White-Light illuminators via a telemetry input, to turn them on instantly for defined period of time.

This provides a more energy and cost efficient solution, reduces visible light pollution, as well as providing a more dynamic response. For example, IR could illuminate the attack zone, and when an intruder is detected by a PIR detector, or when they touch the fence line which is secured with fibre optic cable, these devices would trigger the White-Light illumination to turn on.

Lighting can be triggered individually or in batches (all connected in series/parallel via telemetry). This is not possible with technologies such as metal halide and sodium lighting, due to their slow warm up.



Perimeter Lighting Design for General Area Illumination

Lighting design for general area illumination is entirely different to designing lighting for CCTV lighting purposes. General lighting designs for perimeter applications are mainly concerned with lighting the sterile zone using White-Light.

The key principle for lighting the sterile zone for general area lighting purposes, is to use beam patterns and angles of elevation to ensure even illumination across the entire length and width of the perimeter.

Cameras are usually present in general lighting perimeter applications. However the lighting is designed and installed for safety and security purposes, illuminating the whole sterile zone with visible light; rather than just illuminating the field of view of the camera for CCTV purposes. The cameras however can still utilise this general area illumination so that they are able to generate high quality images at night.

Recommended Lighting Levels

General Area Lighting:

Recommended levels of visible White-light illumination for general area purposes = 5lux
(BSEN standards)

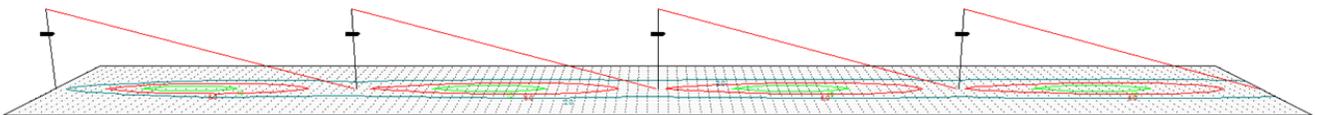


Figure 7: Perimeter general area lighting design example showing 1 light and camera per column. lights mounted at 8m (26ft), cameras mounted at 6m (19ft), 30m (98ft) column spacing.

Lighting Level Notes:

- Lighting level requirements may be different in attack zone or inner site area
- Columns for general lighting in a perimeter application are usually 8m (26ft) high.
- Generally, White-Light illuminators and cameras are kept separate when concerned with general area illumination. The lighting is usually positioned at the top of the column at 8m (26ft), and the cameras positioned further down around 6m (19ft). Mounting the cameras lower down reduces glare directly into the camera lens.
- Typical column spacing is between 25m (82ft) and 30m (98ft).
- The lighting always illuminates the horizontal plane e.g. so that it would illuminate down onto the ground to create a well lit area for site personnel, targeted down to illuminate beyond the base of the next column.
- Lighting is usually positioned to point along the fenceline, rather than directly at the fenceline. However, directly illuminating the fence on a vertical plane is possible; project dependent.

