26 56 00 - Outdoor Area Site Lighting

1. Introduction
   A. This section pertains to outdoor area site lighting systems operating below 600 volts, which are intended to provide illumination along Duke University and Duke University Medical Center walkways, streets and parking areas after dark. A successful outdoor lighting design and installation will help to ensure the safety of the general public and meet users’ needs by taking into account light levels, uniformity, glare, and light trespass.

2. References
   A. IESNA Lighting Handbook (latest edition)
   B. IESNA RP-08 “Roadway Lighting” (latest edition)
   C. IESNA RP-20 “Lighting for Parking Facilities” (latest edition)
   D. NFPA 70 National Electrical Code
   E. City of Durham Unified Development Ordinance (UDO); Article 7.4 “Design Standards – Outdoor Lighting”
   F. Durham County, North Carolina - Code of Ordinances; Article 7.4 “Design Standards – Outdoor Lighting”
   H. Section 26 05 26 – Grounding and Bonding for Electrical Systems
   I. Section 26 08 01 - Electrical Equipment Acceptance Testing
   J. Section 26 20 00 – Low-Voltage Electrical Distribution
   K. Section 26 27 26 – Wiring Devices

3. Information/Resources Supplied by Duke
   A. Site plans in ACAD format (as available)
   B. Circuit configuration, fixture type, and location of existing lights (if required)

4. Design & Performance Requirements
   A. Develop initial light locations, hand-hole locations and fixture selections. DD and CD documents shall show fixture locations and hand-hole locations "grayed" back on the site
drawings to assure they are properly integrated with site design, hardscape, landscape, utilities, and other site conditions.

B. Develop an electrical site plan with all necessary wiring/circuitry, fixture schedule, controls, etc.

C. Provide a report in the DD and CD documents certifying Duke design criteria are satisfied. Ensure light locations and fixture selections provide the proper foot-candles within the average/min/max thresholds.

D. Provide justification and certification that appropriate IESNA recommendations along with Durham City & Durham County ordinances regarding light trespass (where applicable) are satisfied.

5. Outdoor Lighting Design Standards

A. Primary Electrical Distribution, Service Entrance(s), Electrical Distribution(s)
   1. See Section 26 20 00
   2. Wire shall be stranded copper and sized for a maximum 5 percent voltage drop at 125% of design load.
   3. Minimum conduit size for exterior lighting shall be 1 ¼ inch (See Section 26 05 33)
   4. Install two (2) conduits entering and two (2) conduits leaving each pole foundation/base for future use and/or expansion.
   5. Conduits shall be PVC Sch. 40 and extended a minimum of 1 ¼ inch and no more than 2 inches above top of concrete foundation. Provide rigid elbows at all 45 and 90 degree bends/sweeps if not encased in concrete.
   6. Provide at minimum one (1) hand-hole junction between building source panel and first light pole(s) in circuit. See Appendix C.

B. Light Sources & Color Temperature
   1. Light sources shall be LED
   2. Color Temperature shall be between $3,000 – 4,000^\text{Kelvin}$
      a. East and West Campus Quads (and other historically sensitive areas as deemed appropriate) shall be – 3,000°Kelvin
      b. Remaining Campus Wide shall be – 4,000°Kelvin (unless otherwise approved)
   3. Proposed Light Fixture and Color Temperature shall be coordinated with existing/surrounding area lights and approved by the Duke Campus Landscape Architect and Duke Utilities and Engineering Services (DUES).
C. Lighting Levels / Uniformity

1. **Walkways / Bikeways / No Vehicle traffic** – minimum horizontal average of 0.5 foot-candles at ground level with a maximum of 4:1 uniformity (Avg./Min.)

2. **Parking Lots / Roadways** – minimum horizontal average of 1.0 foot-candles at ground level with a maximum of 4:1 uniformity (Avg./Min.)

3. **Parking Garages** – see IESNA RP-20 “Lighting for Parking Facilities”

4. In all cases, light levels and uniformity shall meet or exceed IESNA recommended practices (i.e. IESNA RP-08) for the specific application. An engineered design shall be submitted to the Duke Campus Landscape Architect and Duke Utilities and Engineering Services (DUES) for review and approval at least 60 days prior to installation. Design submission shall include a point-by-point light level calculation and site layout detailing min/max/average foot-candles and uniformity (avg/min).

