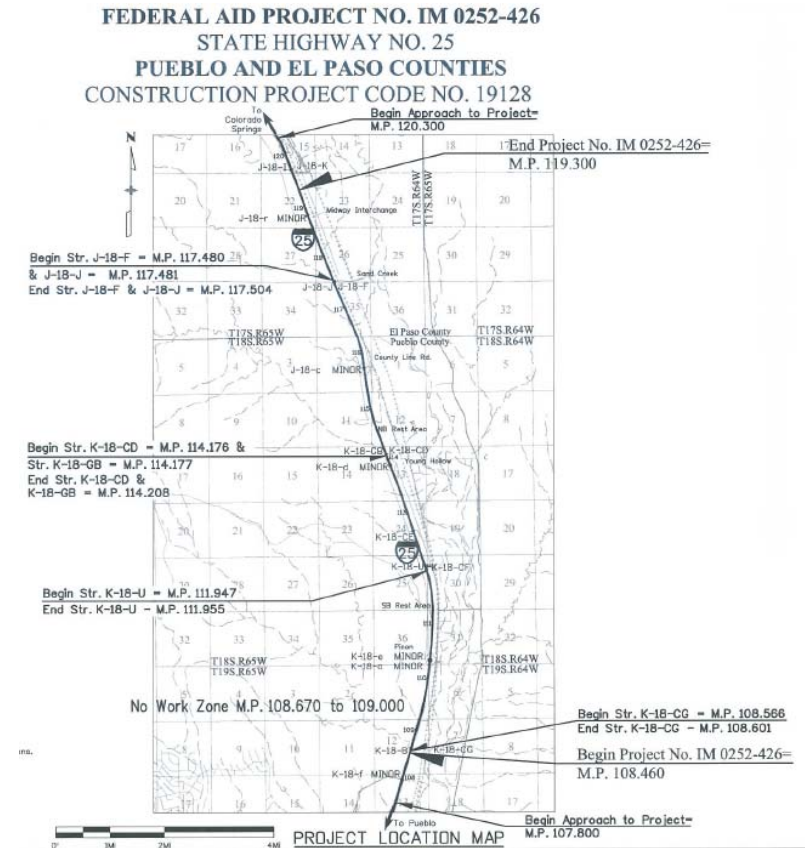


Meeting the CDOT Night Lighting Specification



Project Scope

- ~78,000 Tons Asphalt Mill & Overlay
- 2 Mobile Work Zones
 - Milling
 - Asphalt Placement
- Various Stationary Work Zones
 - Guard Rail
 - Bridge Work
- ~ 80 Nights Worked
- Flagger Stations Maintained within Stationary and Mobile Work Zones

