



Dartmouth College's Overhead Crosswalk Lighting

ITE Hawaii Section
Transportation Solutions Event

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Introduction



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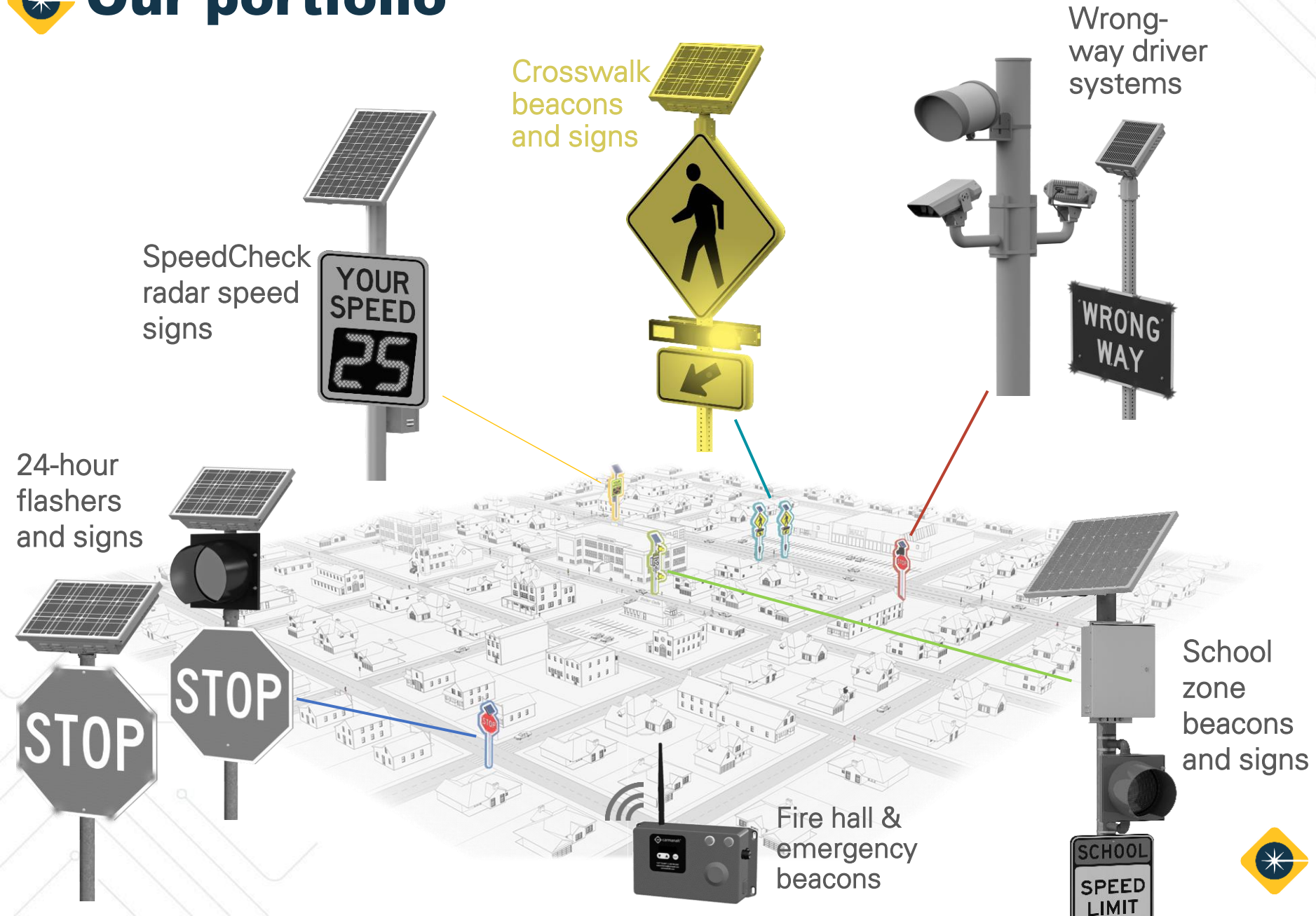


Carmanah Technologies

- Specialize in the design and manufacture of **compliant transportation safety solutions**
- 25-year reputation for delivering durable and dependable solar- and AC-powered systems
- Focused on improving safety at crosswalks, school zones, highways, and more
- Headquartered in Victoria, BC, Canada
- Manufacturing in Houston, TX