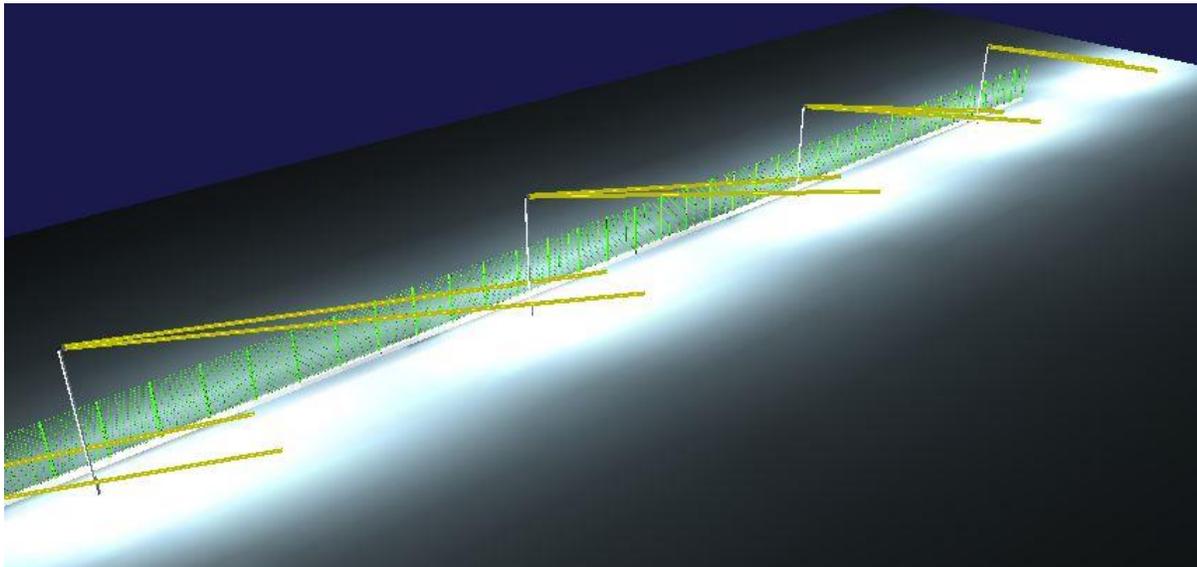
Typical White-Light Solution



The main LED lighting product which we use to design into perimeter lighting projects is the White-Light 200 series illuminator with a 10 degree beam angle, due to its lumen output and distance capability.

** The following examples are generic lighting designs which may not be suitable for every project. Please contact FSI for access to their free lighting design service and accurate lighting design for your specific project requirements.*

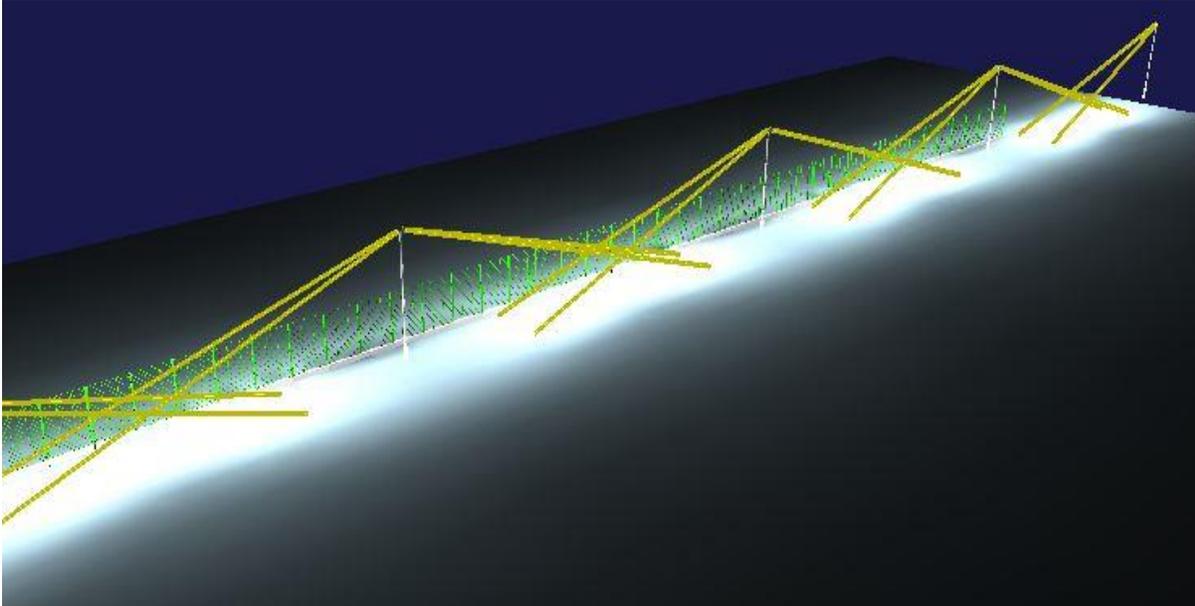
25m (82ft) column spacing – x1 RL200-AI-10 per column



A 25m (82ft) to 30m (98ft) column spacing is most typical for a high security general lighting perimeter application. FSI's recommended practice for illuminating a perimeter with a 25m (82ft) or 30m (98ft) column spacing is to position the lighting on the side of the column, pointed down to illuminate beyond the base of the next column.

