Design Guideline 265600
Exterior Lighting

Scope

The overall goal of exterior lighting (street, parking lot, pedestrian and building-mounted lighting) is to improve and enhance the sense of safety and security in an efficient and sensitive manner. The lighting design shall take into consideration horizontal and vertical luminance and the uniformity of light distribution while minimizing glare, light pollution and light trespass. In addition, the lighting design should impart a sense of order, contribute to the overall campus aesthetic and ambience, enhance wayfinding, and strengthen U-M identity.

Related Sections

U-M Design Guideline Sections:

260513 – Medium, Low & Control Voltage Cables
260533 - Electrical Materials and Methods
260543 - Underground Services for Electrical Systems
3.2 Carbon Reduction and Energy and Water Conservation

U-M Master Specification Sections:

260513 – Medium, Low & Control Voltage Cables
260533 – Electrical Materials and Methods
260543 – Underground Services for Electrical Systems
260800 – Electrical Acceptance Tests
265600 – Exterior Lighting
329210 – Lawn Repair

U-M Standard Details:

Standard Details 9.3-Series Lighting Details

References

ASHRAE 90.1, "Energy Standard" IESNA, "Lighting Handbook"
USGBC, "LEED Reference Guide for Green Building Design and Construction"

Design Process

This Design Guideline standardizes U-M exterior lighting equipment and installation requirements to strengthen U-M identity and to enhance lighting reliability and maintainability. However, it is not intended to limit creativity or innovation. Newer technologies and improved products will be considered, but must be approved by the Design Manager before being used. Significant deviations from this Design Guideline may require External Elements Design Review (EEDR) Committee or Regental approval.

At the end of Schematic Design, submit a preliminary exterior lighting plan showing the proposed lighting

locations and general equipment types.

At the end of Design Development, submit the following electronic files for U-M mock-up and approval:

- Lighting plans showing dimensioned lighting equipment locations and types.
- Lighting simulations showing calculated results, including:
  - Name and version of simulation software used.
  - List of assumptions including Lamp Lumen Depreciation (LLD), surface reflectance values, and other pertinent modeling inputs.
  - Summary results for each area (maximum, minimum, average, avg./max., avg./min.).
  - Average maintained horizontal illuminance on grade, shown in a grid pattern, in footcandles or lux.
  - Average maintained vertical illuminance at 5 feet-6 inches above grade in at least two directions of main travel, in footcandles or lux.
  - Lighting power density.
- Lighting equipment specifications and manufacturer cut sheets, including:
  - Fixture types, descriptions, dimensions, optics, materials, finishes, light distribution types and IESNA-formatted photometric data files.
  - Lamp type for each fixture, and lamp wattage, color temperature, color rendering index and related life.
  - Pole and/or mounting support descriptions, dimensions, materials and finishes.

Design Requirements

Use the referenced U-M Master Specification Sections and Standard Details to specify exterior lighting equipment and installation requirements. Make these documents project specific, but do not deviate from the requirements without Design Manager approval. Turn on hidden text and follow the purple Spec Editor notes when editing specification sections.

Facilitate facial recognition through vertical illumination and careful selection of the color temperature and color rendering of the light sources.

Control light distribution to prevent direct glare to motorists, pedestrians and occupants of adjacent buildings, light pollution, and light intrusion onto adjacent private property.

Compensate for existing or planned light obstacles such as buildings, fully leafed trees, accumulations of fallen leaves and piles of snow.

Locate lighting to emphasize specific building components and site features (i.e. building entrances, fenestration patterns, columns, pedestrian/vehicular nodes or gateways). Locate lighting symmetrically at building entrances. Alternate lighting on both sides of long, straight sidewalks.

Locate lighting to frame important campus views and to avoid competing with existing illuminated and non-illuminated campus elements.

Locate lighting on U-M property. Do not locate lighting in the City right-of-way or on private property. Obtain University Planner and City approval before installing University lighting in City right-of-way.

Provide lighting to illuminate emergency telephone kiosks and bus shelters within the project boundary if they are not currently illuminated.

Coordinate pole base locations with existing and planned underground obstructions including tunnels, duct banks, pipes and electrical cables. Provide custom pole base designs to attach poles to the tops of walls, bridges, parking decks, tunnels and similar structures.

Locate lighting outside the drip lines or root zones of significant (in size or age) vegetation. Request that U-M clear any significant vegetation if required.

Avoid lighting sporting and picnicking areas near Housing facilities because this encourages their use late at night.

Locate building-mounted lighting 12 feet minimum above grade. Lighted bollards, hand rail fixtures, in-wall fixtures, step lights, under-bench fixtures and in-ground fixtures are strongly discouraged because they are unreliable. Underwater pool and fountain fixtures are prohibited. Fixtures capable of being stepped on or touched shall not exceed 120 degrees F to the touch.