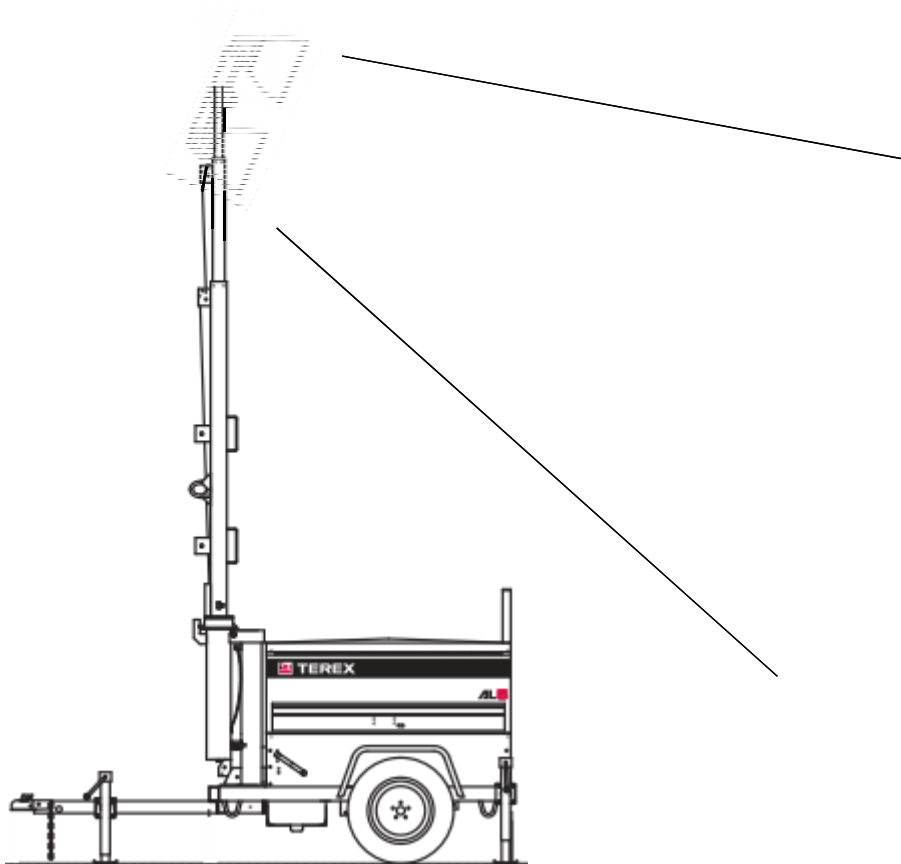


Equipment

- Mobile work

Type of Equipment
Asphalt Paver
Windrow Elevator
Asphalt Roller
Asphalt Roller
Asphalt Roller
Wheel Loader
Wheel Loader
Asphalt Distributor Truck
Quality Control Van
Shoulder Machine
Road Milling Machine
Road Milling Machine
Flat Bed Traffic Control Truck

632 Night Lighting




- 632.01 Description
- 632.02 Material & Equipment
- 632.03 Portable Generator & Inverters
- 632.04 Light Meter
- 632.05 Lighting for night work shall include:
- 632.06 Night Work Lighting Plan
- 632.07 Inspection of Lighting
- 632.08 Lighting for Flagger Stations
- 632.09 Method of Measurement
- 632.10 Basis of Payment


632.01 Description

- This work consists of furnishing, installing, operating, maintaining, moving, adjusting, and removing lighting to illuminate construction work spaces for night work. Night work will be defined as work performed between 30 minutes before sunset and 30 minutes after sunrise.

Our Goals:

- ♪ Was not to get shut-down or delayed due to compliance with this new unknown specification.
 - ♪ Have lights in place that perform to specification that does not create too much fugitive light problems for the public and our employees.
 - ♪ Did not require mechanic or operators to continually make adjustments or repairs.
- 

632.02 Materials & Equipment

- Contractor shall provide lighting for night work space where construction equipment, workers on foot, or both are present.
 - The work space may be stationary or may move as the work progresses.
 - Illumination may be accomplished by using a combination of portable lights, floodlights, equipment mounted lights, or other lighting methods.
 - Portable lights shall be aimed either generally parallel or perpendicular to the roadway, aimed downward towards the work to avoid glare to oncoming drivers.
 - In the event of any failure of the lighting system, the construction operation shall be discontinued until the required level of illumination is restored.
 - Existing street and highway lighting and Vehicle headlights shall not be permitted as the sole means of illumination.
- 

632.03 Portable Generators & Inverters

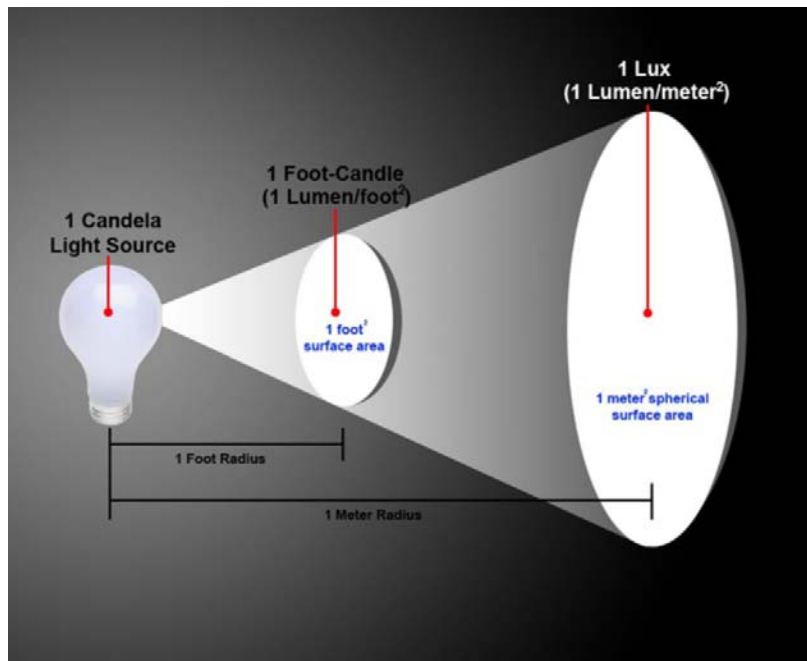
- The Contractor shall provide a portable generator, inverter generator, or both as needed to power the added equipment mounted lights on motorized equipment if the existing power supply on the equipment is insufficient to power the added lights.
- Must have GFCI, mounted and able to operate safely through shift.
 - ♪ Paver had a 23KW OEM installed generator that ran 6, 500W light fixtures
 - ♪ Shoulder Machine had a 6.5KW, gas powered generator, mounted that ran 6 500W light fixtures
 - ♪ Amperage draw, circuit types, and charging systems should be considered when choosing light types.