The angle of elevation of the illumination is such that it doesn't put glare into the camera on the adjacent column. All cameras must face the same way as the lighting.

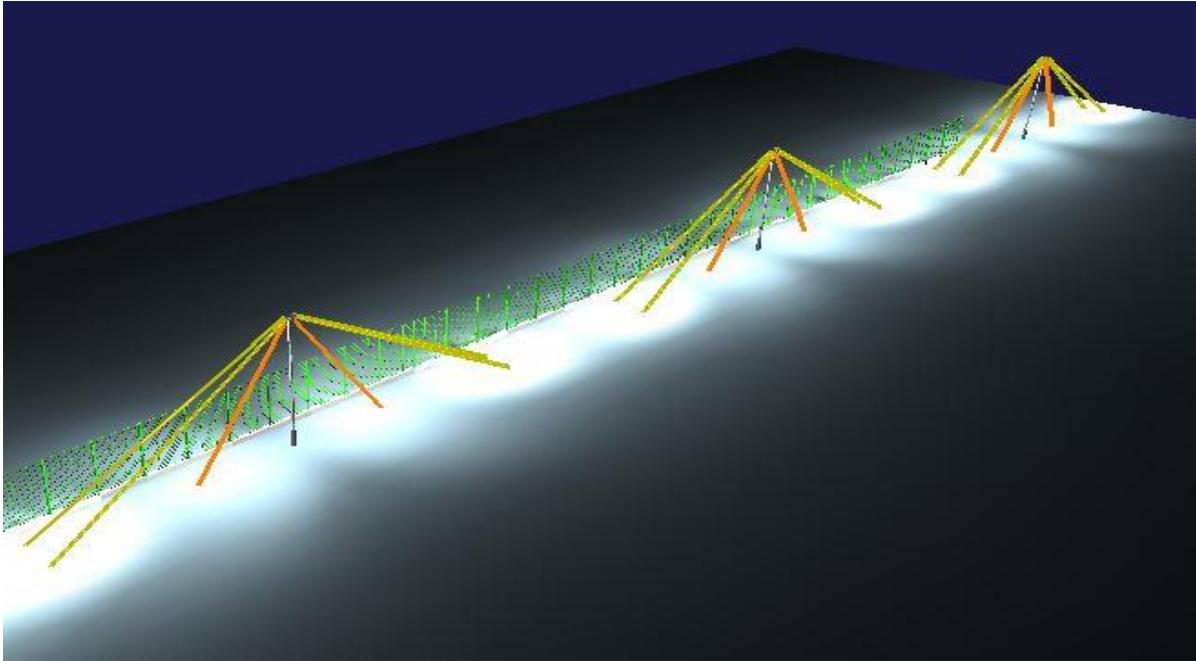
35m (115ft) column spacing – x2 RL200-AI-10 per column



Recommended practice for illuminating a perimeter with a 35m (115ft) column spacing is to utilize two lighting units, one each side of the column, to achieve a greater distance whilst still achieving even coverage and the minimum lux levels.

The lighting should be pointed down so that the beam patterns cross paths at a center point with the illumination from the adjacent column. There is more risk of the lighting in this design putting glare into the camera lens, but ensuring that the angle of elevation isn't tilted up too high will avoid any direct overexposure.

