532 Ancillary Superstructures

532.1 Description

(1) This section describes providing overhead sign structures and high mast lighting towers.

532.2 Materials

532.2.1 General

(1) Furnish structural steel conforming to ASTM as follows:

<= 1/2 inch thick structural tube and pipe ASTM A500 grade C

> 1/2 inch thick structural tube and pipe API 5L PSL 2 grade 46 or ASTM 1085

Tapered vertical supports ASTM A595 grade A or ASTM A572 grade 55

Multi-sided or greater than 26-inch diameter round tapered poles ASTM A572 grade 65

Structural angles and plates ASTM A709 grade 36

(2) Furnish aluminum members conforming to ASTM as follows:

Extruded aluminum ASTM B221, alloy 6061-T6

Structural shapes ASTM B308, alloy 6061-T6

Plate and sheet aluminum ASTM B209, alloy 6061-T6

Pipe ASTM B241 or ASTM B429, alloy 6063-T6

Ensure aluminum material is free from discoloration, nicks, and blemishes.

(3) Furnish stainless steel U bolts, bolts, nuts, and washers for connections to aluminum components conforming to the following:

Bolts for structural connections ASTM A320 grade L1

Nuts for structural connections ASTM A194 grade 8M

Bolts and U-bolts for miscellaneous attachments ASTM F593 group 2

Nuts for miscellaneous attachments ASTM F594 group 2

Washers ASTM A240

(4) Furnish galvanized direct tension indicating (DTI) washers conforming to ASTM F959 type 325 and ensure DTIs have identifying marks applied by the manufacturer. Mechanically galvanize according to ASTM B695, class 55.

(5) Furnish galvanized high strength bolts, nuts, washers conforming to 506.2.5 and as follows:

- Use the size, number, type, and configuration of hardened flat washers the DTI manufacturer recommends for bolt diameters greater than 1 1/8 inches.

- Ensure that the supplier pre-assembles each bolt/nut/washer/DTI assembly before shipping.

- Ensure that bolt/nut/washer/DTI assemblies are accompanied by a certified report of test or analysis giving the results of the supplier's rotational-capacity testing. No field rotational-capacity testing is required.

- Ensure that bolt/nut/washer/DTI assemblies are shipped and stored in sealed and labeled containers.

- Furnish 3 or more additional bolt/nut/washer/DTI assemblies of each rotational-capacity lot for pre-installation testing.

- Submit 2 or more additional bolts and 3 or more additional nuts, washers and DTI’s from each lot and heat for department mechanical testing. The contractor need not submit components from a lot and heat the department previously approved.

(6) Galvanize structural steel according to ASTM A123. Weld base plates to vertical supports. Identify the vertical support type and wall thickness using 1/2-inch lettering stamped under the hand-hole before galvanizing steel vertical supports.

(7) Furnish hand holes with a bolt-on access cover as the plans show. Provide a grounding L-clip welded directly opposite the hand hole on the inside wall of vertical supports.

(8) Furnish shims matching the vertical support material.

(9) Furnish identification plaques as the plans show.

532.2.2 Approved Products and Fabricators

(1) Ensure overhead sign structures are fabricated by an approved fabricator from the APL. Also ensure that the fabricator submits a fabrication progress report on department form DT2334 electronically to the department's fabrication library. Update this form weekly for each overhead sign structure in fabrication.

532.2.3 Miscellaneous Components

(1) Furnish galvanized steel walkway grating.

(2) Furnish galvanized carbon steel chain and include accessories the plans show.

532.2.4 Certification

(1) Submit a certified report of test or analysis to the engineer for castings, vertical supports, truss members, arms, pipes, high-strength bolts, and structural sections. Do not install before the engineer approves these materials.

(2) The engineer may retest materials delivered to the job site; furnish specimens required for this testing.

532.3 Construction

532.3.1 General

(1) Store bolts/nut/washer/DTI assemblies in closed containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.

(2) Protect galvanized members from damage to galvanization during transportation, storage, and erection. Repair areas of damaged galvanization according to ASTM A780. Clean damaged and adjacent areas by sanding, scraping, chipping, or wire brushing. Apply a profile to the bare metal surface using a needle gun before painting.

