Security Lighting

Day 3 - Session 8



Learning Objectives

Students will learn about and understand how to use the following guidance for Security Lighting:

- The role of lighting in providing effective security.
- Describe how light is measured.
- Describe the features that make security lighting effective.
- Identify the primary types of security lighting.





Lighting - Does It Make You Feel?



Lighting - Does It Make You Feel?



Lighting and Safety

Does this lighting make you feel safer?



"To draw potential customers from afar and make Red Roof Inns stand out from the rest of the crowd, we chose MasterColor.®"

Security Lighting - Exercise

How do you know good or bad security lighting when you see it?

Pick a partner and identify two qualities of:

- Good security lighting
- Poor security lighting



Early Street Lighting



Moorish Street Lamp Caliphate of Córdoba (about 1000 AD)

During the night, ten miles of streets were well illuminated by lamps.

Early Street Lighting



Paris the City of Light

Another Louis IVX Initiative Street Lighting of Paris - 1667

Urbis Securitas Et Nitor

Security and Light for the City

Security Lighting First gas fired street light house.

A 40 foot octagon, brick tower was built at 11th and Main Streets. It was surmounted by a large lantern equipped with jets fed by coal gas.

Richmond, Virginia <u>1802</u>



Public Safety and Lighting

" Let us have light, now we are compelled to grope in darkness through our rugged and dangerous city streets."

Public Safety Committee Richmond, Virginia 1846



Security Lighting

Jane Jacobs – 1961

"Street lights can be like the famous stone that falls in the desert where there are no ears to hear it. Does it make a noise?

"Without effective eyes to see, does a light cast light?"



Security Lighting

National Crime Victimization Survey 1991

- 41 percent fear being attacked or robbed during daylight.
- 61 percent fear being attacked or robbed at night.



College campus at dawn with 165-watt lamps

Lighting and Safety

13 studies from the United States and the United Kingdom showed that improved street lighting was linked to a significant 21% decrease in crime in the experimental areas compared with comparable control areas.

Improved Street Lighting and Crime Prevention David P. Farrington and Brandon C. Welsh Swedish National Council for Crime Prevention, 2007

New City Portable Street Lighting

59% nighttime decrease in serious crime





Lighting and Safety

Street Lighting: New York City Public Housing (2017)

- Implemented a temporary outdoor street-lighting program designed to reduce nighttime crime in public housing.
- Installing light towers in developments resulted in statistically significant reductions in complaints of felony crimes, assaults, homicides, and weapons crimes at night, compared with control developments.

Lighting and Safety

Street Lighting: New York City Public Housing (2017)

Compared with control groups, these statistically significant results were found:

- Nighttime index crimes decreased 48%
- Nighttime felony crimes decreased 37%.
- Nighttime assaults, homicides, and weapons crimes decreased 30%.

Source: Chalfin, Aaron, Benjamin Hansen, Lucie Parker, and Jason Lerner. 2017. The Impact of Street Lighting on Crime in New York City Public Housing.

Purpose of Security Lighting

- Provide a clear line of view of an area and enable anyone moving in, or immediately around, the area to be easily seen.
- Deny potential hiding spaces.
- Allow facial recognition from a distance of at least 35 feet.
- Facilitate the proper use of security devices such as CCTV.

Lighting Terms

- Watt amount of electricity going into a light bulb
- Lumen output of a light bulb
- Lumens per watt efficiency of a lighting source
- Average lumens average output over the life of a bulb



Types of Exterior Security Lighting

- Continuous
- Standby
- Emergency
- Portable

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Light Fixture or Luminaire

- The complete lighting unit designed to distribute the light, position and protect the light sources, and connect the light sources to the power supply.
- A light fixture consists of a lamp, a ballast, and a lens.

Light Fixture Components

Lamp

The lamp produces optical radiation. The lamp is also referred to as light source, bulb or tube.

Ballast

A ballast is a device used to obtain the necessary circuit conditions of voltage, current, and waveform for starting and operating. The ballast ensures the lamp stays lit by managing the distribution of energy throughout the fixture.

Lens

A lens is a glass or plastic element used in a light fixture to change the direction and control the distribution of light rays.

Types of Luminaires

Cut-Off & Sag







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Security Lights Home & Business





Luminaire Schedule

Symbol	Label	Qty	Catalog Number	Description	Lamp	File	Lumens	LLF
:	А	3	MV400HP00NRXGXMONGOOSE		400W CLEAR HPS	49732.ies	50000	0.72
Â	В	5	TWAC 100M	WALL PACK W/SPECULAR REFLECTOR, CLEAR POLYCARBONATE LENS & COMPOSITE HOUSING	ONE 100-WATT CLEAR ED-17 METAL HALIDE, HORIZONTAL POS.	It18359.ies	8500	0.72
•	с	8	9100- MV100/WALL WA	SPUN ALUMINUM SHHOUSING, FORMED DIFFUSE ALUMINUM REFLECTOR WITH BLACK PAINTED FLAT BACK SECTION, FLAT GLASS SPREAD LENS.	CLEAR 100-WATT MERCURY VAPOR, A-23 MEDIUM BASE, RATED	ITL36105.IES	3700	0.72

Lighting Issues

- Illuminance / Intensity
- Light uniformity
- Direct glare
- Color Rendition
- Height of the light fixture
- Reflected Light
- Light Trespass
- Efficiency
- Depreciation

What is A Foot-candle?



