

SECTION 418 -- OVERHEAD SIGN SUPPORTS

418.01 -- Description

1. a. "Overhead Sign Support, Location _____" shall consist of:
 - (1) Providing all materials to construct overhead sign supports.
 - (2) Transporting all sign support materials to the project site.
 - (3) Constructing all trusses and other sign support structures as shown in the plans (including attachment of sign brackets to the structure).
 - (4) Providing the Department copies of the manufacturer's designs of the overhead sign support structure and the reinforced concrete foundations for all sign support structures.
 - b. Aluminum or steel trusses that span multi-lane roadways shall be provided with a sign lighting system in accordance with Sections 401 through 412.
 - c. Steel or aluminum truss cantilevers shall be installed at the side of the roadway with the horizontal member overhanging the roadway and shoulder.
 - d. Steel sign brackets shall be attached to existing roadway bridges spanning the roadway and shall be provided with a sign lighting system in accordance with Sections 401 through 412.
 - e. Plans shall be augmented by Contractor-furnished working drawings submitted in accordance with Subsection 105.02.
2. Full Span and Cantilever Sign Structures:
 - a. The overhead sign supports shall be steel or aluminum box or single panel truss structures.
 - b. The work shall consist of designing, furnishing, and erecting a structure, complete with vertical end supports, span members, walkways, sign brackets, foundations, and all necessary material and fasteners for assembling the structures. All material fabrications shall be in accordance with the applicable requirements of Sections 417, 401 through 412, 708, and 1040.
 - c. All overhead sign support structures shall be fabricated in a plant owned and operated by a fabricator sufficiently experienced to manufacture the structures in accordance with these *Specifications*. The Contractor shall furnish the name and address of the fabricator, if requested by the Engineer, and evidence of the fabricator's qualifications and experience.

418.02 -- Material Requirements

1. Aluminum cantilevers, trusses, and other sign supports shall be made from the alloys in Table 418.01 and shall conform to the indicated ASTM requirements.

2. Steel sign supports for Type B (See Section 417 for type definitions) signs shall be fabricated from structural steel conforming to the requirements of ASTM A 36/A 36M with a maximum working stress of 20,000 psi. After fabrication, the cantilever members shall be galvanized in accordance with ASTM A 123.

Table 418.01

Alloy Requirements		
Member or Shape	Aluminum Alloy	ASTM Requirements
Extruded tubes for chord and column members	6061-T6	B211/B 211M; B 429
Bracing Members	6063-T6	B221/B 221M; B 429
Extruded Shapes	6061-T6	B211/B 221M; B 308/B 308M
Plates	6061-T6	B209/B 209M
Post Base and Chord Flange	356.0-T6	
Aluminum Alloy Sand Castings	356.0-T6	B26/B26M
Aluminum Alloy Permanent Mold Castings	356.0-T6	B 108
Grates	6061-T6	B211/B 211M; B221/B221M
Bearing Bars	6061-T6	B211/B 211M; B221/B221M
Cross or Crimp Bars	6063-T5	B211/B 211M; B221/B221M
Pipe Handrail	6061-T6/6063-T6	B 221M; B 241/B 241M
Post and Chord Caps	356.0-F	B 26/B 26M
Anchor Bolts & Nuts	---	A 307
Galvanizing	---	A 153

3. Steel sign brackets to be attached to existing bridges shall be fabricated from structural steel conforming to ASTM A 36/A 36M with a maximum working stress of 20,000 psi.

4. a. The reinforced concrete foundations shall be constructed to the dimensions shown in the plans.

b. The materials and construction methods shall be in accordance with the applicable requirements of Sections 702, 704, and 707 and as required in the plans.

c. Anchor bolts of the specified size for each support shall be placed at the depth shown in the plans, properly aligned and secured in place before placing concrete.

d. Two inch diameter non-metallic electrical conduit shall be installed in each foundation as shown in the plans, with caps on both ends to keep the conduit clean until wiring is installed.