40m column spacing – x2 RL200-AI-10 and x2 RL100-50 per column



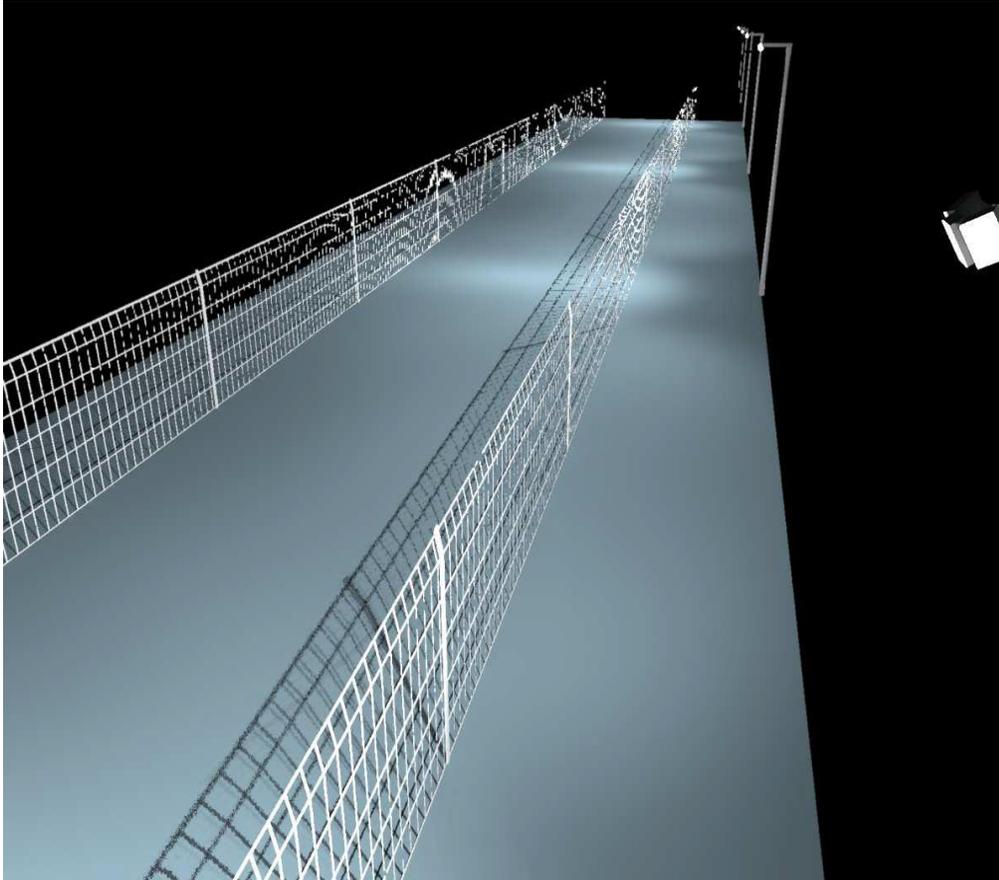
The best technique for illuminating a perimeter with a 40m (131ft) column spacing is similar to the technique for a perimeter with a 35m (115ft) column spacing. Perimeters with both 35m (115ft) and 40m (131ft) column spacing utilise lighting units on either side of the column with the illumination pointing towards the adjacent column. However the beam patterns on a 40m (131ft) column spacing design do not cross.

The elevation needs a higher tilt on the 40m (131ft) spaced design in an attempt to project the beam pattern out further to achieve more distance. The beams do not cross, but they hit the ground and merge at a point which still ensures the minimum lux level. However with the illumination targeted at quite some distance from the column, this leaves the base of the column dark and exposed. Therefore, a small lower powered light fitting pointing directly downwards on each side of the column is needed to ensure the minimum lighting levels are achieved at all areas across the sterile zone.

