

Section 660 High Mast Lighting

660.1 Description

- (1) This section describes constructing a caisson or pile foundation for a high mast light tower, and providing a high mast lighting tower.

660.2 Materials

660.2.1 General

- (1) Furnish materials conforming to the following:

Concrete	501
Luminaires	659
Steel piling	550
Steel reinforcement.....	505

- (2) If not furnished as part of an assembly, use stainless steel threaded fasteners.
- (3) Use grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to [501](#) as modified in [716](#). Provide QMP for class II ancillary concrete as specified in [716](#).

660.2.2 Pole Shafts

- (1) Furnish pole shafts constructed of structural steel conforming to [ASTM A709](#) grade 50 or engineer-approved equivalent and zinc coated conforming to [ASTM A123](#). Furnish pole shafts with a consistent taper from bottom to top, except the lower section may be expanded to accommodate the required apparatus. Furnish poles constructed in 40-foot to 50-foot sections using single thickness steel plate, except the length of the top section may be shorter to provide the required pole height. Provide the engineer with 3 copies of mill test reports that show the material used in pole shafts, anchor bases, and anchor rods conforms to this specification.
- (2) Provide a reinforced access door opening in the base of the pole shaft that secures with a cover. Furnish a cover made with stainless steel hinges that bolts shut with stainless steel hex bolts and is weather tight. Fit the cover with a stainless steel padlock hasp and install a department-furnished padlock.
- (3) Secure the opening below the base plate with a stainless steel or galvanized steel rodent screen.
- (4) Design the base plate so water does not accumulate on the top surface of the base plate inside the pole.
- (5) Before zinc coating of the pole or base plate, number each anchor rod hole in sequence on the base plate or around the bottom of the pole. Locate the numbers so they are not obscured by the zinc coating or covered by installed nuts.

660.2.3 Anchor Rods, Templates, Washers, and Nuts

- (1) Attach the pole to the concrete base with at least 8 anchor rods. For each rod, furnish 2 nuts for securing the bottom anchor plate-template, a leveling nut, bottom washer, top washer, and 2 top nuts. Do not use lock washers.
- (2) Furnish anchor rods conforming to [ASTM F1554](#) grade 55 and Supplementary Specification S4, [ASTM A563](#) heavy hex nuts, and [ASTM F436](#) washers.
- (3) Furnish anchor rods with the top 12 inches and bottom 6 inches having a Unified National Radius roll thread.
- (4) Furnish anchor rods, washers, leveling nut, and 2 top nuts hot-dip zinc coated conforming to [ASTM A153](#) supplemented by [ASTM F2329](#), class C. As a minimum, zinc coat the top threaded portion of the rod plus one inch.
- (5) Furnish a steel top template and a steel bottom anchor plate-template as part of each anchor assembly. Provide a top template of sufficient gauge to hold the anchor rods securely in position at the top, and resist racking or twisting during the pour. Remove the top template after the concrete has set. Use a 1/2-inch-thick bottom anchor-plate template and secure it to each anchor rod. Do not weld templates to anchor rods. Install anchor rods and templates conforming to plan details.

660.2.4 Lowering Device

- (1) Equip the poles with a mechanical lowering system that allows servicing the luminaires and associated electrical and mechanical apparatus from the ground. Furnish lowering devices from a department-approved series and manufacturer and with a 10-year warranty against failure of its components.
- (2) When fully raised, provide a method of securing the luminaire ring to the fixed head assembly. Show either a bottom latch or a top latch system for securing the luminaire ring on the drawings submitted for the engineer's review.

- (3) Design top latch systems to provide the operator with a way to determine whether the raising operation is complete and the luminaire ring is secure. The operator observing clutch slippage does not meet this requirement.
- (4) If securing the luminaire ring to the fixed head assembly, provide a means to relieve tension from the lowering cables onto the winch assembly. Provide strain relief devices that allow removing the winch assembly for servicing while the luminaire ring is fully lowered and blocked up.
- (5) Ensure that the lowering device operates off one leg of the line feeding the pole and uses a portable drive motor that plugs into the line.
- (6) Provide adjustable torque limiters in the winch system or drive motor to prevent excessive stress on the lowering cables, and to allow for proper tensioning against the fixed head assembly.
- (7) For systems where the lifting cables meet on a transition plate, provide access to the top of the plate from the hand-hole, when the ring is fully raised, to allow cable tension adjustment. Furnish 7x9 stainless steel lifting cables. Do not use antirotational cables.