D. Controls & Surge Protection

1. New lighting controls will utilize Duke University SIEMENS Building Automation Systems (BAS) tied to a centralized Photocell to control and monitor site lighting. The Design Team shall coordinate with Duke FMD for the appropriate controls for the application.

2. Legacy lighting controls on campus use a combination Photocell & Timeclock and contactor System.

3. Surge Protection shall be provided for all LED area lighting circuits. The Design Team shall coordinate with Duke FMD for the appropriate surge protection for the application.

4. Appropriate fuse(s) must be installed for each pole.

E. Foundations

1. Light pole foundations shall withstand base reactions as calculated per AASHTO LTS (Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals). See Appendix A&B – “Foundation Details” for approved standard foundation designs

   a. Pedestrian in Lawn and Mulched Areas – Foundations shall have a 4” reveal above grade.

   b. Pedestrian in Hardscaped Areas – Foundations shall be flush with adjacent hardscape.

   c. Pedestrian in Quad and Other areas deemed appropriate – Foundations shall be flush with adjacent grade.

   d. Parking Areas – 36” reveal above grade in areas subject to vehicular traffic (i.e. open parking lots)
e. Street – Foundations shall have a 4” reveal above grade

2. Deviations from approved foundation designs shall be approved by the Duke Campus Landscape Architect and Duke Utilities and Engineering Services (DUES) prior to installation. Calculations shall be furnished for review upon request.

3. Foundations shall have smooth formed finish with a 3/4”-45° chamfered edge.

6. **Duke Approved Poles**

   A. Poles to support post top “Acorn” fixtures shall be Main Street Lighting – Harrisburg series, Fiberglass, 10’-9” (FF1401A using pole base in **Appendix A**) or 16’-9” (FF1406 using pole base in **Appendix B**), Chocolate Brown.

   B. Poles to support LED Streetlights shall be Holophane FRTAU 25’ w/ 6’ Arm (FRTAU-25-7E-BMA-US6-BZ-AB), Chocolate Brown. Utilize pole base in **Appendix A**.

   C. Poles to support LED Parking Lot lights shall be Holophane RTA 25’ (RTA-25-80E-PL-ND-BZ), Chocolate Brown. Utilize pole base in **Appendix A**.

   D. All other pole/fixture combinations must be approved by the Duke Campus Landscape Architect and Duke Utilities and Engineering Services (DUES) management.

7. **Duke Approved Area Light Fixtures**

   E. The following are standard fixtures approved for use, reference **Appendix D** for a map of approved areas for use:

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Manufacturer</th>
<th>Model No.</th>
<th>Typical Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acorn-FC-LED</td>
<td>Holophane</td>
<td>WFCL2 070 4K AS Z L * S L20</td>
<td>Walkway / Bikeway / Parking Areas</td>
</tr>
<tr>
<td>Full-Cutoff</td>
<td></td>
<td>Washington Postlite LED Series 70 Watt–Auto-</td>
<td></td>
</tr>
<tr>
<td>(No Globe)</td>
<td></td>
<td>sensing driver, Non-Dimmable, 4000K color</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>temperature, Fixture color to be Chocolate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brown, Spike Finial, Shorting Cap and 20 Ft.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prewired Leads</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No decorative banding/florets <strong>(RFD191264)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO photo cell, No photo control receptacle</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(*) – L5, Symmetrical FCO, <strong>Type 5</strong> or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L3, Asymmetrical FCO, <strong>Type 3</strong></td>
<td></td>
</tr>
<tr>
<td>Plaza Reflector 1</td>
<td>Architectural Area Lighting</td>
<td>INDA-RD, Indirect Reflector Series, Round,</td>
<td>Plaza / Architectural</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjustable Head – options to be considered on</td>
<td>(approved areas only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>case by case basis</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Plaza Reflector 2</th>
<th>Selux</th>
<th>RR#L, RITORNO Series, Round, Adjustable Head, LED – options to be considered on case by case basis</th>
<th>Plaza / Architectural (approved areas only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garage-LED</td>
<td>Cree, Inc.</td>
<td>PKG-EDG-### Cree Edge Parking Structure</td>
<td>Parking Garage</td>
</tr>
<tr>
<td>Street LED</td>
<td>American Electric Lighting (AEL)</td>
<td>ATB2 40BLEDE70 MVOLT R3 BX NL NR</td>
<td>Vehicle Traffic</td>
</tr>
<tr>
<td>Parking Lot LED</td>
<td>American Electric Lighting (AEL)</td>
<td>ATB2 40BLEDE70 MVOLT R3 BX NL NR</td>
<td>Fixture BR1062 Mount Open Parking Areas</td>
</tr>
<tr>
<td>Teardrop</td>
<td>Holophane</td>
<td>MPL P30S 30K AS Z TG 5 P L30 - Fixture/Globe BHC 48/1 CA DBH BHLF/200 RCA DB - Arm CP A 22 L5J 20 P08 ABG BD – Pole</td>
<td>Campus Entrances</td>
</tr>
</tbody>
</table>

