

## **OUTDOOR LIGHTING**

### **General**

Early in the CD design phase, submit the building exterior, street, parking lot, and pedestrian lighting designs (including calculations) for mock-up and approval by the University's outdoor lighting design reviewer, Mojtaba Navvab PhD, FIES, at (734) 936-0228, [moji@umich.edu](mailto:moji@umich.edu).

If the lighting design deviates from this Design Guideline, also submit it to the University Planner at (734) 764-2455 for approval. Significant deviations may require Regental approval.

Lighting located in City right-of-way must meet City requirements and be approved by the City. Coordinate with the University Planner to obtain the City's requirements and approval.

Contact the U-M Utilities and Plant Engineering Electrical Engineer at (734) 936-2558 for as-built and spare capacity information before adding new lights to existing lighting circuits.

### **Related Sections**

Design Guideline Technical Sections:

16010 – Basic Electrical Requirements

16050 – Basic Electrical Materials and Methods

16110 - Underground Electrical Service

16120 – Wires and Cables

16500 – Lighting Systems

16950 – Electrical Acceptance Tests

U-M Master Specifications

16521 – Outdoor Lighting

U-M Standard Details

16500 Series - Lighting Details

### **References**

IESNA Lighting Handbook

NFPA 70, “National Electrical Code”

### **Design Requirements**

In general, avoid building-mounted lights lower than 12 feet above grade, bollard lights, lights in bench seating, and in-ground uplights. Under-water lights in pools and fountains are prohibited.

Avoid lighting public sporting and picnicking areas which encourages their use late at night.

Avoid lighting that shines into building windows.

## Light Levels

For streets, provide a minimum horizontal light level on the pavement of 0.9 footcandles with an 'average to minimum' ratio not exceeding 5.

For parking lots, provide a minimum horizontal light level on the pavement of 0.5 footcandles with an 'average to minimum' ratio not exceeding 5.

For sidewalks and pedestrian walkways:

- Provide a minimum horizontal light level on the pavement of 0.5 footcandles with an 'average to minimum' ratio not exceeding 5.
- Provide a minimum vertical light level of 0.5 footcandles at 6 feet above the pavement in both directions of travel along the sidewalk.
- In general, lights spaced at 50 to 55 feet apart should meet the light level requirements.
- Successively alternate the lights on both sides of a sidewalk when possible.
- Locate lights symmetrically at building entrances.
- Provide a 100 watt quartz restrike lamp in the light nearest to each emergency telephone kiosk and bus shelter.
- Adjust the lighting levels at building entrances or near other sources of higher ambient lighting to insure that the 'average to minimum' ratio of 5 is not exceeded.
- Adjust the design as necessary to reduce glare to persons on the sidewalk, walkway, adjacent roadway, and/or adjacent buildings.

## Lighting Power

Feed street, parking lot and pedestrian lights at 277 volts from a 480Y/277 volt, 3 phase, 4 wire circuit. Feed them with four # 4 AWG conductors plus a #8 AWG ground conductor in a 1-1/4 inch, Schedule 40 PVC conduit. Conductors shall be copper with Type XHHW brown, orange, yellow, grey, and green insulation. Alternate feeder circuit phases for each successive light so that a single phase failure will not leave large areas in darkness. Balance the load across all three phases, and limit the total load to 29 kVA.

Feed traffic lights, emergency telephone kiosks, illuminated signs, parking lot electric gates, and Parkmasters all separately, and not from outdoor lighting circuits. Feed them at 120 volts single phase with No. 8 AWG copper, XHHW insulated conductors in a 1 inch conduit.

Control building exterior, street, parking lot, and pedestrian lighting with separate lighting contactors. Lighting contactors shall be switched by a Building Automation System (BAS) Direct Digital Control (DDC) panel contact. If BAS control is not available, provide a local photocell. Do not provide a time clock or an individual photocell in each light. Wire the control circuit so that the lighting will be energized in the event of a BAS System or photocell failure. Contact the U-M BAS Department at (734) 647-0962 to coordinate connection to a DDC panel.