5. Anchor Bolts for Cantilever Sign Supports:

a. Anchor bolt assemblies shall be designed and furnished by the pole manufacturer in accordance with ASTM A 687. They shall be hot dip galvanized in accordance with ASTM A 153.

b. The nuts shall meet the requirements of ASTM A 914/A 194M, Grade 2H.

c. The hardened steel washers shall conform to the requirements of ASTM F 436 or ASTM F 436M. The plate washer shall conform to the requirements of ASTM A 36/A 36M. The manufacturer of the anchor bolts shall furnish certification and test reports covering the steel used.

6. Full Span and Cantilever Sign Design Requirements:

a. (1) The overhead span and cantilever sign structures shall be box or single panel trusses designed in accordance with the latest edition of the *Specifications for the Design and Construction of Structural Supports for Highway Signs*, published by the American Association of State Highway Transportation Officials.

(2) The design wind velocity used for structure calculations shall be 80 mph with a 1.3 gust factor.

(3) The sign spans, sign locations, and sign mounting heights used for structure calculations shall be as shown in the plans.

(4) The design areas used for calculations shall be the sign areas shown plus 30 percent.

b. (1) Designs, materials, and basic member shape, once selected, shall be used throughout the project.

(2) Structures shall be aluminum or steel galvanized after fabrication.

(3) All overhead structures shall be designed to be supported by single poles or end frames having no more than 2 vertical main members of a closed cross section.

c. Footings shall be reinforced concrete with the overhead portion of the structure attached by means of base plates and anchor bolts. The top of each footing shall extend a maximum of 1 inch above ground level and shall have a 1 inch chamfer on its edges.

d. Footings shall be designed from soil boring test results obtained from the Engineer or shown in the plans.

e. The bottom of aluminum supporting shafts and all anchor bolts shall receive a heavy coating of aluminum filled, resilient sealing compound completely covering all areas which may contact the concrete. The sealing compound shall be on the NDR Approved Products List.

f. Corrosion of aluminum caused by contact with dissimilar metals shall be prevented by proper design considerations and installation procedures.

g. (1) The structure shall be lighted with walkways provided in front of and in back of the entire length of the signs.

(2) The walkways shall be continuous to the vertical access point/support.

(3) Walkways shall have a railing along the front side which can be folded when not in use. The fold-down handrails shall be limited to sections that are 12 feet or less in length.

(4) No part of a walkway or railing in the folded position shall obstruct normal viewing of the sign.

(5) The cantilever structures shall be lighted and have front and back walkways, continuous over the width of the sign and shoulder and extending to the vertical end support.

(6) The back walkway (closest to cantilever arm) shall extend a minimum of 2 feet beyond the sign's vertical edge.

(7) Vertical deflection of the cantilever arm shall be limited to $L/120$.

h. For access to the walkway, a ladder or other type of foot support shall be constructed on the end support beginning 7 feet above the ground.

i. Sign lighting and electrical equipment for the structure shall be in accordance with the applicable requirements of Sections 401 to 413 and 1073.

j. Before fabrication, the Contractor shall prepare and submit complete design drawings, calculations, and other supporting data for approval. These shall include 6 sets of prints and drawings on standard size plan sheets (36 x 22 inches) and 2 sets of design computations prepared and signed by a registered Professional Engineer licensed in Nebraska.

418.03 -- Construction Methods

1. General:

a. The Contractor shall take precautions to avoid scarring or marring aluminum or galvanized surfaces. Any such damage which, in the judgment of the Engineer, gives an objectionable appearance or contributes to weakening of the structure will be cause for rejection.

b. The Contractor shall remove all casting irregularities from cast parts.

c. Tubing shall be seamless; and exterior and interior surfaces shall be clean, smooth, and free from slivers, lamination, grooves, cracks, or other defects.

d. Poor welding skill, as noted by visual inspection, will be sufficient cause for rejection.