(3) Non-standard structures are designated as Type NS in their various bid item descriptions and have unique designs or components.

532.3.2 Calculations, Shop Drawings, and Certifications

532.3.2.1 Overhead Sign Structures

(1) For overhead sign structures designed by WisDOT or its representative, submit shop drawings identified by structure number to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2326 with each set of shop drawings.

(2) For contractor designed overhead sign structures, submit design computations and material specifications identified by structure number to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2326 with each set of shop drawings. Have a professional engineer registered in the state of Wisconsin sign, seal, and date the shop drawings and certify that the design conforms to AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (AASHTO LRFDLTS-1) with interim revisions, and to the contract.

(3) For contractor designed structures, provide commercially fabricated overhead sign structures conforming to the edition of AASHTO LRFDLTS-1 and fatigue category the plans show. The contractor may provide either straight or tapered vertical support and arm shafts unless the plans specify otherwise.

532.3.2.2 High Mast Towers

(1) For high mast towers, design conforming to AASHTO LRFDLTS-1 with 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 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 120 mph.

(3) Design the tower 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 towers that are round or polygonal in section and designed so that the horizontal tower deflection in any direction at the design wind velocity with a gust effect factor does not exceed 5 percent of the tower height. Measure the horizontal deflection from the vertical plane passing through the centerline of the tower at its base. The tower height is the distance from the bottom of the base plate to the top of the shaft, excluding the fixed head assembly.

(5) Submit shop drawings identified by structure number, design computations, and material specifications to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2326 with each set of shop drawings. Provide component lists, showing the tower, 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 conforming to 660. Have a professional engineer registered in the state of Wisconsin sign, seal, and date the shop drawings and certify that the design conforms to AASHTO LRFDLTS-1 with interim revisions, and to the contract.

(6) If substantial changes from previously submitted calculations and drawings are made, submit the revisions to the engineer for review.

532.3.3 Steel Fabrication

(1) Fabricate and assemble steel components conforming to 506.3. Conform to 506.3.22 for shop inspection and to 506.3.25 for field inspection. Provide mill inspection and test reports conforming to 506.3.21.

(2) Blast clean and then galvanize fabricated steel members and accessories after completing cutting, punching, drilling, and welding.

(3) Complete welding before galvanizing. Clean exterior surfaces of steel after welding to ensure they are free of loose rust and mill scale, dirt, oil or grease, and other contaminants before galvanizing. Galvanize as specified in 532.2.1(6). Ensure that the coating is tight, free from rough areas or slag, and presents a uniform appearance. Clean after manufacturing is complete to remove loose and foreign material.

(4) After galvanization, assemble the individual members making up truss sections, unless fabricated and galvanized in one piece in the shop. Adjust to the proper shape and alignment, and tighten the high-strength bolts to the required tension. Tension high-strength bolts within truss sections conforming to department form DT2322. Assemble the truss sections that make up any one overhead sign structure in the shop, and adjust to proper alignment and camber the plans show. Matchmark truss sections and shims before disassembling for shipment.

(5) Weld or telescope high mast tower sections together so that the splice length is equal in strength and rigidity to the remainder of the tower. For high mast towers with telescoped sections, 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 tower straightness and accuracy of the mating surfaces.

(6) Fabricate tapered vertical supports with a constant linear taper of 0.14 inches per foot and with only one longitudinal welded seam.

(7) For vertical supports containing electrical equipment; provide strain relief, J-hooks, and handholes as the plans show.

532.3.4 Erecting Structures

532.3.4.1 Vertical Supports

(1) Clean each vertical support before installation. Secure vertical supports to anchor assemblies conforming to 532.3.6.1.

(2) Erect using normal vertical support shaft raking techniques. Ensure that the centerline is vertical, unless the plans show otherwise.

(3) Install identification plaques as the plans show.

532.3.4.2 Trusses, Monotubes, and Arms

(1) Assemble the sections making up the full span, together as a single unit, before attaching to vertical supports.

(2) Install truss or monotube arms to vertical supports after erecting the vertical supports.

