SECTION 265668 – EXTERIOR ATHLETIC FIELD LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The following specifications detail the minimum performance and related criteria for illumination of the exterior athletic playing surfaces including luminaires, poles, support and mounting components, and accessories. Any deviations from this specification must be documented in writing and submitted to the Engineer for approval, in addition to the submittal requirements listed in this document.

B. System Design: The Contractor shall perform all calculations and develop all plan and detail drawings required, in conjunction with these specifications, for installation of a complete and operational athletic field lighting system.

C. This specification section is intended to define the performance and design requirements for illumination of the athletic field. The Contractor shall provide the athletic field lighting system to meet or exceed the requirements set forth by the criteria in these specifications.

1.2 DEFINITIONS

A. Athletic Field: Area of athletic play, including but not limited to the playing surface, sidelines, run-off areas, team areas, and coaching boxes.

B. Athletic Field Lighting System: Lighting control system intended to illuminate Athletic Field, Spectator Areas, and other areas as indicated utilizing high-out, amiable luminaires. System includes luminaires, lamps, drivers, support structures, wiring, controls and other components required for a complete and operating system.

C. CRI: Color-rendering index.

D. CU: Coefficient of utilization.

E. CV: Coefficient of Variation; a statistical measure of the weighted average of all relevant illumination values for the playing area, expressed as the ratio of the standard deviation for all illuminance values to the mean illuminance value.

F. Delegated-Design Submittals: Documents, including drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and Authorities Having Jurisdiction.

G. Illuminance: The density of luminous flux, or flow of light, reaching a surface divided by the area of that surface.

1. Horizontal Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches (915 mm) above the ground, unless otherwise indicated.

2. Vertical Illuminance: Measurement in foot-candles (lux) on a vertical surface at an elevation coinciding with plane height of horizontal measurements.

H. LED: Light Emitting Diode.

I. LER: Light fixture efficacy rating.

J. Light fixture: Used interchangeably in this section with “Luminaire.”

K. Light Trespass: Light spill into areas and properties outside the playing areas, which is either annoying or unwanted.

L. LLD: Lamp Lumen Depreciation, which is the decrease in lamp output as the lamp ages.

M. LLF: Light Loss Factor, which is the product of all factors that contribute to light loss of the system.

N. Luminaire: Complete lighting fixture.

O. NRTL: National Recognized Testing Laboratory.

P. NVLAP: National Voluntary Laboratory Accreditation Program.

Q. Playing Surface: Area of athletic play such as the field, court, pool, track, or pitch.

R. Pole: Light fixture support structure, including tower used for large area illumination.

S. Spectator Area: Seating and egress areas designed for spectators adjacent to and facing the Playing Surface, including but not limited to grand stands, seating bowls, walkways, and aisles.

T. Support Structure: Free-standing or building mounted structure used for support and mounting of luminaires and accessories. Includes but is not limited to poles, masts, towers, and truss systems.

U. Target Illumination: Average maintained illumination level, calculated by multiplying initial illuminance by LLF.

V. UG: Uniformity Gradient; the rate of change of illuminance on the playing field, expressed as a ratio between the illuminances of adjacent measuring points on a uniform grid.

1.3 SUBMITTALS

A. General:

1. Submit all components of the exterior athletic field lighting system specified for use on this Project, in a single submittal package of portfolios, so that all components can be reviewed at one time.

2. Prepare portfolios from manufacturer's standard specification sheets and identify each component. Do not combine more than one component on a single sheet.

3. Submit Shop Drawings as required by Division 1.

B. Product Data: For each luminaire and support/mounting component, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:

1. Name of manufacturer.

2. Descriptive cut sheets providing physical description of luminaire including materials, dimensions, effective projected area, and verification of indicated parameters.
   a. Fixture efficacy.
   b. Coefficient of utilization tables.

c. Light fixture voltage.
d. The number, type and wattage of the light fixture lamps (including product data, where applicable).
e. Lens type (if applicable).

3. Light fixture options that are to be provided.

4. Details of attaching light fixtures, mounting and accessories.

5. Construction of light fixture housing and door (if applicable).

6. Driver cut sheet with options marked, providing physical description of driver including, but not limited to, voltage, lamp, power factor, amperage and wattage. Include energy-efficiency data (if applicable).

7. Light fixture finish and color (if applicable).

8. Life, output, and energy-efficiency data for lamps. Lamp data certified by NVLAP, or NRTL. Energy data shall comply with IESNA LM-47.