“ZZZ” Content - Definitions

- **Foot-candles and lux:** the amount of visible light falling on a surface

Other Related Definitions:

- **Watt:** a measure of the total power output of a light source
- **Lumen:** a measure of the total visible light output of a light source
- **Candlepower:** an obsolete term that has been replaced by “candela”
- **Candela:** a measure of the intensity of a light source in a particular direction



- ♪ Full, unobstructed sunlight 10,000 fc
- ♪ An overcast day 1,000 fc
- ♪ Light near a window 100 - 5,000 fc
- ♪ This room 20 – 50 fc
- ♪ Full Moon Light .01 fc


Light Meter

- The Contractor shall furnish a light meter for use by the Engineer. The meter shall have a digital display calibrated to NIST standards, shall be cosine and color corrected with an accuracy of +/- 5 percent. The light meter shall remain the property of the Contractor after final acceptance.

- ♪ Light meters range in cost from \$50.00 to \$500.00
- ♪ Be careful to choose a meter that can be calibrated
- ♪ Calibration takes several weeks and cost \$75.00 + and has to be renewed annually

Sponsored ⓘ

Extech



Instruments - Ea31 - EasyView Light Meter...

Stores

Home Depot	Free shipping - \$115.87
Sears	Free shipping - \$124.43
Test Equipment Depot	Free shipping, no tax - \$115.49
Zoro	Free shipping, no tax - \$116.60
ShopExtech.com	No tax - \$149.99


[View all stores and prices »](#)

Details


Display type: Digital

Feature: Incident


Lighting for Night Work Shall Include

- Minimum lighting intensity of 5 foot candles for work space illumination.
 - Illuminate the stationary work where construction equipment, workers on foot or both are present.
 - Light sources shall be positioned not to interfere with or impede traffic.
 - Illumination for mobile operations within a closed travel lane with traffic control devices will be defined as 25 feet in front of and behind and 5 feet to each side of each piece of moving equipment.
 - Workers performing materials testing for either mobile or stationary operations shall have their work space illuminated as stated. For concrete operations at night, the Contractor shall illuminate the designated concrete truck washout location including the access and the wash out site.
- 

Lighting for Night Work Shall Include

- Workers on foot, performing work within a moving work space shall wear ANSI approved high visibility apparel and headwear for Class 3 risk exposure including vest, Class E pants or leg gaiters, and reflective tape on hard hats.
 - Portable light towers and lights mounted on stands shall be sturdy and free-standing. Minimum illumination levels as stated in (1) above shall be maintained at a distance of 5 feet on all sides of stationary equipment with either equipment mounted or free standing lights.
 - The Contractor shall ensure that all pieces of equipment have operating lights to illuminate operator's controls, backhoe and loader buckets, and illuminate the equipment reach limits around rotating equipment.
 - The TCS vehicle shall have the rear of the truck illuminated while installing, maintaining, and removing traffic control devices unless sufficient lighting levels exist with stationary lights.
- 

Night Work Lighting Plan

- The Contractor shall submit a lighting plan to the Engineer for review signed by the Contractor's designated person three days in advance of the Preconstruction Conference
 - Layout drawing and supplemental narrative showing light locations, equipment mounted lights, and configuration including both typical spacing and lateral placement for each work activity
 - Tabulation of lights for those lights that are included within the Night Work Lighting pay item. Lights included in the tabulation such as tower lights, lights mounted on stands and lighting mounted to mobile equipment (not original equipment lights) but those additional equipment mounted lights or portable lights that provide the 20 feet in front and behind illumination zone shall have catalog cuts giving the specific brand names, model numbers, lamp type and wattage
- 

Night Work Lighting Plan - Continued

- Narrative description of those operations where workers will be on foot in a moving work space.