2. Fabrication of Sign Structures:

a. Aluminum alloy fabrication shall conform to AWS procedures and the following:

(1) Thermal cutting will not be allowed.

(2) Material 1/2 inch or less in thickness may be sheared, sawed, or milled. Material over 1/2 inch in thickness shall be sawed or milled. Cut edges shall be true and free from excessive burrs or ragged breaks.

(3) Material to be bent may be heated to a temperature not exceeding 400°F for a period not exceeding 15 minutes to facilitate bending.

(4) Bolt holes shall be drilled full size or subpunched 1/8 inch smaller than the nominal diameter of the fastener and reamed to size. Unless otherwise indicated in the plans, the finished diameter of the holes shall be not more than 7 percent greater than the nominal diameter of the fastener.

(5) The length of the vertical end frames for structures shall be field checked before fabrication.

b. Fabrication of steel materials (center mounts, cantilevers, and sign brackets) shall be in accordance with the applicable requirements of Section 708. Center mount and cantilever structures shall be galvanized as required by the plans. Sign brackets shall be painted in accordance with the applicable requirements of Section 709 and as required by the plans.

3. Aluminum Welding Requirements:

a. (1) The aluminum alloys shall be welded in accordance with the ASTM requirements listed below:

Wrought heat-treatable alloys Alloy 6061 Alloy 6063 Cast heat-treatable alloy Alloy 356.0

(2) Material used for permanent backing shall be at least equivalent in weldability to the base metal being welded.

(3) These *Specifications* include provisions for welding by the gas metal-arc process and the gas tungsten-arc process.

(4) Bare wire electrodes for use with the gas metal-arc process and welding rods for use with the gas tungsten-arc process shall conform to the requirements of *Specifications for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes*, AWS A5.10.

(5) Tungsten electrodes for the gas tungsten-arc process shall conform to the requirements of *Specifications for Tungsten-Arc Welding Electrodes*, AWS A5.12. Filler metals to be used with particular base metals shall be as shown in Table 418.02. Other filler metals may be used as approved by the Engineer.

Table 418.02

Filler Metal Requirements	
AWS Base Metal	Use Filler Metal
6061 welded to 6063	ER5356
6063 welded to 6063	ER5356
356.0 welded to 6061	ER4043
356.0 welded to 6063	ER4043

(6) (i) Filler metals shall be kept covered and stored in a dry place at relatively uniform temperatures.

(ii) Original rod or wire containers shall not be opened until time to be used.

(iii) Rod and wire shall be free of moisture, lubricant, or other contaminants.

(iv) Spools of wire temporarily left unused on the welding machine shall be kept covered to avoid dirt and grease contamination.

(v) If a spool of wire is to be unused for more than a short length of time, it shall be returned to the carton and the carton tightly resealed.

(7) (i) Shielding gases shall be welding grade or better. Shielding gas for gas metal-arc welding shall be argon, helium, or a mixture of the two (approximately 75 percent helium and 25 percent argon).

(ii) Shielding gas for gas tungsten-arc welding done with alternating current shall be argon.

(iii) Shielding gas for gas tungsten-arc welding done with direct current, straight polarity, shall be helium.

(iv) Hose used for shielding gases shall be made of synthetic rubber or plastic.

(v) Natural rubber hose shall not be used. Hose which has been previously used for acetylene or other gases shall not be used.

b. (1) (i) Joint details shall be in accordance with design requirements and detail drawings.

(ii) The location of joints shall not be changed without the approval of the Engineer.

(iii) Edge preparation shall be by sawing, machining, clipping, or shearing. Gas tungsten-arc or gas metal-arc cutting may also be used.

(iv) Cut surfaces shall meet the American Standards Association surface roughness rating value of 1,000.

(v) Oxygen fins, tears, and other defects which would adversely affect the quality of the weld will not be allowed.

(vi) Dirt, grease, lubricants, or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing.