9. Details of installation and construction.

10. Photometric data based on laboratory tests of each light fixture type, complete with indicated lamps, and accessories. Comply with IESNA LM-5.
a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

11. Dimensions, and finishes of poles/light fixture supports. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.

C. Delegated-Design Submittals: For exterior athletic lighting indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation:

1. Drawings and specifications for construction of the athletic field lighting system.

2. Manufacturer’s determination of LLF used in design calculations. Lighting calculations shall include a LLF of 0.80. Provide a list of recoverable and non-recoverable LLFs used in the submitted calculations for review by the Engineer.

3. Manufacturer Cut-sheets: For support structures, including mounting brackets, arms, appurtenances, bases, anchorages, and foundations from manufacturer.

4. Design calculations for the following:
a. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires. Scans for both initial and maintained light levels shall be submitted along with the specified spill light calculations.
b. Target illuminance.
1) Point Calculations of horizontal and vertical illuminance, CV, and UG at minimum grid size and area.

5. Electrical system design calculations for the following:
a. Short-circuit current calculations for rating of panelboards, where applicable.
b. Total connected and estimated peak-demand electrical load, in kilowatts, of lighting system.

c. Ampacity requirements of feeder required to supply the lighting system.

6. Wiring requirements, including required conductors and cables and wiring methods.

7. Structural analysis data and calculations used for pole and support structure selections.
   a. Manufacturer Wind-Load Strength Certification: Submit certification that selected total support system, including poles, complies with AASHTO LTS-4 or as noted elsewhere in this specification for location of project.

D. Informational Submittals:

1. Shop Drawings:
   a. Wiring Diagrams: Power and control wiring.
   b. Aiming Diagrams: Playing surface plans showing aiming points for light fixtures.

2. Qualification Data: For qualified Installer.

E. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 or as noted elsewhere in this specification and that loads imposed by light fixtures and attachments have been included in design. This certification shall be based on design calculations by a Professional Engineer.

F. Field quality-control reports.

G. Operation and Maintenance Data: For light fixtures, support structures, and mounting equipment to include in operation and maintenance manuals.

H. Warranty: Sample of special warranties specified in this Section.

1.4 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Prior to the Bid Date, substitutions will not be considered unless the Engineer has received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the fixture designation, name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including cut sheets, photometric data, and all other information necessary for an evaluation. Submit a $100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.

C. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Engineer.

D. The Engineer has the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.5 PERFORMANCE REQURIEMENTS

A. Facility Type: Recreational or social facility.

B. Illumination Criteria:

1. Athletic Playing surface type: Soccer.
   a. IESNA RP-6, Class of Play: Class III.
   b. Speed of Sport: Moderate
   c. Athletic organization standard: NCAA US Soccer Foundation, Televised event for Championship field and Non-Televised Event for remaining fields.

2. Performance Requirements:
   a. Athletic Playing Surfaces shall be lit to the levels specified in the chart below. Manufacturer shall provide computer models guaranteeing average maintained light levels on the field for the length of the warranty.

Athletic Playing Surface Illumination Criteria

Area of	Target Illumination	Maximum to Minimum Uniformity Ratio (Horizontal Lighting (Horizontal) & Vertical)	Grid Spacing
Championship Field (Field 1)	100 fc	1.7:1.0	30'x30'
Typical Soccer Fields (Fields 2-6)	75 fc	2.0:1.0	30'x30'
Multi-purpose Fields (Fields 7-10)	50 fc	2.0:1.0	30'x30'

3. Recoverable Light Loss Factor of 0.80 for LED, per recommendations from the US Soccer Foundation shall be applied to the initial light level design to achieve the maintained light levels listed above. Lighting Systems that use the IESNA recognized time power adjustments (IESNA 10th edition handbook) will be acceptable and must achieve the specified Target Illumination. Lighting calculations shall be developed based on the grid spacing as specified in the chart above.

4. Measured average illumination level shall meet or exceed the requirements listed above, be +/- 10% of predicted mean in accordance with IESNA RP-6-01, and measured at the first 100 hours of operation. If measured initial average illumination levels in manufacturer's submittals cannot be met additional fixtures shall be added to meet the requirements at no additional cost to the Owner. Increases to electrical distribution system including but not limited to additional panelboards, transformers, circuit breakers, feeders, and branch circuits caused by additional fixtures shall also be provided at no additional cost to the Owner.

5. CV and maximum-to-minimum uniformity ratios for each lighted area shall be equal to or less than those listed in IESNA RP-6 for the indicated class of play.

6. UG levels within each lighted area equal to or less than those listed in IESNA RP-6 for the indicated speed of sport.

7. Lighting shall be directed at the playing surface.

C. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires. Scans for both initial and maintained light levels shall be submitted with the bid.