Martin Marietta Materials

June 4, 2014

Mr. Brian Barrera
CDOT Region 2
905 Erie Ave.
Pueblo, CO 81001

Re: CDOT Project DM 0252-426 / 19128
Night Work Lighting Plan

Mr. Barrera:

In order to achieve the night work lighting requirements as outline in Section 632 of the project Special Provisions Martin Marietta Materials, Inc. is investing in the purchase of sixty five Vision - X brand LED lights. The model number of the lights being purchased is Z CDOT-UMX44M. Of the sixty five lights being purchased fifty five will be place on individual pieces of equipment as subtotaled in the equipment lighting detail below as well as in the model renderings. Ten lights will be kept on site full time in the field service truck to either add or replace lights as needed.

In addition to individual equipment lighting, a minimum of 5 Terex AL5 Light Towers will be on site full time to support lighting needs for stationary or slow moving operations. Slow moving operations are classified as operations such as guardrail placement, signage install and concrete curbing. Ten light plants total have been secured for this project and three will be kept on standby at the Hot plant on 615 Santa Fe Drive for use as needed. If all ten units are not Terex AL5 Light Towers and equal or greater replacement will substitute and specifications will be provided at that point.

The Traffic Control Supervisors truck and all traffic control trucks are equipped with rear facing illumination as specified and will be available for inspection by the Project Engineer at any time.

If glare becomes an issue with new lighting or factory installed lighting shields will be installed if adjustment is not successful or the factory lighting will be disabled or covered with a solid shield on a case by case basis.

All Labors on site to include subcontracted work force will be required to wear at a minimum Class 3 Vest, full length reflective pants or high visibility reflective leg gators as well as reflective banding on all hard hats. Extra PPE and reflective banding will be kept on hand at all times in the Martin Marietta Materials site trailer in case a piece of PPE is not deficient or lost.

Flaggers on this project will not be placed alone on the road way, they will at all times be in the lighting zone of either the stationary light towers or in the lighting zone of the milling or paving machine. If additional lighting is deemed necessary to adequately light said flagger additional lighting

Martin Marietta Materials Inc. / 615 Santa Fe Dr. / Pueblo, CO 81006 / Phone: (719) 543-3823 / Fax: (719) 545-3640

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Martin Marietta Materials

will be installed directly or a mobile light pack will be supplied. The goal is to not have the flagger tote around a light pack or be distracted with moving the light pack and keep attention on their safety and traffic.

Three certified EXTECH EA31 Light Meters have been purchased for this project. One for use by CDOT Project Engineer, one for Martin Marietta Materials site superintendent and one as a backup which will be kept at the 615 Santa Fe Drive Office in Pueblo, CO.

Please see attached supporting documentation to support information presented.

Equipment Lighting Detail

Type of Equipment	Vision-X Z CDOT- UMX44M	Terex AL 5 Light Tower
Asphalt Paver	5	
Windrow Elevator	4	
Asphalt Roller	4	
Asphalt Roller	4	
Asphalt Roller	4	
Wheel Loader	5	
Wheel Loader	5	
Asphalt Distributor Truck	4	
Quality Control Van	4	
Shoulder Machine	6	
Road Milling Machine	4	
Road Milling Machine	4	
Flat Bed Traffic Control Truck	2	
Stationary Work Zone Lighting*		5
Subtotals	55	5

*Martin Marietta & Subcontracted work zones that are stationary or have minimal movement per shift

Regards,

Nick Guerra
Martin Marietta Materials, Inc.
Estimator/PM
(719) 499-3995

Martin Marietta Materials Inc. / 615 Santa Fe Dr. / Pueblo, CO 81006 / Phone: (719) 543-3823 / Fax: (719) 545-3640