(') Fixture, Arm and pole to be Dark Bronze in color.

8. Documentation and Review Requirements

A. Provide detailed lighting layout / report with calculated light levels and uniformity (avg/min).

B. Provide detailed site plan that clearly indicates the location of area lights, hand holes, equipment, and routing of all ductbank(s) in coordination with other utilities or proposed work. Provide an elevation that clearly indicates the service entrance penetrations into the facility. Consideration shall be given to conflicts with present and future adjacent tree canopy.

C. Provide detailed one-line and riser diagrams (as applicable) for all electrical equipment.

9. Installation and Performance Requirements

A. Contractor to supply and install pole base concrete foundations, hand holes, conduit and pull wire as required. Provide a minimum of 24 inches of wire extending out of the pole foundation conduit. Conduit shall stub up no more than 2 inches above concrete foundation.

B. Duke DUES High Voltage to provide and install pole and fixtures, make final connections, and perform functional testing.

C. Do not mix 277/480V and 120/208V conductors in the same raceway, pullbox or junction box except where control wiring is different voltage than power.
D. All concrete shall have a minimum 28 day compressive strength of 3,000PSI. Mix designs shall be submitted for review/approval upon request in conformance with ACI 301.

E. Conduit routing and trenching to be approved by DUES. The sum of all bends between pull points shall not exceed 270 degrees.

F. See Appendix A & B for Foundation Details.

G. See Appendix D for Approved Fixture Locations.

H. See Section 26 08 01 for Electrical Equipment Acceptance Testing requirements.

10. **As-Built Requirements**

A. Provide as-built lighting layout / report with calculated light levels and uniformity (avg/min).
Appendix A: Foundation Details – A-1

**GENERAL NOTES:**

1. CONCRETE COMPRESSIVE STRENGTH (f′c) SHALL BE A MINIMUM OF 3,000 psi AT 28 DAYS.
2. ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 55, HOT DIP GALVANIZED PER ASTM F2329.
3. REINFORCING STEEL SHALL BE ASTM A915 GRADE 80, SUPPLIED BY GENERAL CONTRACTOR.
4. NUTS SHALL BE HEAT TREATED ASTM A983 GRADE OH, HOT DIP GALVANIZED PER ASTM A193.
5. PLATE SHALL BE ASTM A572 GRADE 50, HOT DIP GALVANIZED PER ASTM A105.
6. LOCK NUT SHALL BE HOT DIP GALVANIZED PER ASTM A193.
7. EXTEND (2) 1 1/2" PVC CONDUITS BETWEEN EACH POLE BASE.
8. ALLOWABLE SOIL BEARING = 2,500 psf PRESUMPTIVE.
9. DESIGN WIND LOAD = 90 mph.

**S-1**

MacCONNELL & Associates, P.C.

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<table>
<thead>
<tr>
<th>15&quot;-9&quot; MAX. HARRISBURG POLE</th>
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<tr>
<td>3&quot;-0&quot; REVEAL</td>
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</tbody>
</table>

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Appendix A: Foundation Details – A-2

GENERAL NOTES:
1. CONCRETE COMPRESSIVE STRENGTH (f‘c) SHALL BE A MINIMUM OF 3,000 psi AT 28 DAYS.
2. ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 55, HOT DIP GALVANIZED PER ASTM F2329.
3. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60, SUPPLIED BY GENERAL CONTRACTOR.
5. PLATE SHALL BE ASTM A577 GRADE 50, HOT DIP GALVANIZED PER ASTM A153.
6. LOCK NUT SHALL BE HOT DIP GALVANIZED PER ASTM A153.
7. EXTEND (2) 1/2" PVC CONDUITS BETWEEN EACH POLE BASE.
8. ALLOWABLE SOIL BENDING = 2,500 psf PRESUMPTIVE.
9. DESIGN WIND LOAD = 90 mph.