1. Grid Pattern Dimensions: For playing areas of each sport and areas of concern for spill-light control, correlate and reference calculated parameters to the grid areas and intersection points of the indicated grid pattern. Grid Spacing specified charts above.

2. Building reflectance shall not be included in the lighting design calculations.

3. Determine LLF according to IESNA RP-6 and manufacturer's test data.
   a. Use LLD at 80 percent of rated lamp life for LED lamp sources. LLF shall be applied to initial illumination to ensure that target illumination is achieved at 100 percent of lamp life and shall include consideration of field factor.
   b. LLF shall not be higher than 80 percent, and may be lower when determined by manufacturer after application of the ballast output and optical system output according to IESNA RP-6.

4. Use a field factor of 15 percent according to IESNA RP-6, in establishing initial illuminance.

5. Light Fixture Mounting Height: 80’-0”.

6. Luminaire Placement: Luminaire clusters shall be outside of glare zones defined by IESNA RP-6.

D. Electrical Power Distribution Requirements:

1. Electrical power available for Athletic Field Lighting System:
   a. Normal Power: 480Y/277 volts, three phase, four wire.

2. Include roughing-in of service indicated for non-sports improvements on the Project site.

3. Balance load between phases. Install wiring to balance three phases at each support structure.

4. Include required overcurrent protective devices and individual lighting control for sports field or venue.

5. Include indicated feeder capacity and panelboard provisions for future lighted sports field construction.

6. Maximum Total Load: 1200 amperes.

7. Maximum Total Voltage Drop from Source to Load: 5 percent, including voltage drops in branch circuit, subfeeder, and feeder.

E. Lighting Controls System: Manual, low voltage, or digital; providing the following functions, integrated into a single control station.

1. Control Station: Key-operated master switch.

2. Control Zones: Provide multiple levels of control as indicated below. Each level of control shall have a dedicated switch labeled with the zone it controls. Provide an additional master control switch that turns all zones on and off via a single switch.
   a. Playing Field: Provide one level of control for all luminaires aimed at the playing field.

1.6 POWER DISTRIBUTION AND CONTROL

A. Wiring Method for Subfeeders, Branch Circuits, and Control Wiring:

1. Non-metallic raceway as specified within other sections or drawings; No. 10 AWG (or as noted on plans) copper minimum conductor size for power wiring.

B. Electrical Enclosures Exposed to Weather: NEMA 250, Type 3R enclosure constructed from stainless steel, with hinged doors fitted with padlock hasps or lockable latches.

C. The circuit conductors, feeders, circuit breakers to lighting poles indicated are based on preliminary lighting system designs from the basis of design manufacturer. The final number of branch circuit/feeder conductors, the sizes of the branch circuit/feeder conductors, number of circuit breakers, sizes of circuit breakers and other system components required to provide a complete functioning lighting system shall be provided and included within the Contractor's bid based the final lighting system design that meets the illumination requirements specified herein and on the drawings.

D. Voltage drop shall be considered for all branch/feeder conductors. Engineer may request a submittal for all voltage drop calculations for the lighting power distribution system.

1.7 STRUCTURAL ANALYSIS CRITERIA FOR SUPPORT STRUCTURE SELECTION

A. Dead Load: Weight of light fixture and its horizontal and vertical supports, and supporting structure, applied as stated in AASHTO LTS-4.

B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.

C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.

D. Wind Load: Pressure of wind on support structure and light fixture, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for support structure exceeding 50 feet in height is 70 mph.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.

B. Manufacturer Qualifications: Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Manufacturer's responsibilities include fabricating sports lighting and providing professional engineering services needed to assume engineering responsibility.

1. Engineering Responsibility: Preparation of delegated-design submittals and comprehensive engineering analysis by a qualified Professional Engineer.

2. Manufacturer shall be capable of providing "Turn-Key" services to Contractor which include delegated design of all components of the athletic field lighting system, including but not limited to luminaires, support structure locations and design, photometric calculations, and lighting control system requirements. Manufacturer shall furnish and install all components of the athletic field lighting system required for a complete and operating system. General and Electrical Contractor shall furnish and install feeders and

branch circuit conduits and conductors from the building to the connection point(s) indicated in the Manufacturer's Delegated Design documents.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the NVLAP Program for Energy Efficient Lighting Products.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" and AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

G. Comply with IEEE C2, "National Electrical Safety Code."

H. Comply with NFPA 70 National Electrical Code (NEC).

1.9 FIELD VERIFICATION

A. All testing and computer analysis shall generate values based upon the grid size and number of target points referenced in Illumination per LM-5, the IESNA guide for photometric testing of area and sports lighting installations as indicated below:

	Area of Lighting	
	Grid Size	Min. No. of Test Points
Soccer	30'x30'	96

B. Playing Surface Measurements:

1. Horizontal footcandles (fc): The light meter shall be in a horizontal position 36" above the playing surface. The cell of the meter shall be self-leveling and mounted on a tri-pod.