45-50m column spacing

The same technique is used for perimeters with a 45 (148ft) and 50m (164) column spacing, however the illumination levels tend to drop towards the absolute minimum requirement. Beyond 50m (164) is not a recommended column spacing for achieving good illumination levels for general area illumination at night. At this distance, the cameras on the columns would also be affected too. The targeting angle of illumination would be too shallow, and would cause glare into the camera lens and impair the image.

Illuminating the Fence



White-Light illumination can also be targeted directly at the fence line should the project require it to. Higher lighting levels can be achieved using this lighting design approach, due to the light travelling a shorter distance and hitting the fence on a vertical plane, rather than the ground on a horizontal plane.

FSI Lighting Design Service

Whether using Infra-Red or White-Light for CCTV and/or general area illumination, all security professionals can utilize FSI's full support and expertise when handling perimeter projects.

FSI's team of expert lighting designers can help you design and specify the best lighting for your project requirements, for the highest level of night time surveillance, site safety, and energy and cost efficiency.

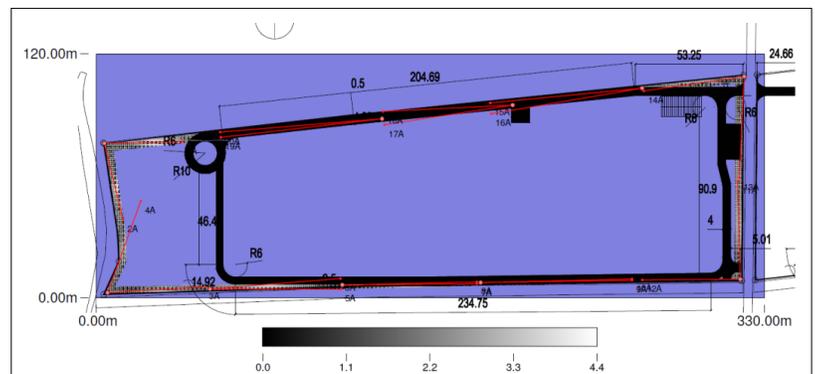
Working closely with the customer, FSI will firstly determine the requirements of the lighting for the specific application. With site drawings from the customer, FSI lighting design experts use professional design software packages to create tailored lighting solutions to highlight the best lighting positions, minimum number of fittings, illumination angles and detailed lighting levels to meet the specific requirements of each project.

All FSI products are independently photometrically tested to determine the exact power and light distribution. Using this photometric data in conjunction with lighting design software, FSI lighting designers are able to provide a lighting solution which adheres to any specific lighting requirements which may be stated in the project tender document.

FSI can provide two different types of lighting design – 2D and 3D.

2D Lighting Design Process

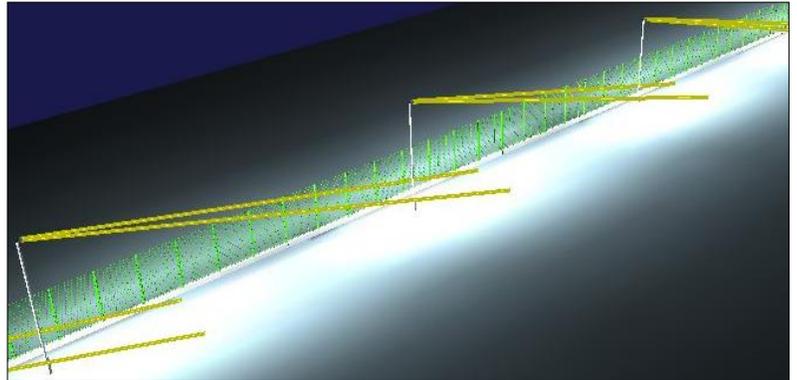
A 2D design is used to plot the individual light fittings onto the site plan, indicate the direction and spread of the illumination, and use contour lines to show figures of detailed lux levels within different areas. This type of design explains exactly how FSI will achieve the desired outcome, and can be used as a guide during the installation stage.



3D Lighting Design Process

A 3D design is used to provide the customer with a visual representation of what the final installed lighting solution will actually look like.