(vii) On all edges and surfaces to be welded, the oxide shall be removed just before welding by wire brushing or by other mechanical methods such as rubbing with steel wool or abrasive cloth scraping, filing, rotary planing, or sanding. If a wire brush is used, the brush shall be made of stainless steel.

(2) Hand or power driven wire brushes which have been used on other materials shall not be used on aluminum.

(3) (i) Where mechanical methods of oxide removal are found to be inadequate, a standard chemical method shall be used.

(ii) Chemical removal of aluminum oxide shall be accomplished by one of the chemical treatments recommended in the AWS or the Aluminum Association *Welding Aluminum* pamphlet.

(iii) Welding shall be done within 24 hours after chemical treatment.

(iv) When gas tungsten-arc welding with direct current, straight polarity, is being used, all edges and surfaces to be welded shall have the oxide removed by a standard chemical method.

(v) Welding shall not be done on anodically treated aluminum unless the condition is removed from the joint area to be welded.

(4) (i) All butt welds requiring 100 percent penetration, except those produced with the aid of backing, shall have the root of the initial weld chipped or machined out to sound metal before welding is started from the second side.

(ii) Butt welds made with the use of backing shall have the weld metal thoroughly fused with the backing.

(iii) Where accessible, backing for welds that are subject to computed stress or which are exposed to view on the completed structure and which are not otherwise parts of the structure shall be removed and the joints ground or machined smooth.

(iv) In tubular members, butt welds subjected to computed stresses shall be made with the aid of permanent backing rings or strips.

(5) The procedure used for production welding of any particular joint shall be the same as that used in the procedure qualification for that joint.

(6) Undercut shall not be more than 0.01 inch deep when its direction is transverse to the primary stress in the part that is undercut. Undercut shall not be more than 1/32 inch deep when its direction is parallel to the primary stress in the part that is undercut.

(7) No overlap shall be allowed.

(8) All craters shall be filled to the full cross section of the welds.

(9) Welds having defects greater than the levels of acceptance specified above shall be considered as rejected unless corrected as indicated below.

(10) All welding operations, either shop or field, shall be protected from air currents or drafts to prevent any loss of gas shielding during welding. Adequate gas shielding shall be provided to protect the molten metal during solidification.

(11) The work shall be positioned for flat position welding whenever practicable.

(12) In both the shop and field, all weld joints shall be dry at the time of welding.

(13) The size of the electrode, voltage, amperage, welding speed, gas or gas mixture, and gas flow rate shall be suitable for the thickness of the material, design of joint, welding position, and other circumstances attending the work.

(14) Gas metal-arc welding shall be done with direct current, reverse polarity.

(15) Gas tungsten-arc welding shall be done with alternating current or with direct current, straight polarity.

(16) (i) When the joint to be welded requires specific root penetration, the Contractor shall make a sample joint and a macroetched cross section of the weld to demonstrate that the joint welding procedure used will attain the required root penetration.

(ii) The sample joint shall have a length of at least 1 foot and shall be welded with the electrode, polarity, amperage, voltage, speed, gas mixture, and gas flow rate that are proposed to be used in production welding.

(iii) Tolerance for variation of amperage and voltage shall be plus or minus 10 percent for amperage and plus or minus 7 percent for voltage during fabrication.

(iv) The Engineer, at his/her discretion, may accept evidence on record in lieu of the preceding test.

(17) Where preheating is needed, the preheating temperature shall not exceed 350°F for heat-treated alloys and 600°F for non-heat-treated alloys. The temperature shall be measured by temperature indicating crayons or by pyrometric equipment. Heat treated alloys shall not be held at the maximum preheat temperature or at temperatures near the maximum for more than 30 minutes.

c. Weld Quality:

(1) Regardless of the method of inspection, the acceptance or rejection of welds shall be determined by the following conditions:

(i) Cracks in welds or adjacent base metal are not acceptable.

(ii) Copper inclusion is not acceptable.

(iii) Porosity in excess of that allowed by Appendix IV, Section VIII of the ASME Boiler and Pressure Vessel Code will not be acceptable.