2. These readings shall be taken with the Owner or their representative present.

C. Evaluation Procedures

1. All luminaires shall be operating and properly aimed.

2. The system shall be operating for at least 30 minutes prior to testing to allow for lamp stabilization.

3. Testing shall be done when the air and sky are clear and extraneous light is at a minimum.

4. The test personnel shall take all possible precautions not to cast shadows or reflect light from items such as clothing, PPE, or measurement instruments.

5. The test personnel shall use a light meter that has been calibrated within 12 months of the test. The light meter shall have been calibrated to the lamp type or light source being used.

6. A variation between computer generated performance and field measured results is expected. Field measured results shall be within plus or minus 10% of the predicted computer generated results.

D. Prior to Project completion, the manufacturer's representative shall provide a final report from the test results that shall provide the following items:

1. Name of installation.

2. Date and time of the test.

3. Description of the weather.

4. Description of the lighting system. This shall include the number and types of luminaire for each location, the mounting heights, and lamp manufacture and type, and other pertinent details.

5. Type, make, model, serial number, and copy of calibration certificate for the light meter used. Light meter must display to the 0.01.

6. Identification of number and location of test grid.

7. Actual horizontal and vertical footcandle readings taken at each test point.

8. Average illumination levels.

9. Maximum to minimum ratios.

10. Coefficient of Variation.

11. Uniformity Gradient.

1.10 COORDINATION

A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

1.11 WARRANTY & MAINTENANCE SERVICE

A. 10-Year Warranty: Each manufacturer shall supply a signed warranty which shall include all parts, labor and equipment necessary to maintain the system for 10 years and shall include: all lamp replacements; guaranteed minimum light levels; routine maintenance.

1. Warranty may exclude fuses, impact damage, vandalism, abuse and unauthorized repairs or alterations.

B. Special Warranty: Include a full service product assurance and warranty program providing trouble-free lighting equipment operation, including parts and labor as well as group lamp replacements as often as required during the term of the warranty to ensure minimum lighting design levels are maintained each season.

1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 10 years from date of Substantial Completion.

2. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 10 years from date of Substantial Completion.

C. The fixture crossarm shall be warranted (Limited Warranty) for a period of 10 years and warrants to the purchaser that all assembly(s) shall be free from defects in materials and workmanship from the date of shipment. A copy of the manufacturer's warranty shall be submitted to the Owner.

D. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 3 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realignment.

E. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 10 years from the date of equipment shipment. Per IES individual lamp outages shall be repaired when the outage causes the light on the field to drop below 10% of the maintained light levels or when a fixture outage, at Owner's discretion, materially impacts safety and/or playability of the field. Owner agrees to check fuses in the event of a luminaire outage.

F. Services: Repair or replace components of luminaires, and lamps; align luminaires. Provide lifting equipment as required.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Handle all poles with web fabric straps.

PART 2 - PRODUCTS AND MATERIALS

2.1 ATHLETIC LIGHTING SYSTEM REQUIREMENTS

A. Base bid:

1. LED luminaires, light lighting standards as indicated above.
   a. Number of Poles: As indicated on the Drawings

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ephesus

2. Musco

3. Qualite.

B. Substitutions of comparable products must provide a complete submittal package as outlined in this section for Engineer review at least (10) days prior to bid.

1. Acceptance of a substitution does not negate the Contractor and lighting manufacturer's responsibility to comply fully with the requirements of these specifications. Any exceptions to the specifications must be clearly stated in the prior approval submittal documents.

2.3 LUMINAIRES – LED, GENERAL REQUIREMENTS

A. Luminaires: Listed and labeled, by an NRTL acceptable to Authorities Having Jurisdiction, for compliance with UL 1598 for installation in wet locations.

1. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without using tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent their accidental falling during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lens.

2. Exposed Hardware: Stainless-steel latches, fasteners, and hinges.

3. Spill-Light Control Devices: Internal lenses, internal louvers, or external baffles furnished by manufacturer and designed for secure attachment to specific luminaire.