Provide code-required emergency lighting at building exit discharges. Exit discharges include landings, porches, stairs, ramps, and infrequently sidewalks, up to the point where they qualify as the public way. Feed this emergency lighting with generator-backed emergency lighting circuits when available, or with an indoor-located lighting inverter when a generator is not available. Do not specify local battery packs for exterior emergency fixtures.

The University is transitioning from fluorescent and metal halide to LED exterior lighting. Provide LED fixtures for new installations. Request Design Manager approval before matching non-LED fixtures when replacing or adding fixtures within an existing group.

Specify a lighting color temperature of 4000 - 4100 degrees K. Request Design Manager approval before matching a different color temperature when replacing or adding fixtures within an existing group.

Specify LED fixtures by stating manufacturer's standard lumen output. Do not specify LED fixtures by stating wattage which may change as technology advances.

Comply with Design Guideline SID-D requirements related to energy conservation.

- U-M exterior lighting is governed by life safety regulations which provide security to pedestrians at all hours of the night. Therefore it is exempt from ASHRAE 90.1 requirements for dimming or shutoff during nighttime hours.
- Exterior lighting power densities shall not exceed the power allowances in ASHRAE 90.1. Support U-M energy conservation efforts and provide power densities as low as reasonable within the overall lighting design goals.

On a project pursuing LEED certification, investigate earning the “Light Pollution Reduction” LEED point.

Provide maintained (not initial) exterior light levels in accordance with IESNA recommendations which are summarized for most applications in the following table. Base light level calculations on an ambient air temperature of 50 degrees F.

Area Designation	Criteria	Attribute	Target *Raise light levels at brightly lit building entrances when necessary to meet this uniformity.
Pedestrian ways distant from roadways	Horizontal illuminance	Average maintained illuminance on pavement	0.5 footcandle
Pedestrian ways distant from roadways	Horizontal illuminance	Average-to-minimum uniformity	5:1*
Pedestrian ways distant from roadways	Vertical illuminance	Average maintained illuminance at 5-feet/6-inches above grade in at least two directions (in direction of main travel)	0.5 footcandle
Pedestrian ways distant from roadways	Vertical illuminance	Average-to-minimum uniformity	5:1*
Pedestrian ways adjacent to roadways	Horizontal illuminance	Average maintained illuminance on pavement	0.5 footcandle
Pedestrian ways adjacent to roadways	Horizontal illuminance	Average-to-minimum uniformity	5:1*
Pedestrian ways adjacent to roadways	Vertical illuminance	Average maintained illuminance at 5-feet/6-inches above grade in at least two directions (in direction of main travel)	1.0 footcandle
Pedestrian ways adjacent to roadways	Vertical illuminance	Average-to-minimum uniformity	5:1*
Parking lots	Horizontal illuminance	Minimum maintained illuminance on pavement	0.6 footcandle
Parking lots	Horizontal illuminance	Average-to-minimum uniformity	4:1
Roadways	Horizontal illuminance	Average maintained illuminance on pavement	0.9 footcandle
Roadways	Horizontal illuminance	Average-to-minimum uniformity	4:1

Feed street, parking lot and pedestrian lighting at 277 volts from 480Y/277 volt, 3 phase, 4 wire circuits. Feed them with four No. 4 AWG conductors plus a No. 8 AWG ground conductor in a 1-1/4 inch, Schedule 40 PVC or HDPE conduit. Alternate feeder circuit phases for each successive light so that a single phase failure will not leave large areas in total darkness. Balance the load across all three phases and limit the total load to 29 kVA. Before adding lighting to an existing circuit, request that U-M provide the existing load on the circuit.

Feed building-mounted lighting at 277 volts single phase. Feed them with No. 10 AWG conductors plus a No. 10 AWG ground conductor.

Provide dedicated circuits for emergency telephone kiosks, illuminated signs, parking lot electric gates and Parkmasters. Feed them at 120 volts single phase except when the equipment requires 277 volts single phase. Feed them with No. 10 AWG conductors plus a No. 10 AWG ground conductor in a 1 inch, Schedule 40 PVC or HDPE conduit. Coordinate the underground power conduits with the underground IT conduits.

Control street, parking lot, pedestrian, and building-mounted lighting with lighting contactors. See the applicable Standard Details. Lighting contactors shall be switched by a Building Automation System (BAS) Direct Digital Control (DDC) panel contact. Provide photocell control of the contactors only if DDC control is not available. Do not provide time switch control or individual photocells in the fixtures. Wire the control circuits so they are fail safe and the lighting will be energized in the event of a BAS System or photocell failure.

Products

Street and Parking Lot Lighting

In general, provide the U-M standard low profile, full cutoff, black aluminum LED fixtures on 30 foot, round, tapered, black aluminum poles. Pole height may be reduced when necessary to minimize light trespass on surrounding areas. On the top deck of parking structures, the poles shall be hinged at the base so fixtures can be maintained without requiring a bucket truck.