Our portfolio



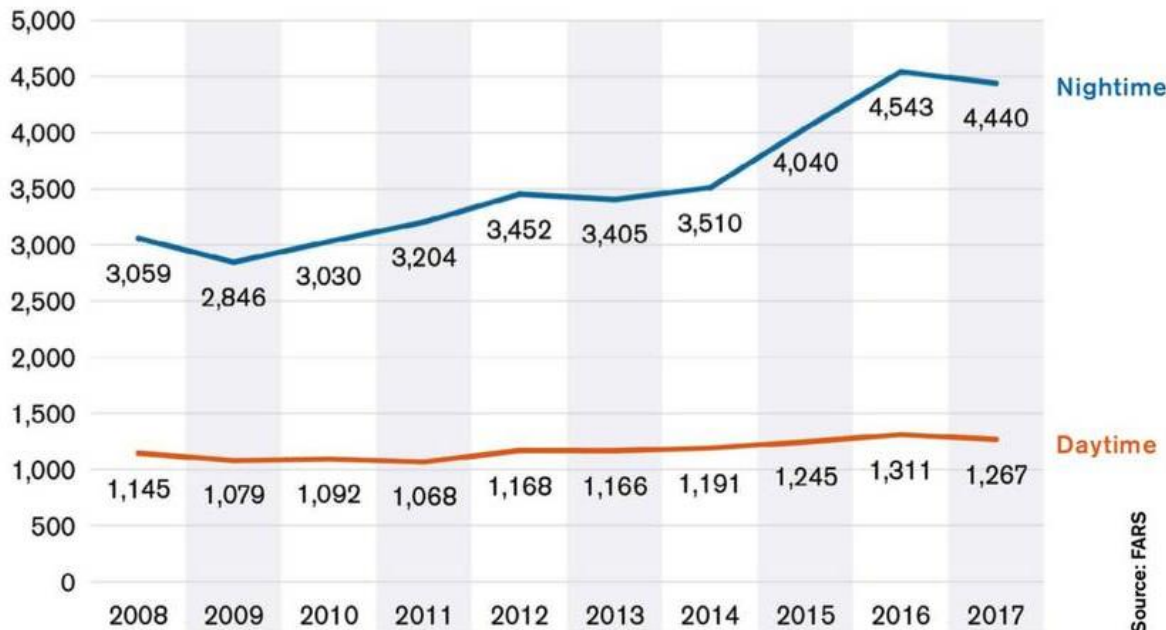


Overhead lighting



More dangerous to walk after dark...

Figure 6 Number of Daytime and Nighttime Pedestrian Fatalities, 2008 - 2017



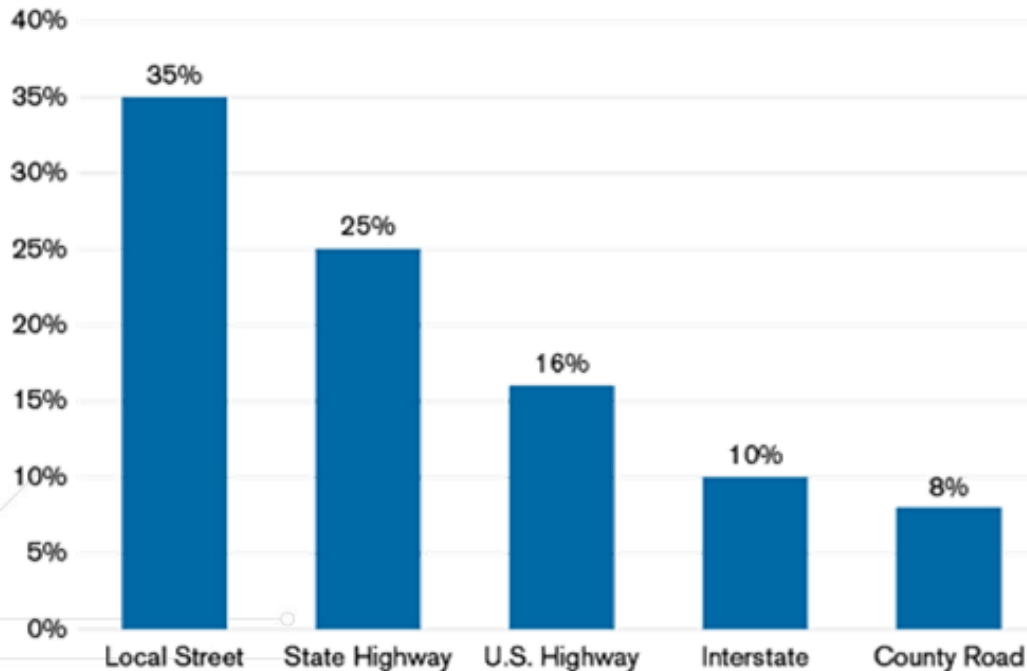
75% of pedestrian fatalities occur after dark

Nighttime crashes accounted for more than 90% of the total increase in pedestrian deaths in the past decade



... especially on local and suburban roads

Figure 8 Pedestrian Fatalities by Roadway Type, 2017



- More than a third of pedestrian fatalities occur on local streets < 500 vehicles/day
- 72% of pedestrian fatalities occur at **non-intersection locations**



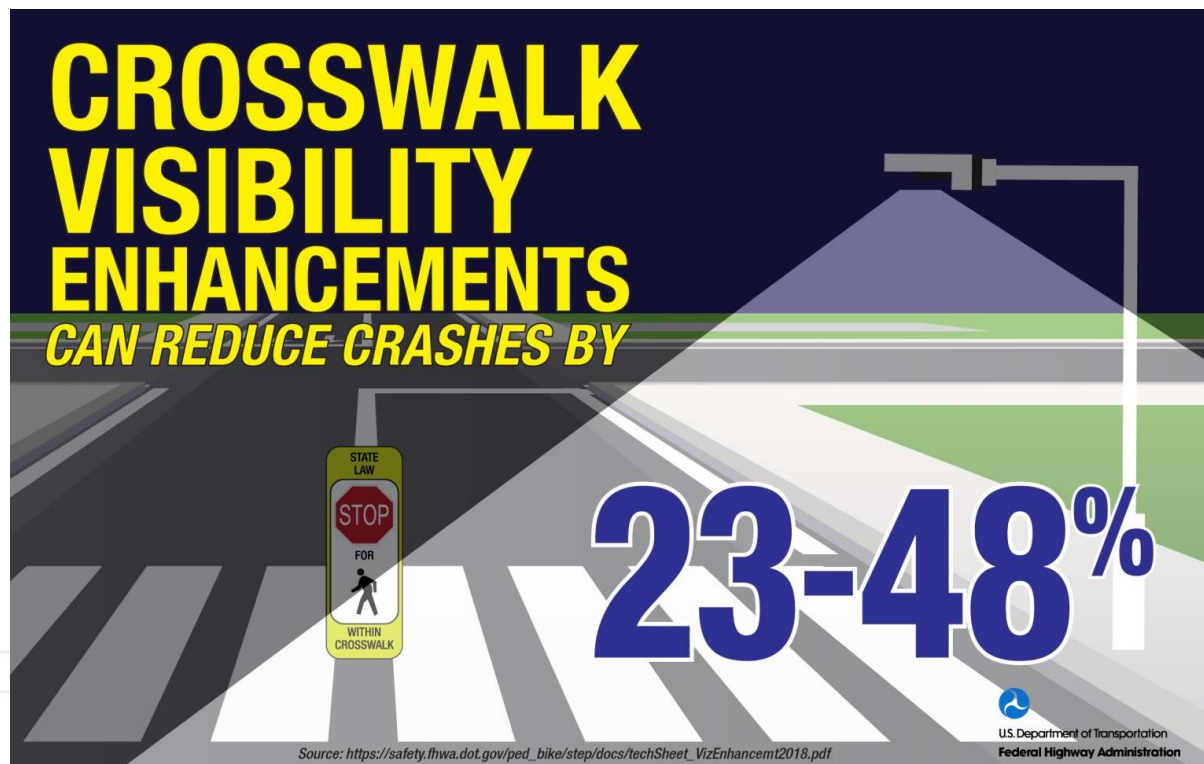
Explaining the increase?