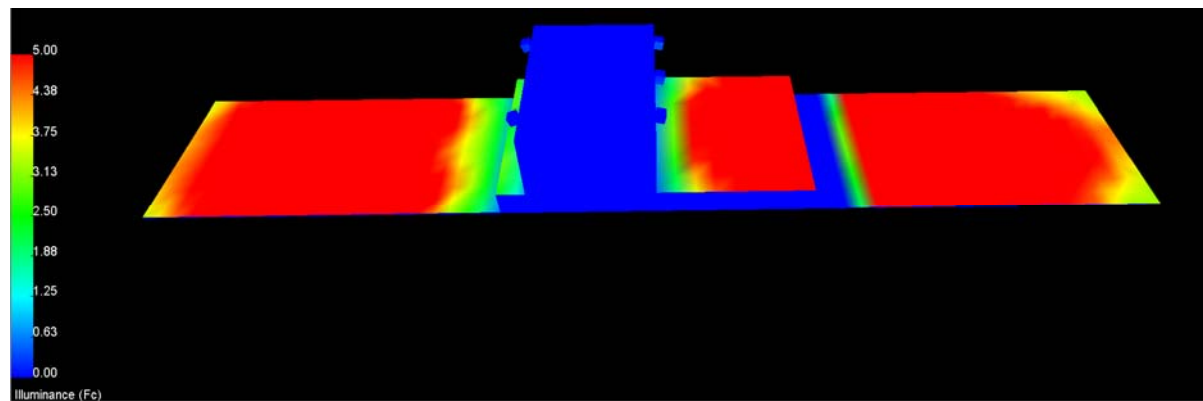
Page 2 of 2

Asphalt Paver Light Engineering – Key Elements

- Light Aiming and Position

	X	Y	Z	Orient	Tilt	Roll	Spin	XaimPt	YaimPt	ZaimPt
XIL-UMX440	2	9	7	180	70	0	0	N.A.	N.A.	N.A.
XIL-UMX440	2	2	7	180	70	0	0	N.A.	N.A.	N.A.
XIL-UMX440	11	5.5	7	0.843	78.368	0	0	45	6	0
XIL-UMX440	11	9	7	0	78.366	0	0	45	9	0
XIL-UMX440	11	2	7	358.31E	78.371	0	0	45	1	0

- 3D Light Distribution Rendering

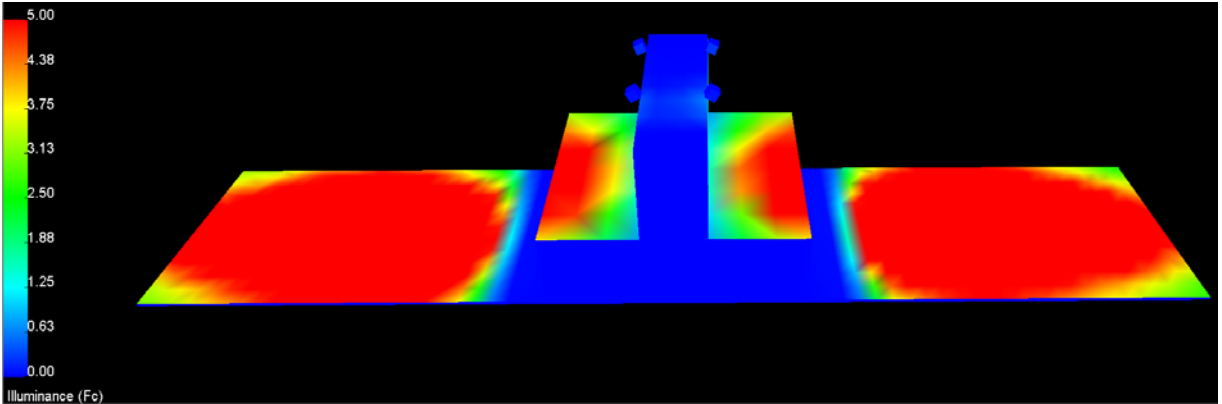


Asphalt Roller Light Engineering – Key Elements

- Light Aiming and Position

	X	Y	Z	Orient	Tilt	Roll	Spin	XaimPt	YaimPt	ZaimPt
XIL-UMX440	10	4	12	6.34	56.472	0	0	28	6	0
XIL-UMX440	6	4	12	177.13E	59.068	0	0	-14	5	0
XIL-UMX440	6	9	12	185.90E	67.628	0	0	-23	6	0
XIL-UMX440	10	9	12	354.094	67.628	0	0	39	6	0