(iv) Lack of fusion, incomplete penetration, or tungsten or oxide inclusions are acceptable only if small and well dispersed.

(2) For highway sign structures, the dye penetrant method shall be used on butt welds in columns, main chord members, and on fillet welds connecting columns to bases and main chord members, including the associated flanges, gussets, or main load carrying brackets or members. This method shall also be used on fillet welds connecting flanges to the main truss chord members.

(3) The dye penetrant tests shall be performed in accordance with the requirements of ASTM E 165, Standard Methods for Liquid Penetrant Inspection, Method B.

(4) Dye penetrant inspection may be omitted if the Inspector examines each layer of weld metal with a magnifier (3X power minimum) before the next successive layer is deposited.

(5) Dye penetrant inspection will be required and performed at the Contractor's expense. Personnel performing liquid penetrant inspections shall be qualified as required in AWS. In all cases where the dye penetrant method is done by the Contractor, the inspector must be present when the inspection is made.

d. (1) The Contractor may make the corrections shown in Table 418.03 when a weld is defective. These corrective measures shall be approved by the Engineer before work begins.

Table 418.03

Welding Defects	
<u>Problem</u>	<u>Corrective Action</u>
Defective weld Cracks in weld or base metal	Remove and replace the entire weld. Determine full extent of crack by dye penetrant method or other positive means. Remove crack throughout its length and depth and reweld.
Excessive porosity, lack of fusion Copper or tungsten inclusion	Remove defective portions and reweld. Remove defective portions and reweld.
Excessive concavity of crater, undercut, undersize weld	Clean and deposit additional weld metal.
Overlap	Reduce by removal of excess weld metal.

(2) The Contractor shall remove the defective areas by chipping or machining. Oxygen cutting shall not be used. Before rewelding, the joint shall be inspected to assure that all of the defective weld has been removed. If dye penetrant has been used to inspect the weld, all traces of penetrant solutions shall be removed with solvent, water, heat, or other suitable means before rewelding.

e. Qualification of Procedures, Welders, and Welding Operators:

(1) Joint welding procedures which are to be employed in executing contract work under these *Specifications* shall be previously qualified by tests prescribed in Part B, Section IV, of the ASME Boiler and Pressure Vessel Code. The qualifications shall be at no additional cost to the Department. The Engineer, at his/her discretion, may accept evidence of previous qualifications of the joint welding procedures to be employed.

(2) All welders and welding operators to be employed under these *Specifications* shall be previously qualified by tests as prescribed in Part V, Section IX, of the ASME Boiler and Pressure Vessel Code. The Engineer, at his/her discretion, may accept evidence of previous qualification of the welders and welding operators to be employed. The same process and type of equipment that is required for execution of the construction work shall be used in qualifying welders and welding operators.

f. Steel welding shall be in accordance with Section 708.

4. Inspection of Single Panel or Box Truss Sign Structures:

a. The Contractor shall inspect single panel and box trusses in accordance with Section 708. All mill test reports and certifications shall be furnished to the Engineer before any requests for shop inspection are made.

b. To determine compliance with these welding procedures, all welds shall be visually inspected and a random sample of welds shall be chosen by the inspector to be investigated using dye penetrants.

5. Fastening to Supports:

a. In fastening a sign to the supports, the Contractor shall follow the recommendations of the manufacturer of the extrusheet panels as to frequency of post clamps and torque on nuts.

b. The Contractor shall exercise care in handling and erecting signs so damage is prevented. The Contractor shall replace at no additional cost to the Department any sign which is damaged before final project acceptance.