- More people are commuting on foot in general
- More people are [working at night](#)
- Collision avoidance systems in new vehicles [aren't as effective as manufacturers claim](#)—especially at night
- Headlights on most cars aren't bright enough, even though [better technology exists](#)
- Increase in distracted driving at all hours



A proven countermeasure

Positive safety effects of roadway and crosswalk lighting are well-documented



And, accidents that occur on unlit roads are almost twice as likely to be fatal as those that occur on well-lit roads



Aren't streetlights enough?

- Streetlights are typically 25 ft. or higher from the road surface and spaced +100 ft. apart
- Designed to serve the needs of motorists in navigating and avoiding obstacles
- **Not designed to illuminate a pedestrian or light an entire crosswalk area**



What determines pedestrian visibility?

Contrast

- Visible difference between an object and its background
- Positive contrast = preferred

Negative contrast



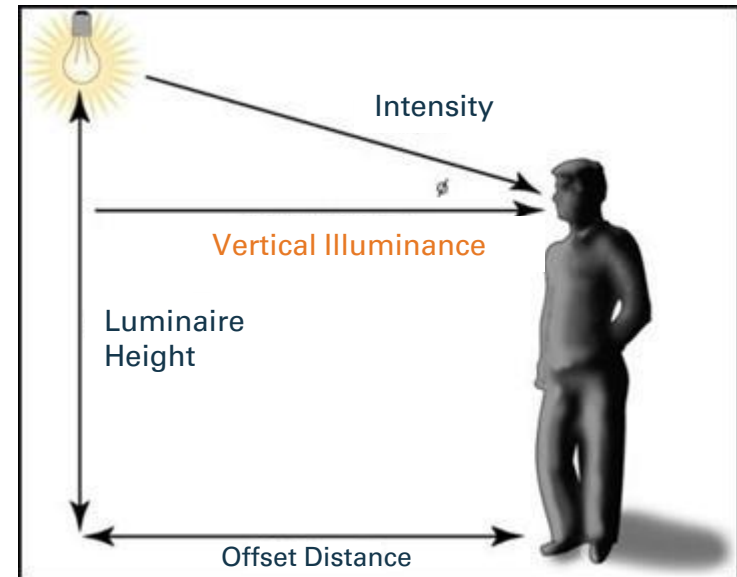
Positive contrast



Vertical illuminance

- Amount of light that falls on a vertical surface (e.g. the profile of a pedestrian)

Goal of a lighting designer is to maximize the **positive contrast** and **vertical illuminance** of **pedestrians** on or near the crosswalk from the perspective of approaching drivers

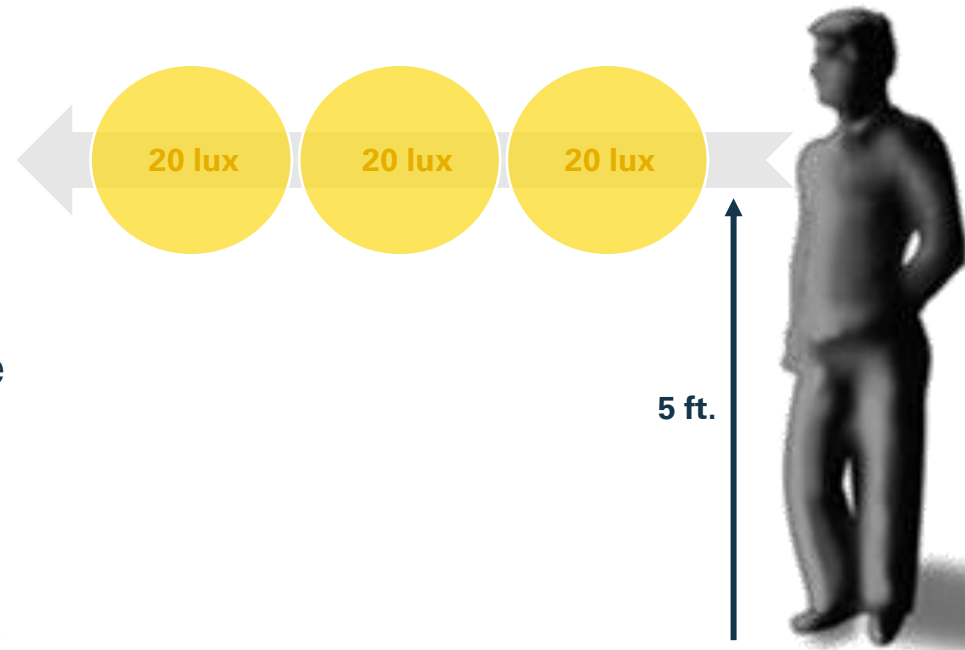


FHWA / IES lighting standards

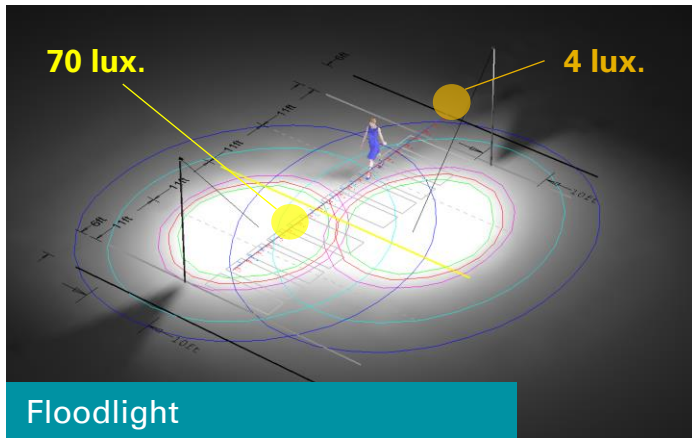
“A vertical illuminance level of **20 lux** measured at 5 feet from the road surface allowed drivers to detect pedestrians in midblock crosswalks at adequate distances **under rural conditions.**”

“A higher level of vertical illuminance may be required when:

1. Possibility of continuous glare from opposing vehicles.
2. Crosswalk is located in an area with high ambient light levels.”