- 3D Light Distribution Rendering



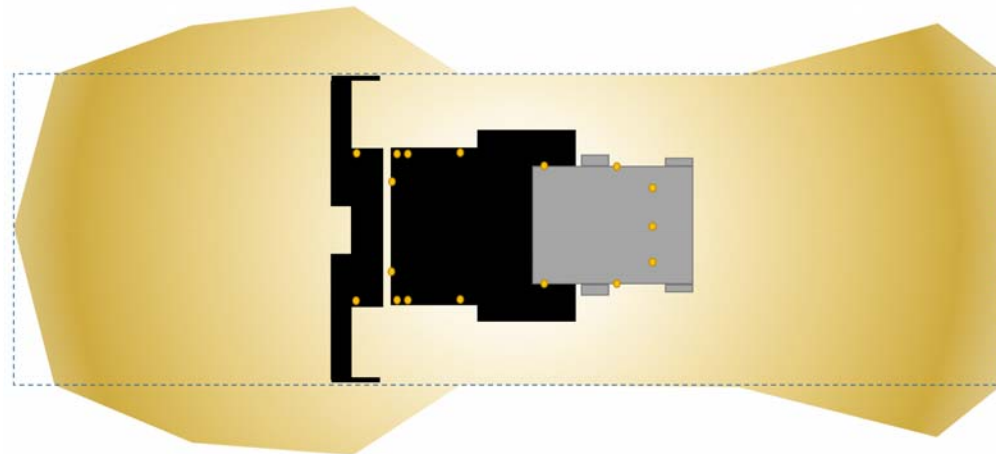
Inspection of Lighting

- Lighting inspection by the Engineer will be performed jointly with the Contractor's designated person on a drive through the project to include (1) observation of the lighting setup to evaluate glare potential for drivers and workers and (2) light meter measurements to determine minimum illumination levels.
- Light meter readings will be taken within the work space where work is being performed, in a horizontal plane, light sensor part of the meter held parallel to the ground with the sensor aimed upward, 3 feet above the pavement or ground surface.
 - ♪ Mounted Light Meter to Camera Tripod to enable easy and constant readings.
 - ♪ Tethered 25' string with magnet on one end and affixed to tripod. This allowed quick and safer means when measuring.