4. All luminaires shall be constructed with a die-cast aluminum housing to protect the luminaire system.

5. Luminaires shall be bracket-mounted with remote or integral drivers.

B. Remote Driver Mounting: Grouped in cabinets, in enclosures mounted with bottom of enclosure at a minimum of 10'-0" above finish grade. The enclosures shall include drivers and safety disconnect switches. One disconnect switch shall be provided per circuit for each pole structure. Access panels shall be provided as necessary and required.

C. Luminaires shall be provided with aiming devices, degree scale and position locks. Luminaires shall be factory marked to correspond with proper pole, position on pole, and aiming angles.

D. For safety, the entire system shall be NRTL Listed as a complete system.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Formed and supported to prevent warping and sagging.

G. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

H. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

I. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.

1. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   a. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill

scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

b. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

c. Color: Manufacturer’s standard color..

2. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

a. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

b. Color: Manufacturer’s standard color.

c. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

J. LED Lamp Technology

1. Minimum L70 of 100,000 hour lamp life, instant on/off and dimming capabilities.

2. Color Temperature: Provide 5600K color temperature.

3. Color Rendering: 68 CRI minimum

4. Maximum of 115,000 initial delivered fixture lumens to minimize glare potential.

5. Fixture Operating Temperature Range of -40 Degrees C to 55 Degrees C. Maximum Junction Temperature for the diodes of 80 Degrees C

6. Flicker of ≤ 2%.

2.4 POLES AND SUPPORT COMPONENTS - GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Poles Selection" Article, with a gust factor of 1.3.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

2.5 SUPPORT STRUCTURE (STEEL POLES)

A. Support-Structure Wind-Load Strength: Project specific pole/structure drawings stamped by a Professional Engineer licensed in the state where the project is located are required. The poles/structure shall be designed to meet or exceed the current local structural code(s) and all pertinent AASHTO Standards. Poles and other support structures, brackets, arms, appurtenances, bases, anchorages, and foundations shall comply with AASHTO LTS-4-M Design requirements for wind speed, exposure category, and importance factor shall be documented in design and calculations.

1. Dead Load: Weight of light fixture and its horizontal and vertical supports, and supporting structure, applied as stated in AASHTO LTS-4.

2. Live Load: Single load, distributed as stated in AASHTO LTS-4.

3. Ice Load: Applied as stated in AASHTO LTS-4.

4. Wind Load: Pressure of wind on pole and light fixture, calculated and applied as stated in AASHTO LTS-4.

B. Support-Structure Seismic Strength: Poles or other support structures, brackets, arms, appurtenances, bases, anchorages, and foundations shall be designed to prevent separation of components or fracture of poles, luminaire supports, or pole foundations during a seismic event.

C. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

D. Mountings, Fasteners, and Appurtenances:

1. Corrosion resistant, compatible with support components, and which shall not cause galvanic action and contact points.
   a. Steel Components: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M.
   b. Mounting Hardware Fasteners: Hot-dip galvanized, complying with ASTM A 153/A 153M, or minimum 18-8 grade stainless steel.

2. Accommodate attachments and wring of other systems, as applicable.

E. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

F. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; multi-piece construction up to 80 feet in height with access handhole in pole wall.

1. Shape: Round, tapered, segmented with steps.

2. Pole Shaft: The shaft shall be round or 8, 12, or 16 sided and be high strength low alloy tapered tubular steel that is equal to current ASTM A595 or ASTM A570 standards, with hot-dip galvanized coating inside and out. No single pole sections shall exceed 41 feet in length. All connections of pole sections shall be by slip fitting the top section over the lower section by a length of 1.5 times the female inside diameter. The shaft shall be pre-assembled by the manufacturer to assure perfect alignment and proper slip distance. It will then be match marked with a permanent marking for correct field assembly. All shafts shall be color coded for the Contractor’s convenience during assembly, and color codes shall be forwarded to the Contractor before shipment. No intermediate horizontal welds will be permitted. All sections shall be pre-tested at the factory before shipment to insure proper fit-up for the Contractor’s convenience. Lifting rings shall be welded to each end of every pole section. Rings shall be designed to withstand applied loading of each pole section. The rings shall be used to lift the pole sections and in the assembly of the sections.

3. Resistance to Corrosion: Steel components of the pole shall be hot-dip galvanized to current ASTM A123 standards. To avoid problems of galvanize adherence to differing steel alloys, all steel components used for the pole shall be of the same type steel. Each shaft assembly shall be completely coated both inside and out with a single dip. Double dipping will not be permitted in compliance with USGA (United States Galvanizing Association) recommended practices. All miscellaneous hardware shall be galvanized in accordance with ASTM A153 specifications. Top of pole shall be capped or sealed to prevent rainwater from entering the interior of the pole.