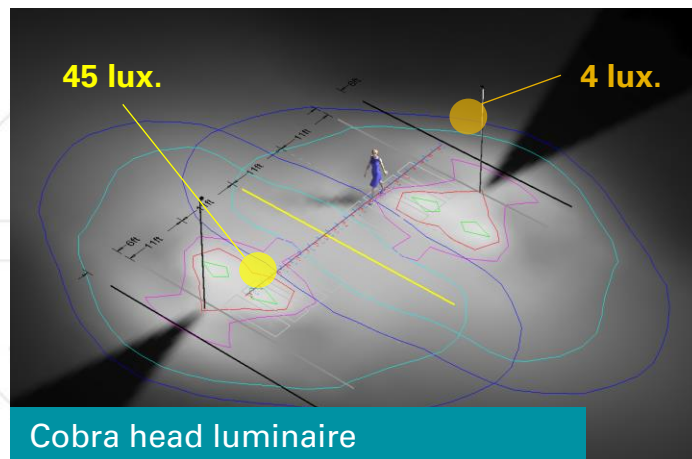


Achieving the spec



Floodlights can meet the 20 lux avg., but illuminance is inconsistent

- Range could be from 4 to 70 lux
- Problematic if you are trying to avoid shadows and hotspots



Cobra head luminaires meet the spec with much more uniformity

- Our range is 4 to 45 lux
- LED, overhead, dark sky friendly

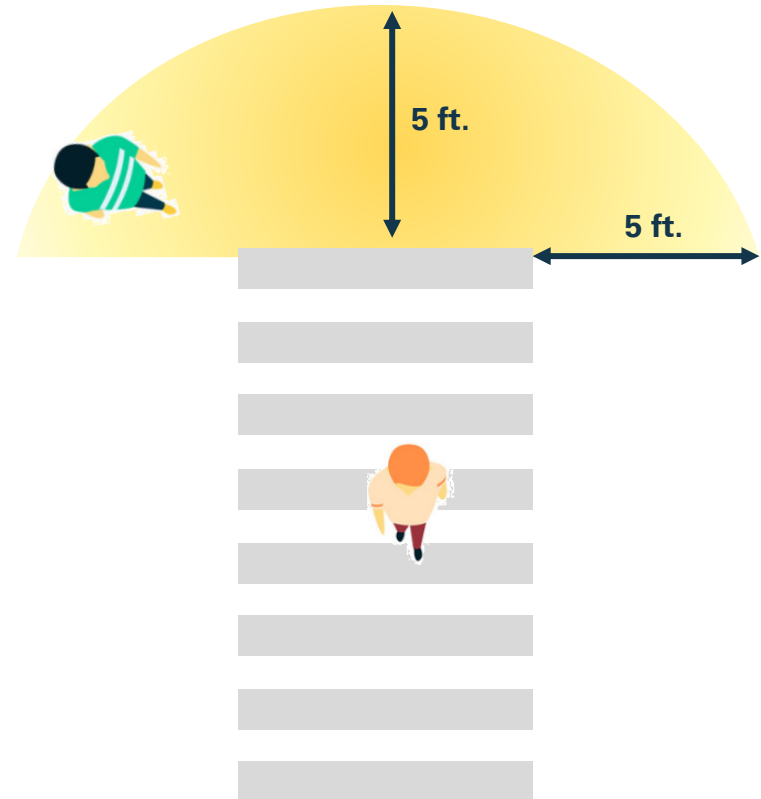


Light where you need it

Light the approach and exit area
outside of the crosswalk

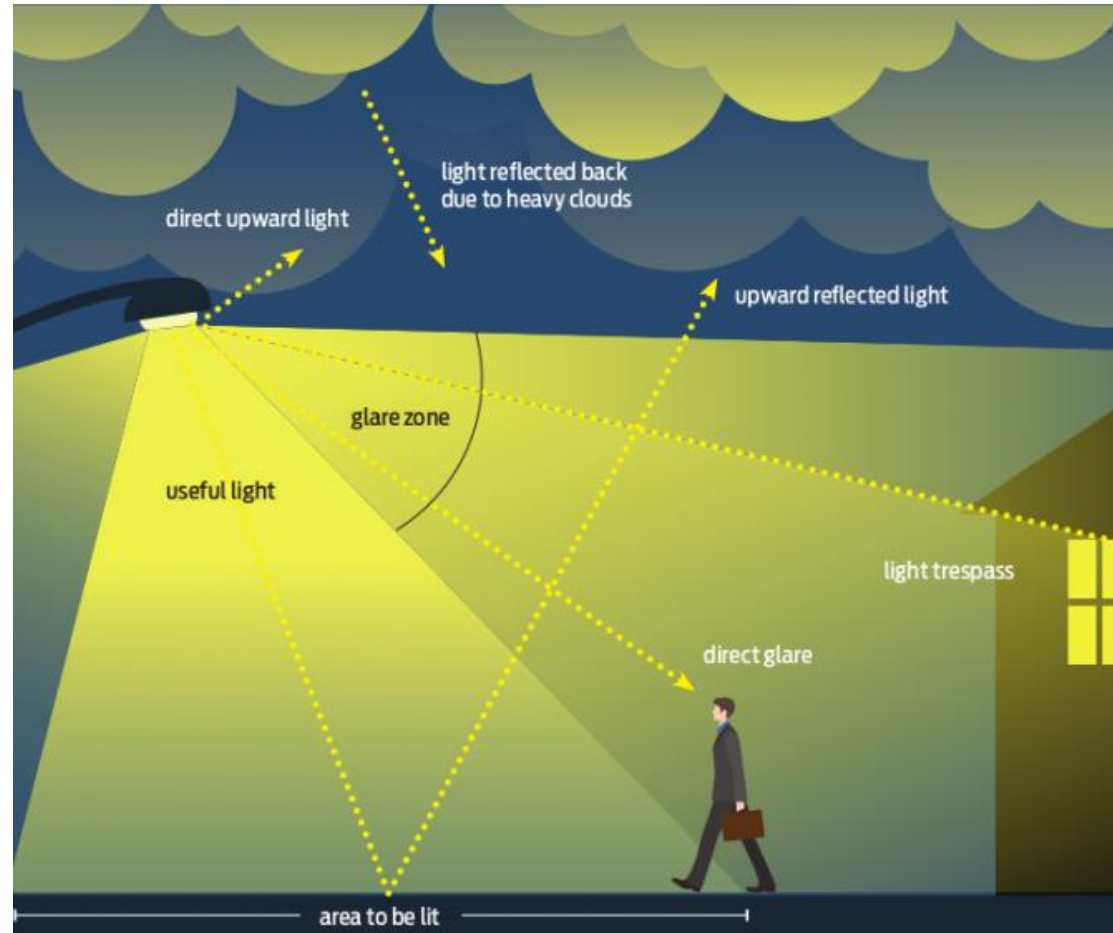
“The horizontal calculation grid should
span the entire crosswalk, plus 5 feet
within the walkway/approach, at
ground level”

– Colorado DOT



Glare

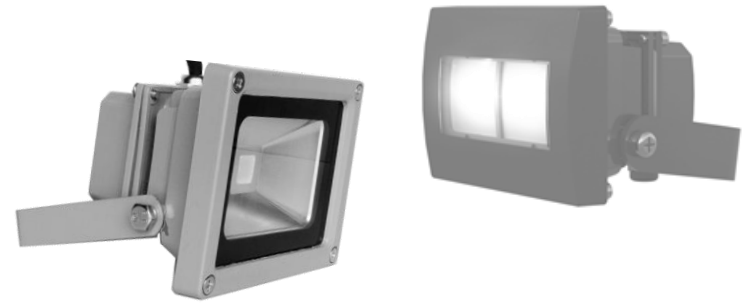
- Excessive brightness that causes discomfort or impairment of vision
- Reduces visibility for both pedestrians and drivers