REFERENCE:
S-1
Appendix A: Foundation Details – A-3

GENERAL NOTES:
1. CONCRETE COMPRESSIVE STRENGTH (f′c) SHALL BE A MINIMUM OF 3,000 psi AT 28 DAYS.
2. ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 55, HOT DIP GALVANIZED PER ASTM F2329.
3. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60, SUPPLIED BY GENERAL CONTRACTOR.
5. PLATE SHALL BE ASTM A572 GRADE 50, HOT DIP GALVANIZED PER ASTM A153.
6. LOCK NUT SHALL BE HOT DIP GALVANIZED PER ASTM A153.
7. EXTEND (2) 1/2" PVC CONDUITS BETWEEN EACH POLE BASE.
8. ALLOWABLE SOIL BEARING = 2,500 psf PRESUMPTIVE.
9. DESIGN WIND LOAD = 90 mph.

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Appendix A: Foundation Details – A-4

SECTION X

1. Concrete compressive strength (fc) shall be a minimum of 3,000 psi at 28 days.
2. Anchor bolts shall be ASTM F1554 Grade 55, hot dip galvanized per ASTM F2329.
3. Reinforcing steel shall be ASTM A615 Grade 60, supplied by general contractor.
4. Nuts shall be heavy hex ASTM A563 Grade DH, hot dip galvanized per ASTM A153.
5. Plate shall be ASTM A572 Grade 50, hot dip galvanized per ASTM A153.
6. Lock nut shall be hot dip galvanized per ASTM A153.
7. Extend (2) 12" PVC conduits between each pole base.
8. Allowable soil bearing = 2,500 psi presumptive.

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Appendix B:  Foundation Details – B-1 (ONLY FOR USE WITH 16'-9" HARRISBURG)

GENERAL NOTES:
1. CONCRETE COMPRESSIVE STRENGTH (f'c) SHALL BE A MINIMUM OF 3,000 psi AT 28 DAYS.
2. ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 55, HOT DIP GALVANIZED PER ASTM F2239.
3. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60, SUPPLIED BY GENERAL CONTRACTOR.
5. PLATE SHALL BE ASTM A572 GRADE 50, HOT DIP GALVANIZED PER ASTM A153.
6. LOCK NUT SHALL BE HOT DIP GALVANIZED PER ASTM A153.
7. EXTEND (2) 1½" PVC CONDUITS BETWEEN EACH POLE BASE.
8. ALLOWABLE SOIL BEARING = 2,500 psi PRESUMPTIVE.
9. DESIGN WIND LOAD = 25 mph.

15'-9" MAX. HARRISBURG POLE 3'-0" REVEAL

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Project: DUKE UNIVERSITY
Job #: A10881-00
Light Pole Foundation Details
Date: 06/08/17
Reference: S-1
Appendix B: Foundation Details – B-2 (ONLY FOR USE WITH 16'-9" HARRISBURG)

**ELEVATION**

- **A S-1**
- **B S-1**

**LIGHT POLE BASE**

**ANCHOR BOLT DETAIL**

**GENERAL NOTES:**
1. CONCRETE COMpressive STRENGTH (f_c) SHALL BE A MINIMUM OF 3,000 psi AT 28 DAYS.
2. ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 50, HOT DIP GALVANIZED PER ASTM A232.
3. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60, SUPPLIED BY GENERAL CONTRACTOR.
5. PLATE SHALL BE ASTM A572 GRADE 50, HOT DIP GALVANIZED PER ASTM A153.
6. LOCK NUT SHALL BE HOT DIP GALVANIZED PER ASTM A153.
7. EXTEND (2) 1½" PVC CONDUITS BETWEEN EACH POLE BASE.
8. ALLOWABLE SOIL BURDEN = 2,500 psi, PRESUMPTIVE.
9. DESIGN WIND LOAD = 80 mph.

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**15'-9" MAX. HARRISBURG POLE 4" REVEAL**

**REFERENCE**

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<th>REFERENCE</th>
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<td>S-1</td>
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Appendix C: Hand Hole & Conduit Detail

Hand Hole size may vary depending on need. Minimum 12" Wide x 18" Length x 18" Depth. LOGO shall read “ELECTRIC”
Appendix D: Approved Fixture Locations