Pedestrian Lighting

Provide the U-M standard 16 inch, round globe LED fixtures with 6 spoke, black globe baskets, mounted singly, in doubles, or in fives on round, tapered, black aluminum poles. Specify single globe fixtures as 6020 lumens each, double globe fixtures and five globe fixtures as 4090 lumens each globe, and all fixtures with Type V distribution. As an alternative to mounting the fixtures on poles, mount them on column tops or with wall brackets. Specify pole lengths and mounting brackets to locate the horizontal center bands of the single globe fixtures at 12 feet, 0 inches above grade. Double globe and five globe fixtures can be taller.

Building-Mounted Lighting

In general, provide black aluminum LED downlight, hanging or wall sconce fixtures at building entrances to compliment the building's architecture. Floodlighting or highlighting of building facades is generally discouraged. Provide black aluminum LED wall packs at loading docks and similar service areas. Select and aim wall packs to minimize glare.

Lighting Contactors

Lighting contactors for street, parking lot and pedestrian lighting shall be NEMA 1, 3-pole, 4-wire, 480 volt, 100 amp, combination fused switch contactors with 50 amp fuses. They shall be electrically held and include a hand-off-auto switch and a 300VA, 277-120V control power transformer. These lighting contactors will be furnished by the U-M Utilities Power and Lighting Shop (734 647-7049) for installation by the contractor. Place the appropriate Standard Detail on the lighting drawings.

Lighting contactors for building-mounted lighting shall be NEMA 1, 3-pole, 4-wire, 480 volt, 30 amp, combination fused switch contactors with 20 amp fuses. They shall be electrically held and include a hand-off-auto switch and a 300VA, 277-120V control power transformer. These lighting contactors shall be provided by the contractor. Place the appropriate Standard Detail on the lighting drawings.

Junction Boxes

In-ground junction boxes shall be precast polymer/fiberglass, nominally 13 inches by 24 inches by 15 inches high, bottomless, with a single piece removable cover engraved “UM OUTSIDE LIGHTING”.

Execution

Pole Bases and Underground Work

Direct the contractor to contact Miss Dig (800 482-7171 or 811) before performing excavation work.

When existing lighting is being demolished, specify the following:

- Power shall be maintained to lighting on the same circuits but outside of the work area.
- Demolished lighting fixtures and poles shall be turned over to the U-M Utilities Power and Lighting Shop.
- Existing pole bases and wiring shall be removed completely. Underground conduits may be abandoned in place. Holes left by the pole bases shall be backfilled. Pavement shall be restored to match existing and lawn areas shall be leveled and prepared with fresh top soil for re-seeding by the University.
- Temporary lighting shall be provided at the same lighting levels as the demolished lighting until the demolished lighting is replaced. As an alternative, construction fencing shall be provided to prevent public access to the area until the demolished lighting is replaced.

Locate pole bases in accordance with the appropriate Master Specification Sections and Standard Details. Bases should not be located on sidewalks. They should be located to minimize impact on snow removal and lawn mowing, and where they will not be damaged by maintenance equipment.

Show on the plan drawings a spare 1-1/4 inch conduit stubbed out from every fourth or fifth pole base, especially at corners and intersections, for expansion of the lighting circuit in the future. Select pole bases with one or two active conduits. Do not exceed three conduits per pole base. Stub out the spare conduits 3 feet and aim them toward open lawn areas.

Provide a 5/8 inch diameter x 8 foot long copper clad ground rod for each light pole base, and connect it to the pole ground lug. See the Standard Details.

Specify Schedule 40 PVC or HDPE conduits to feed in-wall, step and in-ground lighting. Develop a detail requiring conduits to enter fixtures only from below.

Design underground conduit runs parallel to parking lot edges, sidewalks, and driveways, and adjacent to the pavement edges, to avoid interfering with future landscaping or other excavations.

Provide in-ground junction boxes at key locations to enable expansion of the lighting in the future. Avoid locating in-ground junction boxes in sidewalks or driveways. Hide them in landscaping whenever possible.

When streets, parking lots, or sidewalks are cut for the installation of any underground utilities, provide a 6 inch sleeve for future exterior lighting circuits. See the Standard Details.

Lighting Control

Locate lighting contactors indoors, preferably on the inside of an exterior wall. When feeding street, parking lot and pedestrian lighting, penetrate the exterior wall below grade with Schedule 40 PVC conduits. Seal the penetrations per Specification Section 260533. Extend the conduits to in-ground junction boxes located 5 feet from the building wall.

Quality Assurance

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

Record Drawings

Specify that electronic files of record drawings or scanned mark-ups of construction drawings be provided at Substantial Completion for forwarding to the U-M Utilities Power and Lighting Shop. Record drawings shall show the dimensioned locations of lighting poles, stubbed-out spare conduits, in-ground junction boxes, underground sleeves, the circuit numbers for all circuits, and deviations from the design. Dimensions shall be from permanent building or landscape features.