- Lights that cause glare are typically unshielded and non-directional, emitting large amounts of spill light



Minimizing glare

“[Floodlighting] should not be used for conventional roadway lighting due to the increase in glare when compared to conventional roadway luminaires.”

– IES



Floodlights

“It is recommended that flat glass luminaires, mounted with the luminaire lens parallel to the roadway be used to **minimize potential glare.**”

– IES

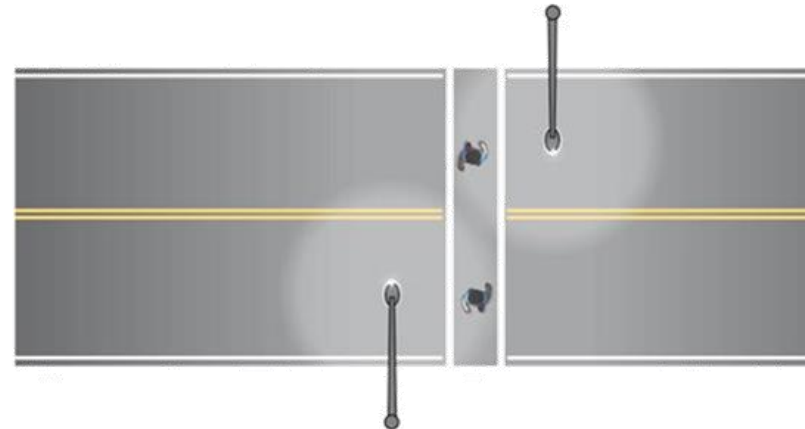
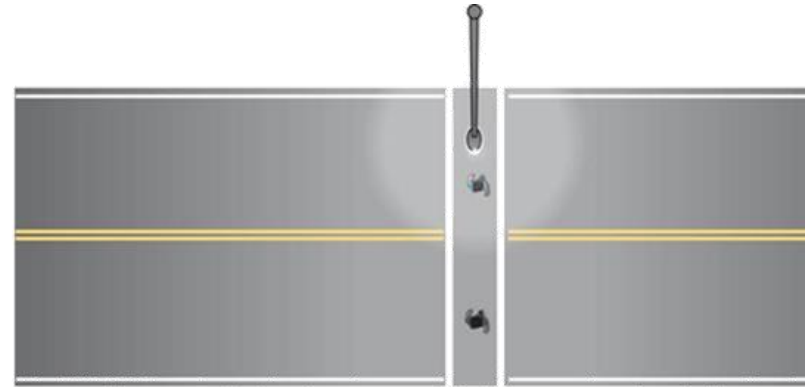


Cobra head luminaires



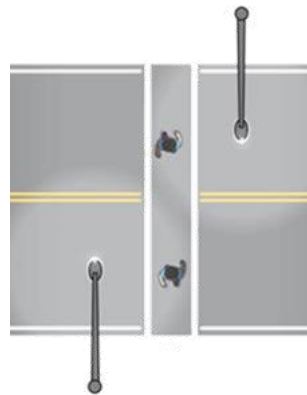
Placement

- Historically, many agencies have installed a single luminaire directly over the crosswalk – this often isn't enough
- To achieve 20 lux min. illumination across the entire crosswalk, two fixtures are typically required – one on either side of the road