532.3.4.3 High Mast Towers

(1) Ensure that the completed tower, with attachments, is straight and plumb throughout its height. Do not perform final plumbing on a sunny or windy day.

(2) Ensure that the surface of telescoped tower sections permanently blocks moisture from entering the faying surfaces.

(3) Set the high mast light tower joint overlap in the field as follows:

- On the male end, make a chalk mark at a distance from the end equal to the required overlap plus 1 foot.

- Make the connection so that the distance from the end of the female section to the chalk mark is 1 foot.

532.3.4.4 Structure Mounted Signs

(1) Under the Sign Structure Mounted bid items, provide sign mounts on structures as the plans show.

532.3.5 Welding

(1) Perform shop welding as the plans show and conforming to the following:

For steel AWS D 1.1, Structural Welding Code - Steel.

For aluminum AWS D 1.2, Structural Welding Code - Aluminum.

(2) Visually inspect welds. If the engineer directs, test butt welds in members subject to tension or stress reversal by radiographic or ultrasonic methods over the entire length of the weld. Test other butt welds in these members by the same methods, except the engineer will determine the length of weld to test. Use either the dye penetrant method, or the magnetic particle method to test the fillet welds connecting columns to bases and main chord members, including the associated flanges, gussets, or load carrying brackets or members, and on fillet welds connecting flanges to the truss chord members. Perform the dye penetrant test according to ASTM E165 and perform the magnetic particle method according to ASTM E709.

(3) Shop weld high mast towers and attachments conforming to AWS D 1.1 and as follows:

1. Use complete-penetration welds for tower 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 can inspect partial penetration welds by the magnetic particle method.

5. Make longitudinal welds to 60 percent depth penetration. In any location within 6 inches of a circumferential weld or within the joint overlap area plus 6 inches, 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.

(4) Do not weld steel structures 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.

(5) Shop weld aluminum catwalk supports and handrails conforming to AWS D 1.2. Do not weld aluminum in the field.

532.3.6 Installation

532.3.6.1 Installing on Anchor Rods

(1) Install structures on anchor rods conforming to 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 before final structure inspection.

(2) Ensure that anchor rods are tensioned by personnel who have completed the online WisDOT ancillary bolting class and hold a current certificate of completion. Submit the current certificate of completion with form DT2321.

532.3.6.2 Anchor Assemblies for Poles on Structures

(1) Install anchor rods and templates for non-standard structures as the plans show. Tension anchor rods for light poles conforming to the light pole manufacturer's recommendations.

532.3.6.3 High Strength Bolts

(1) Ensure that high strength bolts are installed by personnel who have completed the online WisDOT Ancillary Bolting Course and hold a current certificate of completion. Submit the current certificate of completion with form DT2322.

532.3.6.3.1 Pre-Installation Testing

(1) Notify the engineer before performing the required field pre-installation testing.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before testing. Test bolt/nut/washer/DTI assemblies for configurations used for installation.

(3) Perform pre-installation testing in the field conforming to department form DT2322 for each bolt/nut/washer/DTI size and configuration installed. Provide the engineer with test results by submitting 2 copies of department form DT2322.

532.3.6.3.2 Bolt Installation for Tensioned Connections

(1) Do not begin bolt installation without engineer approval

(2) Lubricate high-strength bolt threads with a wax-based lubricant before installation.

(3) Tension high-strength bolts using DTIs. Install the DTI on the bolt with the protrusions facing away from the connected materials. Install bolt/nut/washer/DTI assemblies in the same configuration used for pre-installation testing.

(4) Tighten conforming to department form DT2322 to provide the correct installation tension in one shift of work on the same day bolts are installed. If not fully tensioned during initial tensioning, provide new bolt/nut/washer/DTI assemblies and fully tension immediately. During the operation, ensure no rotation of the part not turned by the wrench.

(5) Snug systematically from the most rigid part of the connection to the free edges. Repeat until the full connection is in a snug condition and the faying surfaces are in firm contact. Systematically tighten the connection until the required number of refusals is achieved. If the gaps on the DTI are completely closed, discontinue tightening. If all gaps are closed before reaching the installation torque required in DT2322, replace the bolt assembly.