G. Steel Mast Arms: Truss type, continuously welded to pole attachment plate. Material and finish same as pole.

H. Brackets for Light Fixtures: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with galvanized-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate light fixture.

3. Match pole material and finish.

I. Pole Climbing steps:

1. Pole climbing steps shall be 5/8” x 6-1/2” galvanized step bolts with locking nuts attached to lugs welded to shaft of light pole at alternating 16” spacings; first step at minimum elevation 12’-0” feet above finished grade.

J. Handhole: Each pole shall have a 5" x 8" handhole with reinforcing frame designed to replace the removed section. A detachable cover shall also be provided with each handhole. Additional handholes shall be placed at the cage location to provide access for wiring.

K. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

M. Service Platforms: Platforms shall be made of tubular members to effectively reduce the wind drag. The cage shall consist of at least one horizontal steel-supporting member, a minimum of 5-1/2” OD 10 gauge material, and vertical luminaire supports of 2” Schedule 40 pipe. All angles shall conform to ASTM designation A36. The vertical luminaire supports shall be available with horizontal, angle luminaire supports with holes to accommodate luminaire adapter plates or pip tenons to accommodate specific size slipfitters. All pipe and tubing components shall be 35 KSI minimum yield strength. The platform shall be a cage with vertical members, minimum 46" in height with two horizontal 3/16" diameter, and 7 x 19 galvanized aircraft cables for enclosure and safety support of maintenance person. The floor shall be 3 lb. expanded metal grating. The floor shall incorporate a hinged door allowing for access to the cage and shall be capable of closing prior to uncoupling of climbing safety device. The entire basket shall be capable of internal wiring from the pole shaft to the luminaire mounting supports. The pole top mounting bracket shall have internal drip shielding for wire entrance. Finish shall match pole finish.

N. Safety Cable: Safety cables shall be manufactured from 5/16” galvanized or stainless steel cable and include a safety belt equipped with a stainless steel follower and brake. The cable system shall incorporate a tension spring and intermediate cable guide(s) to insure the cable is taut and offset from the pole shaft. The cable shall transition into the platform assembly in a manner that does not require the maintenance personnel to detach from the safety cable prior to entering the cage and closing the door.

O. Base: Base Plate or Pre-cast Base. Concrete base design and materials shall be the responsibility of the field lighting pole manufacturer supplier/installer. Pole base structural design shall be signed and stamped by a Professional Engineer licensed in the state where the project is located.

1. Base Plate: Base plates shall conform to ASTM A36 Grade 42. It shall be designed to resist the shaft's maximum moment at its full yield stress. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bars. If a telescopic weld is utilized, both external and internal lap joints shall be welded completely. Plates shall be hot dipped galvanized (ASTM A123) and powder coated as required.
    a. Anchor Bolts: Anchor bolts shall be A36 Mod 55 with a minimum yield of 55,000 or A193-B7 with a minimum yield of 105,000 psi. They shall be designed to support the shaft at its maximum moment and not exceed the yield of the bolt. The moment shall be applied across the base so as to produce the maximum force in the anchor bolts. Anchor bolts shall be galvanized approximately 18", threaded end only. A checking template shall be provided for the Contractors use. Each anchor bolt shall be supplied with one (1) leveling nut and one (1) hold down nut and two (2) flat washers with strength equivalent to or exceeding the proof load of the bolt.

2. Direct buried steel poles are not allowed.

P. Foundations:

1. Foundation Drawings: Project specific foundation drawings sealed by a Professional Engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.

2. Foundations shall be pre-stressed concrete bases embedded in concrete backfill or an anchor bolt foundation designed such that the steel pole and any exposed steel portion of the foundation be located a minimum of 18 inches above final grade. The concrete for anchor bolt foundations shall be allowed to harden for a minimum of 28 days before the pole stress is applied.

3. Extend cast-in-place bolted foundations 36 inches (914mm) above grade, minimum.

Q. Loading: Vertical forces due to pole weight, luminaires, attachments, maintenance device, panelboards, (4) future luminaires per pole, and one (1) maintenance person shall be included in the maximum stress at the base. Wind pressures, adjusted for shape and height, are applied to the centroids of all projected areas. Eccentric moments due to deflection under maximum wind and eccentric loads shall be considered. Sum of maximum stresses shall not exceed the guaranteed minimum yield strength of the material. Base and anchor bolts shall be designed to withstand the maximum combined stress at the base of the pole.