Placement

- Luminaires are often aligned with the crosswalk
- Poles can limit access to the crosswalk ramp
- Luminaires (and typically, their poles) should be in advance of the crosswalk to create **positive contrast** of the pedestrian
- Placement depends on several variables (mounting height, lumen output, mounting arm), but should generally be 10 – 16 ft. before the crosswalk





Overhead lighting + crosswalk beacons



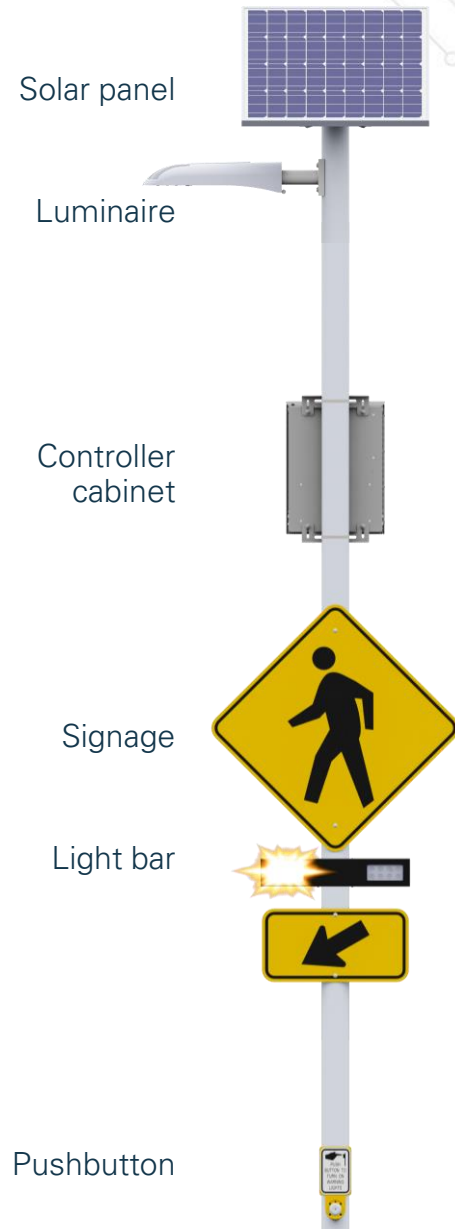
Overhead lighting + RRFBs

Most common layout is **pedestrian-activated** overhead lighting + rectangular rapid flashing beacon (RRFB)

- Luminaire and light bars operated by a single controller
- Wireless communication to other systems including any advance beacons
- AC or solar-powered by a single solar panel and battery

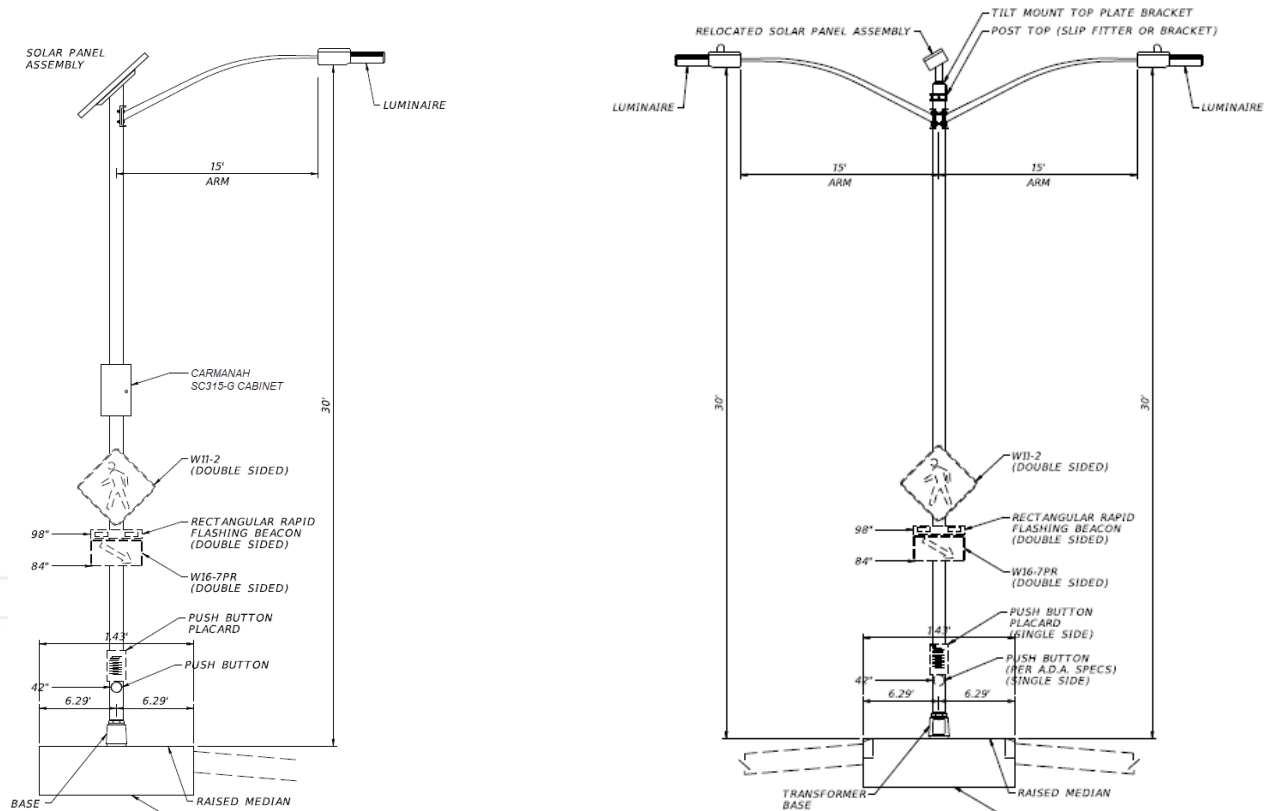
How does it operate?