660.2.5 Fixed Head Assembly

- (1) The fixed head assembly shall include no moving parts, except for the necessary pulleys, rollers, and sheaves that guide the lowering ring, lowering cables and electrical conductors during the lowering operation. For the fixed head assembly, use chromated or stainless steel. Use pulleys, rollers, sheaves, and associated bearings, bushings, and shafts made of corrosion-resistant materials. Use permanently lubricated and sealed bearings and bushings.
- (2) For systems that use a roller assembly to support the power chord at the head frame, use an assembly made of rollers mounted between highly corrosion resistant steel plates. Ensure the power chord rides on at least 6 rollers made from acetate resin mounted on stainless steel pins. Furnish a roller assembly with a minimum bending radius of 7 inches. If using a pulley, use a minimum radius of 8 inches.
- (3) Furnish stainless steel lifting cable sheaves with a minimum radius of 3 inches. Use sheaves with permanently lubricated bronze bearings and a stainless steel pin. For the depth of the vee on the pulley, use at least the diameter of the cable. Provide guards to prevent the cable from lifting off the pulley.
- (4) Protect all of the head assembly with covers, screens, or shields, to prevent entrance of dirt, moisture, ice accumulation, nesting of insects or birds or other contaminants that may harm the head assembly and operation of the lowering device.

660.2.6 Luminaire Ring

- (1) If the plans show unused luminaire tenons, install a counterweight equal in weight to a luminaire, and close the unused tenon off with a threaded cap.
- (2) Furnish either a stainless steel, or a structural steel zinc coated ring. Zinc coat conforming to [ASTM A123](#).
- (3) Furnish a luminaire ring centering system designed to protect both the pole shaft and the luminaire ring assemble and with a 10-year warranty against failure of its components. Ensure that the system operates successfully in winds up to 30 mph. Also ensure that the ring can travel smoothly and unimpeded over the entire length of the pole shaft.

660.2.7 Aviation Lights

- (1) Furnish aviation lights, associated electrical circuits, and detailing the plans show.

660.2.8 Lightning Rod

- (1) Furnish silver tipped lightning rod of engineer-approved design mechanically attached to the pole shaft or head assembly, and electrically connected to the pole shaft.

660.2.9 Miscellaneous Fittings

- (1) Use stainless steel miscellaneous fittings, fasteners, and hardware.

660.2.10 Drive Motor Set

- (1) Furnish a universal portable motor system compatible with the particular lowering system used and capable of powering that system for any combination of the pole height and luminaire load configuration. Ensure that the drive motor set consists of a 120 volt AC motor, a matching transformer, power connection cables, and a motor control switch.

660.3 Construction

660.3.1 Design Calculations and Shop Drawings

Revise 660.3.1(1)&(2) to specify 6th edition AASHTO design standards until new LRFD specifications are implemented.

- (1) Design high mast lighting support structures conforming to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, and Interim Revisions.

Design the completed unit to withstand static and dynamic loads the unit will be subjected to in service. Use a design loading that provides for installation of the full complement of 6 luminaires and the operation of the lowering device.

- (2) Design the high mast light tower and foundation using a design life of 50 years with a wind importance factor of 1.00. Design to withstand a 3 second gust wind speed of 90 mph. Do not use the alternative method for wind pressures described in appendix C of the AASHTO standard specifications.
- (3) Design the pole and its connections, including but not limited to the welds and anchor rods, to the AASHTO fatigue category I criteria. Use the fatigue importance factors for category I tabulated in the AASHTO standards.
- (4) Use poles that are round or polygonal in section, and designed so that the horizontal pole deflection in any direction at the design wind velocity with a gust effect factor does not exceed 5 percent of the pole height. Measure the horizontal deflection from the vertical plane passing through the centerline of the pole at its base. The pole height is the distance from the bottom of the base plate to the top of the shaft, excluding the fixed head assembly.
- (5) Submit for review, 2 sets of structural design calculations for each type of pole and anchor assembly showing that the design conforms to the specifications. Submit to the engineer for review, 5 complete sets of shop drawings and component lists, showing the pole, its alloy identification, plate thickness, weld details, weld procedures, and tolerances; the anchor assembly; the fixed head assembly; the lowering device; luminaire ring; other required apparatus; and tightening procedures for bolted connections other than the mast-to-anchor assembly connection. Ensure that design calculations and shop drawings are signed, sealed, and dated by a professional engineer registered in the state of Wisconsin.
- (6) If any substantial changes from previously submitted calculations and drawings are made, submit the revisions to the engineer for review.

660.3.2 High Mast Foundations

660.3.2.1 General

- (1) If any twisting, racking, or other movement of the anchor rods out of plumb, projection, or pattern, or any damage to the threads exists the engineer will reject the entire base.
- (2) Maintain the clear distance between the soil and the reinforcing steel cage using the means the plan detail shows. Do not weld the anchor rods to each other, the reinforcing steel cage, and the templates or to any other component of the foundation. Protect anchor rod threads above the top of the foundation level from concrete splash.
- (3) Place the concrete in one continuous pour without construction joints. Cure exposed portions of concrete foundations as specified in [502.3.8.1](#). Wait until the concrete has attained 3500 psi compressive strength or 7 equivalent days as specified in [502.3.10](#) before erecting the tower.