(6) Perform QC testing as specified in DT2322 for tensioning with DTIs. The engineer may verify bolt installation by periodically testing with a feeler gauge. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record before final structure inspection.

532.3.6.3.3 Bolt Installation for Snug Tight Connections

(1) Do not begin bolt installation without engineer approval.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before installation.

(3) Tighten bolt assemblies to snug tight in one shift of work on the same day bolts are installed. During the operation, ensure no rotation of the part not turned by the wrench. Snug systematically from the most rigid part of the connection to the free edges. Repeat until the full connection is in a snug condition and the faying surfaces are in firm contact and the nut cannot be removed without a wrench.

(4) DTI washers are not needed in snug tight connections.

532.3.7 Attachment Installation

532.3.7.1 Sign Installation

(1) Install permanent signs as soon as support structures are erected. If permanent signing is not available, install sign blanks to control vibration. Fasten to the supporting structure conforming to 637.3.3.3 and as the plans show.

(2) For full span truss overhead sign structures, ensure that sign blanks are the same sizes and at the same locations as the permanent signs.

(3) For monotube and cantilever overhead sign structures, attach sign blanks to a minimum of 1/4 of the truss length. For full span structures locate near center span; for cantilever structures locate at the end of the span. Use sign blanks that are at a minimum 24 inches larger than the truss depth and project an equal distance beyond the top and bottom chord members.

532.3.7.2 High Mast Light Installation

(1) Install head assemblies and lowering devices conforming to 660.

532.3.7.3 Structure Identification Plaque Installation

(1) Install structure identification plaques on overhead sign structures and high mast structures in the locations the plans show. Also install sequence and circuit identification plaques on high mast light structures as the plans show.

532.3.8 Acceptance and Inspection

(1) Demonstrate to the engineer that electrical and mechanical systems for each high mast tower installation are fully operational. The department will not accept an installation until the engineer is satisfied that it functions properly.

(2) Inspect completed "S" or "L" designated structures before opening to public traffic conforming to the BOS structure inspection manual part 4 for sign, signal, and high mast towers available at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/inspection-manual.aspx

Ensure that a department-certified active team leader for sign/signal inspections, listed on the department's highway structures information system (HSIS) website, performs inspections. Conform to the following:

- Notify the engineer at least 5 business days before inspection.

- Ensure that the team leader performing inspections submits the signed inspection reports and provides punch list items as maintenance items in the inspection report to the engineer within one business day after completing each inspection. Submit that signed final inspection report to the engineer and HSIS at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/hsi.aspx

- Notify the engineer and region ancillary structure project manager upon completion of the punch list items.

532.4 Measurement

(1) The department will measure the bid items under this section as each individual structure acceptably completed.

532.5 Payment

Revise 532.5 to add bid item ranges. Move specific bid items for Butterfly 2-Chord and Butterfly 4-Chord to bid item list.

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

ITEM NUMBER DESCRIPTION UNIT

532.4500-4599 High Mast (height) (structure) EACH

532.5000 Sign Structure Mounted (structure) EACH

532.5010-5039 Butterfly 2-Chord (type) (structure) EACH

532.5040-5099 Butterfly 4-Chord (type) (structure) EACH

532.5100-5199 Monotube Cantilever (type) (structure) EACH

532.5200-5299 Monotube Full Span (type) (structure) EACH

532.5300-5399 Truss Cantilever 2-Chord (type) (structure) EACH

532.5400-5499 Truss Full Span 2-Chord (type) (structure) EACH

532.6000-6099 Truss Cantilever 4-Chord (type) (structure) EACH

532.6100-6199 Truss Full Span 4-Chord (type) (structure) EACH

(2) Payment for the High Mast bid items is full compensation for providing high mast light towers; and for sequence and circuit identification plaques.

(3) Payment for the Sign Structure Mounted items is full compensation for providing sign mounts on structures.

(4) Payment for the Butterfly, Monotube, and Truss bid items is full compensation for providing the sign structures; for high-strength bolt/nut/washer assemblies and DTIs, including those required for testing; and for sign blanks.

(5) The department will pay for removing ancillary structures and their associated concrete foundations under the Removing Ancillary Structures bid items as specified in 204.5.