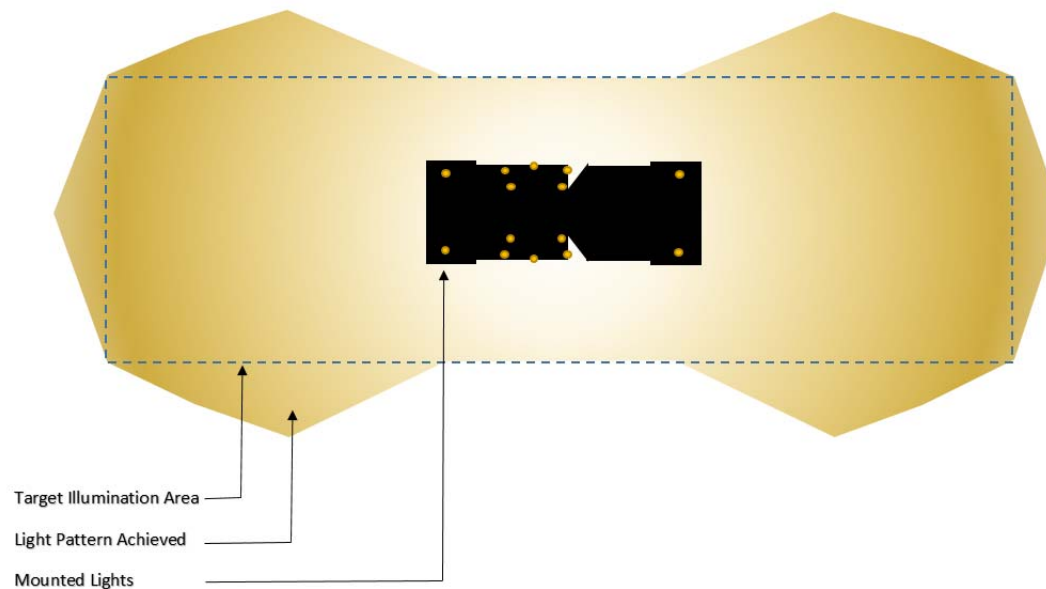
Inspection of Lighting – Paver Example

- 6 – 500W, 4 Amp Fixtures
- 4 – 70W, 2.9 Amp OEM Installed Flood Lights
- 7 – 35W, 2200EL, 35W, 3.8 Amp Vision X LED
 - ♪ 5 fc measured in all required quadrants.
 - ♪ Rear of paver was hard to achieve with out other light contribution.
 - ♪ Front facing lights had to be adjusted down to aide truck backing.



Inspection of Lighting – Roller Example

- 4 – 53W, 4 Amp OEM Installed HID Lights
- 10 – 35W, 2200EL, 35W, 3.8 Amp Vision X LED
 - ♪ 5 fc measured in all required quadrants.
 - ♪ OEM Lights were changed to the Vision X LED
 - ♪ Custom 90 Degree Optic used on the side to get a long and narrow light pattern



Cost Model

- Roller Retrofit as outlined from scratch
 - 4 HID Lights \$2800
 - 10 LED Lights \$2500
 - Labor to Fabricate Mounts & Wire \$2200
 - Shop Supplies \$ 250
 - \$7750

- Paver/Pick-Up Machine Retrofit as outlined from scratch assuming OEM generator
 - 6 500W Lights \$1000
 - 4 70W Halogen Work Lights \$ 600
 - 7 LED Lights \$1750
 - Labor to Fabricate Mounts & Wire \$3300
 - Shop Supplies \$1100
 - \$7750

Light Technology

- As long as the Specification can be achieved any type of light and technology can be used.
 - LED Blade Lights
 - Balloon Lights
 - Incandescent / Halogen
 - LED
 - HID (High Intensity Discharge)
- ♪ We used primarily existing paver lighting we developed over time based on past experiences.
- ♪ Used OEM lights and wiring when we could.
- ♪ Supplemented with the Vision X light per engineering and infield testing.



ITEM #	Z CDOT-UMX44M
BEAM PATTERN	2 x 25° (Top Row) 3 x 40° (Middle Row) 2 x 60° (Bottom Row)

Lighting for Flagger Stations

- For nighttime flagging, flagger stations shall be illuminated by an overhead light source providing a minimum lighting intensity level of 5 foot candles measured 1 foot out from the flagger's chest. The flagger station light shall illuminate the station area with a radius of at least the width of the lane plus 5 feet, and be centered on the flagger in the initial flagging position. The size of the illuminated area shall be increased to account for flagger movements required to control traffic. The flagger station light shall be maintained at an adequate height above the pavement and be capable of being shielded through the use of visors, hoods, louvers, or screens as needed to minimize glare to approaching traffic and spilling over onto adjacent properties.
- ♪ This project maintained flagger stations within the stationary and mobile work zones. It is absolutely critical that the flagger stay within these zones or additional mobile lighting needed.
- ♪ Head & Halo lights used. Which provided good accent and visibility but is not a viable solution to meet the specifications.
- ♪ Mobile lighting station technology can be built or purchased.



Method of Measurement / Basis of Payment

- Lighting for night work will not be measured but will be paid for as a single lump sum.
- Payment for lighting as shown on the Night Work Lighting Plan will include all labor, materials, and equipment necessary to complete and maintain the work.
- Progress payments will be made based on the lump sum price bid as follows: 20 percent when the Lighting for Night Work Plan has been submitted, accepted, and satisfactory lighting of nighttime operations has begun; the remaining 80 percent will be paid in equal monthly progress payments for the remaining time lighting is required for the night work operations.

In Closing

- Don't work at night, get more lane miles paved with lighting spend.
 - Sub-Contractor Education and Commitment
 - Partner with Strong Knowledgeable Suppliers
 - Leverage current performance and safety culture
 - Incorporate Lighting needs when buying equipment.
- 