- Pushbutton pressed during the **day** = light bars turn on
- Pushbutton pressed during the **night** = light bars AND luminaire turn on
- After their preset activation time / crossing duration, the light bars and luminaire turn off



Overhead lighting + RRFBs

Many ways to add overhead lighting to RRFBs:



Overhead lighting + RRFBs

HIGH OUTPUT LED STREET/AREA LUMINAIRE
ACTIVATED WITH THE RRFB

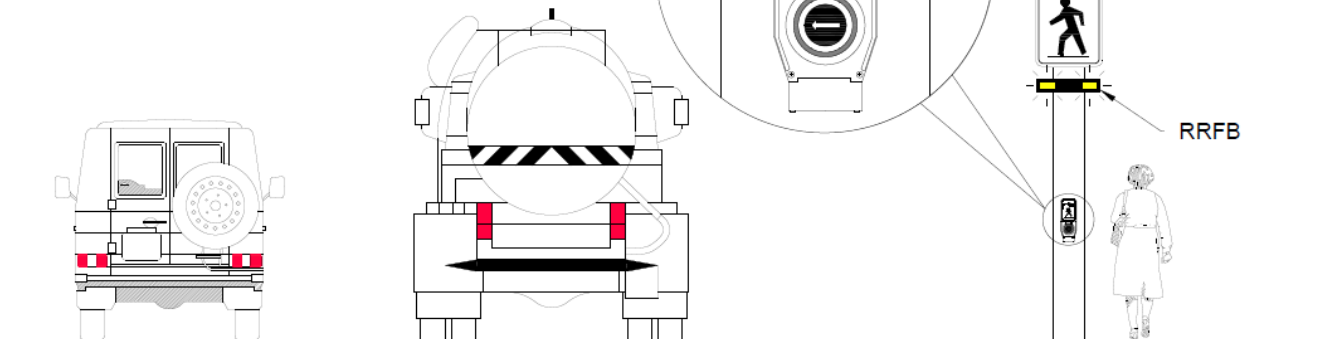
RA-4
90X120

Rectangular Rapid Flashing Beacon

CONTROLLER BOX

RA-4
60X75

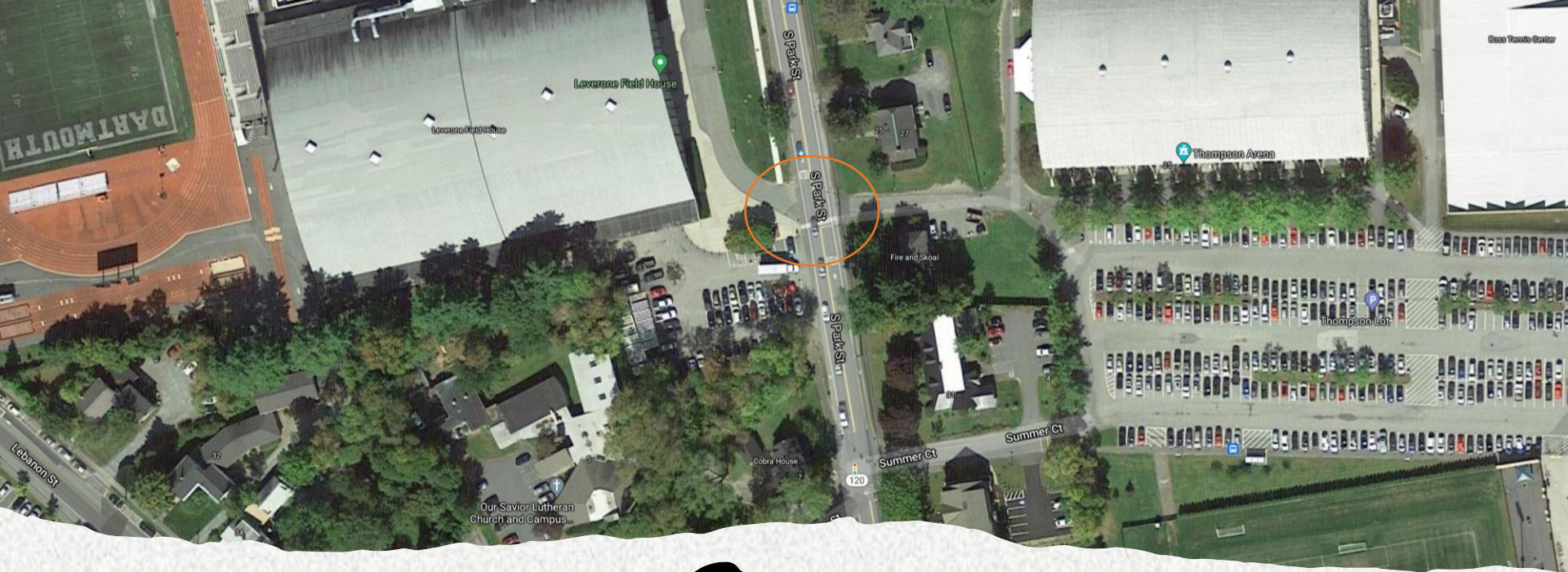
RRFB





Project summary





Dartmouth College Campus in Hanover, NH

South Park St., a cross-town thoroughfare, was flagged for improvements in Hanover's 2012 Bicycle and Pedestrian Master Plan.

- Campus is transected by small-scale streets and pedestrian-only pathways
- Popular midblock crossing sandwiched between multiple arenas and parking lots
- **14,000 + vehicles per day and up to 3,000 ped crossings during sporting events**



Evaluating the crossing

2019 - 2020

- South Park St. is also a two-lane state route (NH-120)
- RRFB crosswalk already installed
- Lighting and visibility were still issues:

“ In a busy college community, with thousands of crossings daily, it is imperative we provide as much warning to drivers as possible while still allowing traffic to move through our community.”