If the customer requires, FSI can also provide visits to site to provide a detailed survey, and provide an energy and cost saving report analysis of the savings made possible by switching to LED technology.



Summary

Ensuring the optimum illumination for perimeter protection is crucial for achieving top level security and safety at night. FSI LED lighting has long been at the forefront of technology innovation and is designed to deliver the best possible night-time CCTV images and site security. It provides the highest level of reliability, long life, low running costs, energy efficiency and zero maintenance, compared to many older technologies such as halogen, sodium or metal halide.

Perimeter applications can utilise both Infra-Red and/or White-Light LED for CCTV purposes. White-Light can also be used for general area lighting, multi-purpose lighting or as an active deterrent to warn off intruders.

Infra-Red for CCTV

Infra-Red LED lighting is generally installed on the perimeter columns alongside CCTV cameras to covertly monitor and detect intruders. FSI Infra-Red lighting provides the greatest distances up to 300m+ (985ft+) at angles from 10-180 degrees. It provides an even spread of crisp and clear, powerful illumination for excellent black and white images at night.

White-Light for CCTV and/or General Area Lighting

White-Light LED illumination can also be used for CCTV. FSI White-Light illumination provides accurate colour rendition and an even spread of illumination for excellent colour CCTV images at night. Where visible White-Light illumination is used on the perimeter columns, it often has a multipurpose function. In addition to providing lighting for colour CCTV, energy efficient FSI

White-Light illumination can also be used to provide a well lit and safe environment for site personnel. Its targeted, even spread of cool white illumination minimises light pollution and often results in less light fittings being needed. Other lighting technologies such as sodium lighting produce an uncontrolled beam and more light pollution, creating an uneven spread light with poor colour rendition.

Perimeter Lighting Solutions Comparison



Traditional Lighting:

400 W Sodium Lighting

- High energy, uncontrolled beam
- More light pollution and less energy efficient due to uncontrollability of beam.
- Bad quality of light, creating dark, unsafe areas due to the uneven light output, and poor color rendition for CCTV



FSI LED Lighting:

100 W LED Lighting

- Low energy, targeted lighting
- Less pollution and more energy efficient.
- Better quality of light for a safe evenly lit area, and good color rendition for CCTV
- Better lumen output
- Less light fittings needed per column

Technology Integration for Smarter Installations

High performance Infra-Red and White-Light LED lighting can also be used in conjunction with a number of other technologies such as PIR, fibre optic cable or VMS systems for a much smarter, greener, more dynamic security system designed to provide instant response to threat whilst minimising running costs.

Infra-Red can be used to covertly monitor the perimeter during all hours of darkness. The quick start nature of White-Light LED illumination allows it to be instantly activated for a pre-defined period of time via external trigger on the detection of an intruder, to create a warning light.

This 'lighting on demand approach' providing lighting only when and where needed reduces the environmental impact of the system whilst delivering significant cost savings. This approach is simply not possible with older technologies such as sodium or metal halide which are slow to start, inefficient and unreliable.

Perimeter security lighting is a crucial part of a security system. Illuminating the camera field of view with an Infrared (IR) or white lighting systems significantly improves the performance of the camera. Since IR lighting is invisible to the human eye, it adds an element for covert camera detection. White light is useful for guard responses and to deter intruders from entering the site. Additionally, Fiber SenSys' lighting is the most energy efficient method to illuminate airports and other large outdoor areas.



Fiber SenSys Model LDxx lighting systems are now fully integrated to provide intrusion deterrence with long-range LED and IR solutions for zone-based automatic lighting to illuminate areas with initial potential intrusion attempts. Lighting scatters the culprits before a crime is committed and saving money by reducing the need and priority to dispatch a security force.

For more information, contact us at:

Tel: +1(503)692-4430

Toll free (US) +1(888)736-7971

www.fibersensys.com

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