What is A Foot-candle?

One foot-candle of light is the amount of light that one candle generates on a one foot square surface from a distance of one foot away.



Foot-candle vs. Lux



Lighting Foot-candle

The further away you move from the source of light the less of foot-candles of light provided.



Lighting Issues - Intensity

Is there enough light to allow you to identify a person's face from a distance of 35 feet?



Lighting Issues - Intensity

Is there enough light to allow you to read a newspaper?



Is the lighting uniform – equal?





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- Blended or even light that avoids pools of light with spots of darkness between them
- 6:1 ratio from brightest to darkest (youthful population)
- 3:1 ratio from brightest to darkest (older population)



- Gone are the old street lights, looming 30 feet above the street, casting bright spots of light but leaving deep pools of dark because they were spaced 120 feet apart.
- The new lights, 16 feet high, so the trees won't block them, stand 40 feet apart.
- Pedestrians won't see those dark places or worry about people lurking in the shadows.

Richmond Times Dispatch: May 2, 2005

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Lighting Issues - Glare

Horizontal light aimed directly into the eyes that destroys night vision.



Lighting Issues - Glare



The glare on the right, from a light fixture pointed at eye level, hides the man at the doorway.

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Lighting Issues - Reflected Light



Reflected Light

- Asphalt 5% most light absorbed
- Foliage 10 20%
- Concrete 25 30%
- Red Bricks 35%
- White Matt Paint 60%
- Glass 70%
- Snow 95%

most light reflected



Color Rendition

• Color rendition allows one to identify colors accurately and confidently.

 Is determined by the lamp's spectral power distribution and illuminance level and is measured by the color rendition index (CRI).

Color Rendition



Energy Efficient Street Lights (Light Emitting Diode/LED)

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Color Rendition

- Natural daylight and incandescent lighting have the maximum CRI value of 100.
- The closer a lamp's CRI rating is to 100, the more it resembles daylight and is able to show true colors of an object to the human eye.

Light Fixture Height

- The height of a light fixture is important to consider. Light fixtures can be mounted on the ground, on buildings, or on poles.
- Increased pole heights allow the use of higherwattage, more efficient lamps.

Lighting Issues - Light Trespass



Lamp Efficacy or Efficiency

- The amount of light produced by a light source for every watt of energy. Lamp output is expressed in lumens per watt. The higher the efficacy number, the more efficient the lamp.
- The most energy efficient technologies are solid state lighting (SSL) light-emitting diode (LED) and induction lighting systems



Performance and Cost of Street Lighting 2019

	LED Street Light Retrofit Kit	High Pressure Sodium	Mercury Vapor	Incandescent
Lumens	15,500	28,000	28,000	5,600
Watts	100	250	400	400
Lumens/Watt	155	112	70	14
Wasted Light	0	14,000	14,000	2,800
Light available (Lumens)	15,500	14,000	14,000	2,800
Available Lumens/Watt	155	56	35	7
Cost per 100 Lumens	0.24	0.65	1.04	5.21
Average Life Span (years)	20+	5	4	3

Source: https://www.myledlightingguide.com/blog-the-cost-of-street-lights

Lumen Depreciation

- Lamp efficiency degrades over time.
- The amount of energy consumed remains constant while the light output slowly reduces.
- This is called lamp lumen depreciation
- Generally does not apply to LED lamps.



Light Loss Factors

- Lamp lumen depreciation
- Luminaire dirt depreciation
- Lamp burnout
- Luminaire component depreciation

LED lights are not impacted by these issues.



Lamp Lens Deterioration



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Measuring Light Levels

Light is measured in foot-candles or lux, using an engineer's light meter.

Lux is typically a European measure of light.

One lux is equal to 10 foot-candles.



Cost : \$150 to \$250

Photometric Lighting Plan



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Photometric Lighting Plan



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Recommended Lighting Levels (non-military)

Illuminating Engineering Society

- Building entrance 5 fc
- Parking deck 5 fc
- Pedestrian tunnel 5 fc
- Open parking lot 2 fc
- Sidewalks/commercial 2 fc
- Sidewalks/residential .4 fc



Recommended Lighting Levels

A useful rule of thumb when considering lighting levels for pedestrians or normal CCTV cameras.