R. Welding: Welding shall be of highest quality and performed by American Welding Society certified welders (AWS D1.1 - Latest Revision). Circumferential and 90 degree base welds shall have 100% penetration and be free of cracking and undercutting. Longitudinal welds shall be free of cracks and undercutting and shall be performed with automatic processes. Quality of welds shall be assured by visual inspection with questionable areas inspected by magnetic particle to AWS D1.1 - Latest Revision, Section 8.15. Longitudinal weld on female section of lap splice shall be 100% penetration with quality being assured by ultra-sonic inspection to AWS D1.1 - Latest Revision, Section 8.15, modified so acceptable inclusion size is compatible with design criteria.

S. The pole shall be designed using drag and height coefficients as published in the latest edition of the Standard Specifications for Structural Supports for Highway Signs and Luminaires. A set of engineering calculations showing point of maximum stress, shear loads and base moments shall be provided for poles of different heights and loading conditions. These calculations shall also provide information on the wind pressure, area, centroid, coefficient of height, coefficient of drag and force at every 10' feet. The calculations shall bear the seal of a Professional Engineer licensed in the State where the project is located. The Professional Engineer shall be employed

on a full time basis by the manufacturer and shall be experienced in pole designs of this nature. The pole shaft, base plate, and anchor bolts, when loaded with the fixture quantity specified and crossarm, shall be designed to withstand an isotach wind velocity of 80 mph with a 1.3 gust factor based on the fifty (50) Year Mean Recurrence Interval Isotach Chart.

T. Poles will be accepted only from manufacturers having products in place for ten (10) years and engaged in supplying products of this nature on a regular basis.

2.6 POLE ACCESSORIES

A. Duplex Receptacle:

1. 120 V, 20 A in a weatherproof assembly with ground-fault circuit-interrupter type.

2. Recessed 48 inches above finished grade.

3. Cast aluminum gasketed cover, Gray, that when mounted results in NEMA 250, Type 3R enclosure, complying with NFPA 70 for wet-locations, and that is weatherproof whether an attachment plug is or is not inserted.
   a. With cord opening.
   b. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.

4. Provided only for poles indicated on the drawings to have a convenience outlet.

2.7 CROSSARM ASSEMBLY

A. Construction Material: The crossarm assembly shall be hot dip galvanized after fabrication to ASTM A123 specifications. It shall be pre-wired to a UL listed or recognized quick connector. Each crossarm shall be labeled for easy installation. All wiring shall be completely enclosed within the crossarm assembly. The crossarms shall be manufactured of rectangular steel tubing (FTY-46 KSI, ASTM A500 GRADE B) material and have silicone gasketed end caps or be continuously welded to prevent water from penetrating inside of crossarm. The assembly shall be mounted to a vertical galvanized steel shaft. A 4”x 6” hand hole shall be provided to allow for access connection of the wiring harness. Structural mounting hardware shall be galvanized. A removable pole top cap shall be provided. All welds shall be fillet type. A strain relief support and ground lug shall be provided. For ease of maintenance, system must be capable of re-lamping from the front or rear of the assembly. There shall be no penetration on the top or sides of the crossarms.

B. Each pole crossarm assembly shall include tubular service platform(s) as necessary to allow for safe maintenance of equipment located at top of poles.

C. Wiring: All wiring shall be factory pre-wired and enclosed inside the crossarm Conductors shall be minimum 12 gauge rated at 600V and have 90°C insulation. Termination of each crossarm shall be by wiring harness.

D. Socket Housing Attachment: Socket housing attachment to the crossarm shall be by a minimum of two stainless steel bolts. To ensure structural strength, the luminaire manufacturer shall provide all mounting hardware.

E. The fixture crossarm shall be warranted (Limited Warranty) for a period of Ten (10) years and warrants to the purchaser that all assembly(s) shall be free from defects in materials and workmanship from the date of shipment. A copy of the manufacturer’s warranty shall be submitted to the owner.

2.8 WIRING HARNESS

A. General Description: Factory manufactured wiring harnesses shall be provided. Each harness shall have top and bottom quick connect plugs and be labeled for connection at each crossarm and ballast enclosure. The harness shall be enclosed and protected along the entire length of the harness. The harness shall be matched to luminaire quantity, wattage and fixture mounting height.

B. Construction: Each harness shall use fully color coded wire for luminaire polarization. All wires shall be minimum 12 gauge rated at 600V and have 90°C insulation. The harness shall be spiral wound and have a stainless steel wire mesh support grip at the top. A ground wire shall be included for continuous system grounding. Each harness shall be labeled for easy identification and 100% electrically tested at the factory before shipment.

C. NRTL Listing: The entire system shall be NRTL listed as an entire system.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

2.9 GROUNDING AND LIGHTNING PROTECTION:

A. Provide stand-alone lightning protection system that complies with NFPA 780 for field lighting structures. Refer to Division 26 Lightning Protection specification for additional information.