660.3.2.2 Augured Foundations

- (1) Construct as specified for concrete bridges in [502.3](#).
- (2) Produce the holes for foundations by auguring. The contractor may install a suitable casing at the same time as the auguring. Make the augured hole vertical and uniform in section. Fill irregularities in the cylindrical surface of uncased holes outside the nominal diameter with concrete. If the top of the hole caves in, the engineer may require the contractor to auger the hole deeper to obtain the required depth and section.

660.3.2.3 Pile Type Foundations

- (1) Drive piles as specified in for steel piling in [550](#).

660.3.3 Pole Shafts

660.3.3.1 General

- (1) Weld or telescope pole sections together so that the splice length is equal in strength and rigidity to the remainder of the pole shaft.
- (2) Before and during erection, examine the pole sections for scratches and marks, and treat them by first removing rust and then coating the damaged area with an engineer-approved cold zinc coating compound. Remove markings placed on the pole for purposes of fabrication, shipping, or erection.
- (3) After erecting and plumbing, ensure the completed pole, with attachments, appears straight and vertical throughout its height, except if distorted by the effects of wind or sunlight or both. Do not perform the final plumbing of the pole on a sunny day.

660.3.3.2 Telescoped Poles

- (1) Overlap the sections at least 1 1/2 times the outside diameter of the larger section at the joint. Test fit the sections at the factory to ensure pole straightness and accuracy of the mating surfaces.
- (2) In the field, measure the joint overlap as follows: On the male end, make a chalk mark at a distance from the end equal to the required overlap plus one foot. Then make the connection so that the distance from the end of the female section to the chalk mark is one foot.
- (3) Upon erection, ensure the surface of the telescoped sections present a permanent barrier to moisture entering the faying surfaces.

660.3.3.3 Welded Poles

- (1) Shop weld pole shafts and attachments conforming to AWS D 1.1, Structural Welding Code - Steel and as follows:
 1. Use complete-penetration welds for pole sections joined by circumferential welds and inspect all welds.
 2. Inspect all circumferential welds, all full penetration welds, and a random 25 percent of partial penetration longitudinal welds.
 3. Inspect full penetration welds by either radiographic or ultrasound inspection methods.
 4. The contractor may inspect partial penetration welds by the magnetic particle method.
 5. Make longitudinal welds to 60 percent depth penetration, except in any location within 6 inches of a circumferential weld or within the joint overlap area plus 6 inches, then make these welds to 100 percent depth penetration.
 6. The contractor may repair a circumferential weld once without the engineer's permission.
 7. Ensure that other weld repairs are engineer-approved.
- (2) Do not weld in the field without the engineer's written approval. The engineer will only allow field welding for repairs in noncritical locations and when a department-approved individual competent to perform inspections is present during the welding. Perform field welding using personnel qualified under AWS D 1.5, Bridge Welding Code for steel.

660.3.4 Anchor Assembly

- (1) Secure masts to anchor assemblies conforming to the procedures enumerated in department form [DT2321](#). Complete department form [DT2321](#) for each structure. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record.

660.3.5 Lowering Device, Head Assembly and Luminaire Ring

- (1) Construct conforming to plan details and manufacturer's instructions.
- (2) Before erecting the fixed head assembly, the engineer will inspect it on the ground.

660.3.6 Acceptance

- (1) Before acceptance each high mast lighting tower demonstrate to the engineer that electrical and mechanical systems function properly.

660.4 Measurement

- (1) The department will measure the High Mast Foundation bid items as a single lump sum unit for each foundation acceptably completed.
- (2) The department will measure the High Mast Lighting Tower bid items as a single lump sum unit for each tower acceptably completed.

660.5 Payment

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
660.0100	High Mast Foundation (location)	LS
660.0200	High Mast Lighting Tower (location)	LS

- (2) Payment for the High Mast Foundation bid items is full compensation for providing steel piling and concrete, including extra concrete required around uncased holes, for reinforcing steel; for anchor rods, templates, nuts, and washers; for electrical conduit; for excavating and auguring; and for backfilling, disposing of surplus material, and restoring the site.
- (3) Payment for the High Mast Lighting Tower bid items is full compensation for providing the pole; for providing a drive motor set, fixed head assembly, luminaire ring, and lowering mechanism with associated mechanical and electrical components, an electrical grounding system, the pole sequence and circuit identification plaques, nuts, and washers, fittings, hardware, aviation lights, and lightning rod; for connecting to the electrical distribution system; and for providing slugging wrenches for each size of nut.

(4) The department will pay separately for luminaires under the Luminaires bid items of [659](#).