- Detection 0.5 fc
- Recognition 1.0 fc
- Identification 2.0 fc

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Recommended Lighting Levels

Defense Security Services - U.S. Department of Defense

<u>Area</u>	Foot-Candles
Approach Zone Nighttime	1
Response Zone Task Surface	10-20
Response Zone Roadway	3
Parking and Roadways	3
Access Zone	1
Search Areas (vehicle-checking)	10



Recommended Lighting Levels

Defense Security Services - U.S. Department of Defense

<u>Area</u>	Foot-Candles
Under Vehicle Inspection	10
Vital Locations or Structures	5
Building Surrounds	1
Pedestrian Entry	2
Single Fence Line	0.2-4
Restricted Are	0.2-5

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Security Lighting Recommendations

- Illuminate entrances, fire escapes, etc. with bright white light.
- Parking lots should be illuminated with bright white lights that allows for uniformity, (not allowing any dark areas in the parking lot).
- Implement a maintenance policy.



Security Lighting Recommendations

- Parking lots should be illuminated so one can identify a human face at 35 feet (three foot candles vertically above the surface).
- Wire cages or industrial strength shatter resistant lenses should be placed over the light to deter vandalism.
- Position lights to avoid glare areas and blind spots.



Better Lighting - Placement



Before retrofit

After retrofit

Source: Lighting Research Center Rensselaer Polytechnic <u>https://www.lrc.rpi.edu/</u>

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Light Sources - Islamabad

How many different types of light do you see?





Incandescent 17 - 23 lumens/watt, short life

Florescent

- 67 83 lumens/watt
- Life 12,000-20,000 hrs.



Mercury Vapor

- A blue-green light
- Lumens/watt: 45-63
- Life: 16,000-24,000 hrs.
- Sharp drop in burning curve



High Pressure Sodium

- A golden yellow light
- Lumens/watt: 50 130
- Life: 7,500 24,000 hrs.
- Very little drop in burning curve



Low Pressure Sodium

- Emits an orange light
- Lumens/watt: 60 150
- Life: 12,000 18,000 hrs.
- Poor color rendition
- Good in fog



Low vs. High Pressure Sodium



High

Low

Metal Halide

- A crystal white light
- Lumens/watt: 70 115
- Life: 5,000 20,000 hrs.
- Works well with CCTV
- Expensive to install and maintain
- So bright it makes other areas appear dark





Lighting Sources

<u>LED</u>

- Emits a monochromatic light that can be tined to any color preference
- Lumens/watt: 120
- Life: 50,000
- Excellent color rendition
- Can be solar powered



Metal Halide vs. LED - Intensity



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HPS vs. LED - Color Rendition



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Solar Powered LED Street Lights

- Solar powered street lights improve safety and security where electric power is unavailable, unreliable, or expensive.
- Some provide near maintenance-free operation for more than five years.





Lighting Quiz

There is adequate security lighting is adequate if you can recognize someone's facial features from a distance of -

- A. 15 feet
- B. 35 feet
- C. 50 feet
- D. 75 feet

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Lighting Quiz

Which of the following is a measure of the amount of light striking a surface?

- A. Ballast
- **B.** Foot candle
- C. Watt
- **D.** Luminance

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Lighting Quiz

The even distribution of light in a given area between transition areas is commonly referred to as -

- A. Adaptation
- **B. Hot Spot**
- C. Uniformity
- D. Glare

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Streetlight Replacement Project

Tacoma Washington

https://www.cityoftacoma.org/government/city_departments/public_works/engineering/streetlight_replacement_project



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Other Issues

• Group Relamping

• Lamp Restrike Time

• Lamp Identification

• Lighting Problems

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Group vs. Spot Relamping





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Group vs. Spot Relamping

	Relamp cycle (hours)	Average relamps per year	Average material cost per year	Average labor cost per year	Total average cost per year
Spot relamping on burnout	20,000	525	\$1,391	\$3,150	\$4,541
Group relamping at 70% of rated life ^b	14,000	750	\$1,988	\$1,125	\$3,133
Difference		225	\$597	-\$2,025	-\$1,428
					31% savings

Lamp Restrike Time

The time it takes a lamp to reach full brightness when the lamp is switched off and then switched back on.

Incandescent	None
Fluorescent	Slight Delay
Mercury	10 - 20 minutes
LP sodium	None
HP sodium	One minute
Metal halide	4 - 20 minutes
LED	None

Lamp Identification

Yellow - sodium

Blue - mercury

Red/white - metal halide

Add a zero (0) to the number to determine the bulb wattage.





Lighting - Problems





Fixture Vandalism

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Fixture Placement

Lighting - Problems



Dead Bugs - Dirt



Poor Location



Guide for Security Lighting



IES G-1-16

Guide for Security Lighting for People, Property, and Critical Infrastructure

Illuminating Engineering Society www.ies.org



Illuminating Engineering Society 120 Wall St. Fl 17 New York, NY 10005-4026 (212) 248-5000

Lighting Guides

Exterior Security Lighting Guide (2017)

Student Guide

Center for Development of Security Excellence

Defense Security Service

https://www.cdse.edu/index.html



Resources

- Lighting Research Center Rensselaer Polytechnic Institute 21 Union St. Troy, NY 12180 USA <u>https://www.lrc.rpi.edu/</u> 518-687-7100
- Center for Development of Security Excellence Defense Security Service U.S. Department of Defense <u>https://www.cdse.edu/index.html</u>