— Peter Kulbacki, Director of Public Works



Evaluating the crossing

2019 - 2020

In-house Operations Manager Mike Chase and Peter Kulbacki (a licensed engineer) worked closely with the Police Department and Dartmouth College to prioritize crossing locations and evaluated:

- ✓ Lighting levels
- ✓ Performed crossing counts
- ✓ Gathered public, School, College, and Police input as to safety
- ✓ Sight distances
- ✓ Turning movements



Overhead lighting + RRFB

2020 installation

- Narrow streets allow for directed overhead lighting to easily illuminate a pedestrian in the crosswalk
- Short 9 – 12" luminaire mounting arms + taller 4" poles
- 2x luminaires; 1x on each side of the crosswalk
- Luminaires offset from the crosswalk

Overhead lighting + RRFB

*“It has worked so well
that we have adopted the
setup as our standard.”*

*– Peter Kulbacki, Director of
Public Works*

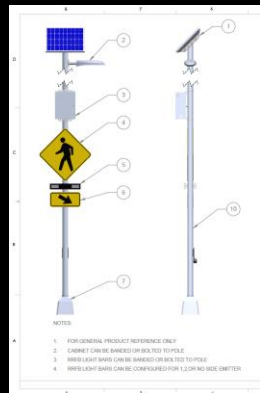
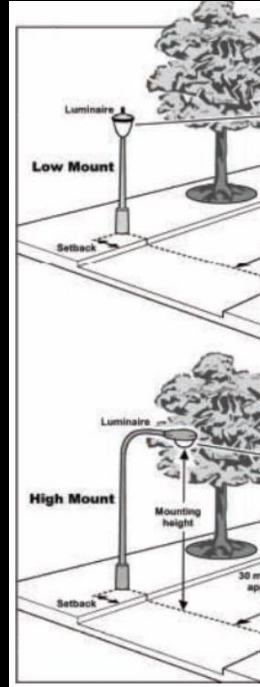


Design considerations



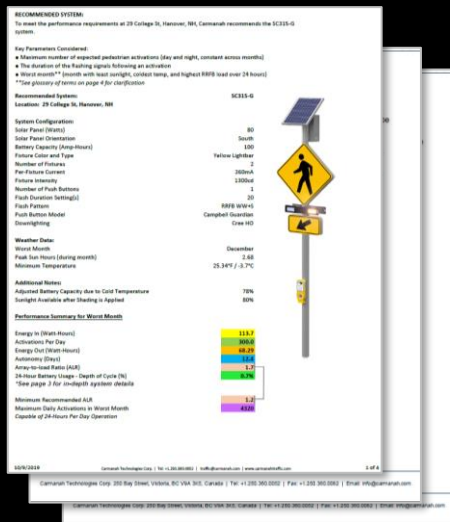
Design considerations

- Pole Type
 - Wind loading and footings
- Luminaire mounting and arm length
 - Short 7 – 12" mounting arms for most crosswalks
 - Davit arms for wider roadways
- Luminaire fixture type
 - Type 4ME is preferred since it outputs a high fraction of light across the crosswalk
 - Type 3M sometimes also works
- Line-of-sign obstructions (trees, buildings, signage)



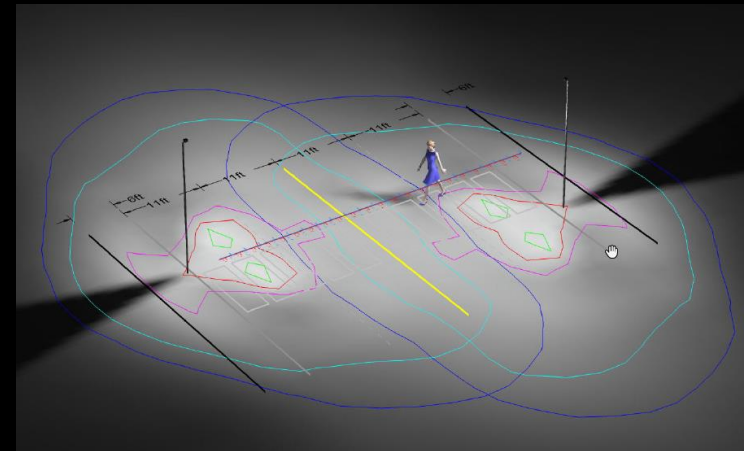
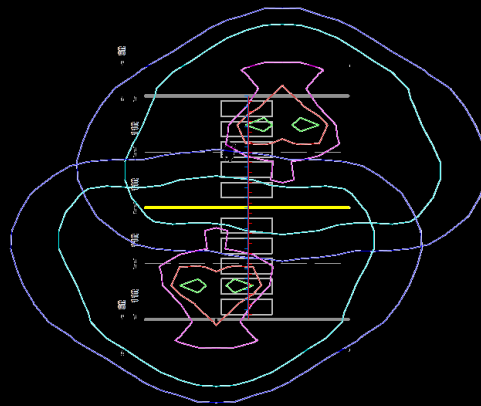
Design considerations

- Solar Power Report to ensure the system is sustainable year round
 - Location and shading details
 - Temperature concerns
 - Average and peak daily activations



Design considerations

- Lighting layout guides fixture placement to achieve the spec and maximize lighting levels
- Fixture height
- Position in relation to crosswalk



Luminaire Schedule						
Symbol	Label	Description	Arrangement	Lumens/Lamp	LLF	Arm
	XSP1HO_3ME_30K_50W	2-14396-2	SINGLE	6930	0.850	0.365
Numeric Summary						
Label	CalcType	Units	Avg	Max	Min	Avg/Min
East	Illuminance	Lux	18.08	46.3	4.4	4.11
West	Illuminance	Lux	17.70	46.6	4.3	4.12

Thank you!

Questions?

Learn more at carmanah.com

- Specifications, manuals
- Test reports, compliance documents
- Case studies

Stay connected with us!



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