## **Products**

### **Street and Parking Lot Lighting**

Street and parking lot fixtures shall be low profile, sharp cutoff, rectangular aluminum shoeboxes suitable for mounting as a single unit or as multiple units on a round, tapered aluminum pole. Each fixture shall include:

- Horizontal, 250 watt, clear, 3200°K, metal halide lamp. Osram/Sylvania MS250/3K/HOR.
- Type III light distribution.
- Rectangular, extruded aluminum support arm nominally 9 inch long.
- High power factor, copper wound, multi-tap, CWA ballast.
- Black polyester powder coat finish.
- Pole cap that is spring loaded, internal fitting.
- Plug-in shorting cap.

Poles shall be 30 foot (except where shorter poles are required due to severe elevation changes or to reduce light infringement on adjacent areas), round, tapered aluminum, with the following features:

- Uniform taper of 0.14 inches per foot from base to 3.5 inch diameter top.
- Base plate suitable for installing over four 1 inch diameter anchor bolts set in a 8-1/4 inch square, 11-3/4 inch diagonal bolt pattern.
- Reinforced hand hole with an aluminum cover plate.
- Internal ground lug mounted just below and on the same side as the hand hole.
- Black polyester powder coat finish.
- Plastic or aluminum split base bolt cover colored to match the pole.

### **Pedestrian Lighting**

Pedestrian fixtures shall be 16 inch diameter, round, with partially obscured, non-diffusing globe, 6 spoke globe basket, and horizontal black center band, suitable for mounting singly, in doubles, or in clusters of 5 on round, tapered, aluminum poles. Each fixture shall include:

- Vertical, 100 watt, clear, 3200°K, metal halide lamp for single fixtures (70 watt for double fixtures and 50 watt for fixtures in clusters of 5). Osram/Sylvania MP100/U/MED, MP70/U/MED or MP50/U/MED.
- Uniform, downward, Type III light distribution.
- Thermally protected, high power factor, metal halide electronic ballast with lamp end-of-life protection, a minimum starting temperature of minus 20 degrees F, less than 10 percent THD, and a sound rating of A.
- Black polyester powder coat finish.

Poles shall be of a height that locates the globe center band at 12 feet above grade. Poles shall be round, tapered aluminum, with the following features:

- Uniform taper of .14 inches per foot from base to 4 inch diameter top.
- Base plate suitable for installing over four 3/4 inch diameter anchor bolts set in a 6-3/4 inch square, 9-1/2 inch diagonal bolt pattern.
- Reinforced hand hole with a cover plate.

- Ground strap bonded at base of pole below and on the same side as the hand hole.
- Black polyester powder coat finish.
- One piece base bolt cover colored to match the pole.

Fuse holders for lighting fixtures shall be Bussmann TRON No. HEB-AA in-line, waterproof, rated 300 volts and 30 amps. Fuses shall be Bussmann No. KTK-5, rated 5 amps.

Concrete for pole bases shall be air entrained, with aggregate not exceeding 3/4 inch and 1.5 pounds of fibermesh per cubic yard, rated 4000 psi after 28 days.

Anchor bolts for street and parking lot pole bases shall be 1 inch diameter x 42 inch long x 4 inch ell, hot dipped galvanized steel, each with two zinc plated flat washers and hex nuts. Anchor bolts for pedestrian pole bases shall be 3/4 inch diameter x 20 inch long x 3 inch ell, hot dipped galvanized steel, each with two zinc plated flat washers and hex nuts.

Grounding electrodes shall be 5/8 inch diameter x 8 foot long copper clad ground rods. Grounding electrode splices and connections shall be exothermic welds; copper or bronze compression ground fittings, or bolted compression lugs (acorn clamps).

In-ground junction boxes shall be pre-cast polymer concrete or polymer foam, heavy duty rated, one size larger than required by the NEC, bottomless, with a single piece cover engraved "UM Outside Lighting" and attached with pentahead stainless steel bolts.