1. Provide lightning protection air terminal on top of structure that is bonded to pole and connected to a copper grounding electrode conductor.

2. Provide bonding conductor from air terminal on top of structure to ground lug at base of structure.

3. Provide (2) 3/4” diameter by [10][12] foot long ground rods at base of structure installed 10 feet apart.

4. Provide bonding conductor from ground lug at base of structure and connect to ground rods.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Complete installations for design of lighting systems for the field shall comply with requirements of the local Building Code and NEC.

C. Use web fabric slings (not chain or cable) to raise and set structural members. Protect equipment during installation to prevent corrosion.

D. Align poles for optimum directional alignment of light fixtures and their mounting provisions on the pole. Install poles and other structural units level, plumb, and square..

E. Fasten light fixture to indicated structural supports.

F. Adjust light fixtures that require field adjustment or aiming.

G. Install remote drivers, remote ballasts, and other auxiliary devices as required by manufacturer.

1. Install ballasts, drivers, and devices within maximum remote distances and with wiring sized per manufacturer's recommendations.

2. Provide label on device indicating panelboard circuit number.

3. Properly support remote lighting devices, including, but not limited to ballasts, power supplies, and drivers, per Code and manufacturer's recommendations.

4. Install controls and remote driver or ballast housings in cabinets mounted to support structure at least 10 feet above grade.

5. Provide cabinets and enclosures suitable for installation environment as required.

H. For controllable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:

1. 0-10V – two low voltage conductors and two line voltage conductors plus ground

2. Proprietary digitally addressable – as required per the manufacturer

3. DMX – two line voltage conductors plus ground and DMX cabling.

3.3 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting light fixture to grounding system.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform tests, inspections, and analysis according to IESNA RP-6 and IESNA LM-5 where applicable.

B. Tests and Inspections:

1. After installing sports lighting system and after electrical circuits have been energized, perform proof-of-performance field measurements and analysis for compliance with requirements.

2. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and

Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-01, Appendix B.

a. Soccer Fields: Lighted area is 210 by 370 feet (64 by 113 m). Measure at least 96 points.

3. Perform analysis to demonstrate correlation of field measurements with specified illumination quality and quantity values and corresponding computer-generated values that were submitted with engineered design documents. Submit a report of the analysis. For computer-generated values, use manufacturer's lamp lumens that are adjusted to lamp age at time of field testing.

C. Prior to installation of the support structures, inspect each installed fixture for damage. Replace damaged fixtures and components.

D. Aim all adjustable light fixtures as directed by the Engineer.

E. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

F. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

G. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Engineers's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

H. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.

I. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

2. Comply with the following IESNA testing guide(s): IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."

J. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

K. Sports lighting will be considered defective if it does not pass tests and inspections.

L. Correction of Illumination Deficiencies: Make corrections to illumination quality or quantity, measured in field quality-control tests, that varies from specified illumination criteria by plus or minus 10 percent. If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and peak-demand kilowatt consumptions are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer and/or Contractor shall be liable to any or all of the following:

1. Add or replace luminaires, change mounting height, revise aiming, or install louvers, shields, or baffles.

2. If luminaires are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures if indicated. The Manufacturer or Contractor shall also replace poles to meet the new wind load (EPA) requirements or verify certification by a licensed Structural Engineer that the poles will withstand the additional wind load. Luminaire mounting heights shall not be adjusted without Engineer's approval.

3. Do not replace luminaires with units of higher or lower wattage without Engineer's approval.

4. Retest as specified above after repairs, adjustments, or replacements are made.

5. Report results in writing.

6. Contractor and/or manufacturer shall pay for additional trips made by Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative at no cost to the owner to re-measure illumination test after corrective measures have been performed.

3.5 ADJUSTING

A. Two (2) site visits, one for initial adjusting during construction and installation of light fixtures and one for final adjustment and aiming of light fixtures after substantial completion, will be provided by the manufacturer.

B. Manufacturer shall adjust and aim all adjustable light fixtures as required to achieve the submitted and specified lighting levels. Contractor shall make provisions for supplying all scaffolds, lifts, and other tools and equipment as required.

C. Where required, adjusting shall be done during hours of darkness. Upon notification by Contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Engineer shall coordinate with Contractor as to a mutually agreed upon time to complete adjusting. Failure of Contractor to notify Engineer during substantial completion will result in failure to comply with specifications.

3.6 DEMONSTRATION

A. Manufacturer's authorized representative will be responsible to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265668