6. Field Installation of Sign Structures:

a. The Contractor shall dress, as necessary to provide a proper seating of the bases, the areas of the foundation concrete upon which the shafts are to be set before the erection of the aluminum vertical end supports. The bottoms of the supporting shafts and all anchor bolts shall receive a heavy coating of aluminum filled, resilient sealing compound, completely covering all areas of aluminum which may contact the concrete. The compound used shall be on the NDR Approved Products List.

b. The Contractor shall assemble the truss sections in the field on the ground and adjust them with shims to provide the camber called for in the plans. While assembled, the truss shall be erected on the end frames in one piece.

c. The end supports shall not be erected more than 24 hours in advance of the truss erection. The end supports shall be erected on the leveling nuts to a truly vertical position and then the top nuts securely tightened to the plate, allowing for 1 1/2 inches of grout under the base plate. The grout shall not be placed until the truss has been erected, adjusted, and bolted to final position.

d. After the structure has been erected and completed and all signs mounted, the area between the top of the foundation and the bottom of the anchor base plates of the vertical end supports shall be filled with a non-shrinking grout by the Contractor as shown in the plans. The grout shall be rodded into place so that all the voids are completely filled. The grouting material shall be a mixture of cement, sand, and a non-shrinking, non-ferrous additive.

7. Overhead Sign Electrical Requirements:

a. Signs requiring electrical luminaires will be identified in the plans.

b. The luminaires shall be on the NDR Approved Products List.

c. The sign lighting luminaires shall be mounted as shown in the plans and in accordance with the manufacturer's instructions.

d. The lamps shall be 150 watt high pressure sodium unless shown otherwise in the plans.

e. All conductors shall be copper and shall be installed in conduit. The feeder cable shall be a minimum No. 8 gauge diameter THWN with a 30 ampere circuit breaker at the service entrance. Each sign structure shall be controlled by a 15 ampere 2 pole NEMA 3R breaker at a location convenient for maintenance of the luminaires.

f. Each sign structure shall have a photoelectric control mounted near the sign. The relays for switching the line current to the lighting fixtures shall be mounted near the circuit breaker or as directed by the Engineer. Separate photocells are not required when sign lighting is tied into the roadway lighting.

g. Structure electrical equipment and material, when required, shall be in accordance with the applicable requirements of Section 1073.

8. a. The Contractor shall provide manufacturer-designed steel or aluminum box-truss overhead sign supports or steel brackets attached to a roadway bridge for Type B signs.

b. The structures that will support the Type B signs shall be constructed in conformance with Sections 417, 702, 704, 707, and 708 and as prescribed in the plans.

9. When two or more signs are required on an overhead sign support, the bottom of all signs shall have the same elevation so they will be horizontally aligned with each other. All signs shall be hung at a minimum of 2 feet above the walkway. Sign posts and vertical supports used as sign stiffeners shall be cut off flush with the top of the sign.

10. a. Anchor bolt assemblies for cantilever sign supports shall be designed and furnished by the pole manufacturer in accordance with ASTM A 687. They shall be hot dip galvanized in accordance with ASTM A 153.

b. The nuts shall meet the requirements of ASTM A 194/A 194M, Grade 2H.

c. The hardened steel washers shall conform to the requirements of ASTM F 436/F 436M. The plate washers shall conform to the requirements of ASTM A 36/A 36M.

d. The manufacturer of the anchor bolts shall furnish certification and test reports covering the steel used. The test report shall show the following:

- (1) Chemical analysis of the steel used.
- (2) Yield strength in pounds per square inch.
- (3) Tensile strength in pounds per square inch.
- (4) Percent elongation in 2 inches.
- (5) Percent reduction in area.
- (6) Charpy V-notch impact results.

418.04 -- Method of Measurement

Overhead Sign Supports are measured by the each.

418.05 -- Basis of Payment

<u>1. Pay Item</u>	<u>Pay Unit</u>
Overhead Sign Support, Location _____	Each (ea)

2. The reinforced concrete footing and anchor bolts required for the overhead sign support shall not be paid for directly, but shall be subsidiary to the item, "Overhead Sign Support, Location _____".

3. The anchor bolt assemblies shall not be paid for directly, but shall be subsidiary to "Overhead Sign Support, Location _____".

4. Payment is full compensation for all work prescribed in this Section.