Connectors for splicing and terminating lighting conductors in direct buried pull boxes shall be Homac No. RAB4 or RAB6 only. Connectors for terminating lighting conductors in poles shall be Utilco No. SLC4-01-L terminal blocks with Utilco No. R6131 boots only.

Lighting contactors for site lighting shall be NEMA 1, 3-pole, 4-wire, 480 volt, 60 amp, combination fused switch contactors with special provisions to accept 50 amp fuses. They shall be electrically held with a hand-off-auto switch and a 300VA, 277:120V control power transformer. When a lighting contactor is installed outdoors, it shall be enclosed in a lockable, NEMA 3 rated enclosure. Site lighting contactors will be provided by the U-M Utilities Power and Lighting Shop. The Contractor shall contact the U-M UPL Shop Foreman at (734) 647-2049 at least 5 working days in advance to arrange for pick-up.

## **Execution**

### **Excavation and Pole Bases**

The Contractor shall contact Miss Dig at (800) 482-7171 before performing excavation work.

When existing outdoor lighting is being demolished, existing pole bases shall be removed completely. Holes left by demolished pole bases shall be backfilled and compacted with MDOT Class II sand or clean dirt to a depth of 6 inch below grade. The last 6 inches shall be backfilled with clean topsoil. Holes in lawn areas shall be reseeded.

Street and parking lot lighting pole bases shall be 24 inch diameter, round, rebar reinforced concrete. Bases for 20 foot or shorter poles may be 18 inches in diameter. Bases for street lighting poles shall extend 4 inches above finished grade, and bases for parking lot lighting poles shall extend 2 feet above the finished grade of the parking lot.

Pedestrian lighting pole bases shall be 18 inch diameter, round concrete in lawn areas, and 18 inch square concrete in or adjacent to concrete or masonry areas. Bases shall extend 4 inches above grade.

Pole bases shall be located in accordance with the appropriate U-M Lighting Standard Details. Bases should not be located in sidewalks. They should be located to minimize impact on snow removal and lawn mowing, and where they will not be damaged by maintenance equipment.

Exposed portions of concrete bases shall be free of voids and honeycombs. Top edges shall receive a uniform, 1 inch, 45 degree chamfer.

A third 1-1/4 inch conduit should be stubbed out from each pole base for expansion of the lighting circuit in the future.

A 5/8 inch diameter x 8 foot long copper clad ground rod shall be provided for each light pole and connected to the pole ground lug with a No. 6 AWG bare copper ground wire. See the Lighting Standard Details. The ground rod shall be imbedded in the pour of the base and shall not rise above the base. The grounding electrode conductor shall extend up through the top center of the base and into the pole.

### **Installation**

In-ground junction boxes shall not be located in sidewalks or driveways. They shall be hidden in landscaping if possible.

Conduit runs that parallel parking lot edges, sidewalks, driveways, etc., should be located within three feet of the pavement to prevent interferences with future landscaping or other excavations.

When streets, parking lots, or sidewalks are cut for installation of underground utilities, a 6 inch sleeve should be installed for future outdoor lighting circuits. See the Standard Lighting Details.

Poles shall be set so handholes are readily accessible and have working clearance from trees, shrubs, and other obstructions.

Terminations in poles shall be made in accordance with the U-M Lighting Standard Details.

Poles and bases shall be plumb, and lighting fixtures shall be level.

The center band of pedestrian lighting fixtures shall be level, and one spoke of the globe basket shall be perpendicular to the street, sidewalk or wall.

### **Quality Assurance**

The Contractor shall contact the U-M Code Inspection Department at (734) 764-2457 before pouring concrete, backfilling excavations, and energizing circuits.

### **Record Drawings**

Provide record drawings (as-builts) showing the actual locations of lighting poles, stubbed-out spare conduits, underground sleeves, and junction boxes, the circuit numbers for all loads, and deviations from the design. Sleeve ends and junction boxes shall be dimensioned from permanent building or landscape features.