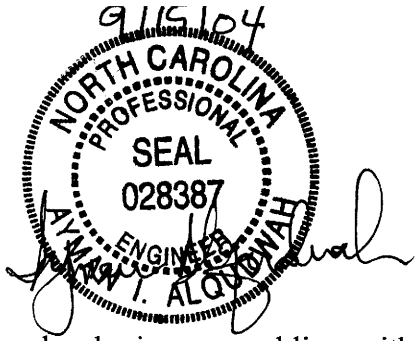

OVERHEAD SIGN ASSEMBLIES

Design, fabricate, furnish and erect various types of overhead sign assemblies with maintenance walkways, when specified in the plans and attach Type A and Type B signs to the structure in accordance with the requirements of the plans.

Fabricate supporting structures from tubular members of either aluminum or steel. Only one type of material may be used throughout the project.

Among the types of overhead sign assemblies included in this specification are: span structures, cantilever structures, and sign structures attached to bridges.

Design overhead sign assemblies to including footings and submit shop drawings for approval.

The provisions of Section 900 and Section 901 will be applicable to all work covered by this provision.

CONSTRUCTION METHODS

(A) General

Fabricate overhead sign assemblies in accordance with the details shown in the approved shop drawings and the requirements of these specifications.

Fabricate sign panels for overhead sign assemblies in accordance with the requirements for type A and type B signs, as indicated in the plans, unless otherwise approved by the Engineer.

No welding, cutting, or drilling in any manner will be permitted in the field, unless approved by the Engineer.

Drill bolt holes and slot to finished size or they may be punched to finished size, provided the diameter of the punched holes is at least twice the thickness of the metal being punched. Flame cutting of bolt holes and slots will not be permitted.

Use two coats of a zinc-rich paint to touch minor scars on all galvanized materials.

(B) Location and Field Verification

The support lengths and dimensions for the overhead sign assemblies shown in the original plans are estimated for project bid purposes.

The Engineer, unless Contractor is required to complete all project survey in accordance with Section 801, will establish the proper offset, longitudinal location, footing elevation and S dimension for each overhead sign assembly. The Engineer will furnish field-verified S dimensions and slope verification at the supports to the Signing Section for a revision of the Structure Line drawings. If Contractor Surveying is required on project in accordance with Section 801, Contractor completes field verification of s-drops and slopes and submits to Engineer. The Engineer is responsible to confirm that these verifications are completed

accurately and in correct format and submits to the Signing Section for a revision to the structure line drawings.

Prepare shop drawings for overhead sign assembly when the revised dimensions and slope verifications have been determined and the appropriate plan revision is completed.

Provide the proper vertical plumb, level, and orientation of all signs and supports.

(C) Shop Drawings

Design the overhead sign supports, including footings prior to fabrication. Submit computations and shop drawings for the designs to the Engineer for acceptance.

Have a professional engineer registered in the State of North Carolina perform the computations and render a set of sealed, signed, and dated drawings detailing the construction of each structure.

Submit to the Engineer for approval complete design and fabrication details for each overhead sign assembly, including footings and brackets for supporting the signs, maintenance walkways, when specified in the plans, electrical control boxes, and lighting luminaires. Base design upon the revised structure line drawings, wind load area and the wind speed shown in the plans, and in accordance with the "Standard Specifications for Structural Structures for Highway Signs, Luminaires and Traffic Signals".

Submit thirteen copies of completely detailed shop drawings and one copy of the design computations for each overhead sign assembly to the Engineer for approval prior to fabrication. Shop drawings includes complete design and fabrication details, including foundations, provisions for attaching signs, maintenance walkways, when applicable, and lighting luminaires to supporting structures, applicable material specifications, and any other information necessary for procuring and replacing any part of the complete overhead sign assembly.

Allow at least 40 days for shop drawing approval after the Engineer receives them. If revised drawings are required, additional time will be required for review and approval of final shop drawings.

Approval of shop drawings by the Engineer will not relieve responsibility for the correctness of the drawings, or for the fit of all shop and field connections and anchors.

(D) Design and Fabrication

The following criteria governs the design of overhead sign assemblies:

Design shall be in accordance with the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 4th Edition, 2001.

Within this Specification, there are several design criteria that are owner specified. They include:

- The wind pressure map that is developed from the 3-second gust speeds, as provided in Article 3.8, shall be used.

- Overhead cantilever sign structures shall include galloping loads, truck-induced gust loading and natural wind gust loading in the fatigue design, as provided for in Article 11.7.1, 11.7.4 and 11.7.3 respectively.

- The natural wind gust speed in North Carolina shall be assumed to be 5 meters per second or 11.6 mph for inland areas, and 7 meters per second or 15.7 mph for coastal areas. The coastal area shall be defined as any area within 2 miles from the waterfront facing the ocean or sound and all area where the design basic wind speed is above 120 mph, as shown in Figure 3-2.

- The fatigue importance category used in the design, for each type of structure, as provided for in Article 11.6, Fatigue Importance Factors, shall be Category II unless otherwise shown on the contract plans.

The following Specification interpretations or criteria shall be used in the design of overhead sign assemblies:

For design of supporting upright posts or columns, the effective length factor for columns "K", as provided for in Appendix B, Section B.5, shall be taken as the following, unless otherwise approved by the Engineer:

Case 1 For a single upright post of cantilever or span type overhead sign structure, the effective column length factor, "K", shall be taken as 2.0.

Case 2 For twin post truss-type upright post with the post connected to one chord of a horizontal truss, the effective column length factor for that column shall be taken as 2.0.

Case 3 For twin post truss-type upright post with the post connected to two truss chords of a horizontal tri-chord or box truss, the effective column length factor for that column shall be taken as 1.65.
The base plate thickness for all uprights and poles shall be no less than that determined by the following criteria and design.

- Case 1 Circular or rectangular solid base plate with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/5 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt shall be $M = (P \times D_1) / 2$
where P = anchoring force of each anchor bolt

D_1 = horizontal distance between the center of the anchor bolt and the outer face of the upright, or the difference between the radius of the bolt circle and the outside radius of the upright
M = bending moment at the critical section of the base plate induced by one anchor bolt
The critical section shall be located at the face of the anchor bolt and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections shall be considered ineffective.

- Case 2 Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/5 of the upright diameter

The magnitude of bending moment induced by the anchoring force of each anchor bolt shall be $M = P \times D_2$
where P = anchoring force of each anchor bolt
D_2 = horizontal distance between the face of the upright and the face of the anchor bolt nut
The critical section shall be located at the face of the anchor bolt top nut and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections shall be considered ineffective.

The thickness of base plate of Case 2 shall not be less than that calculated based on formula for Case 1.

Uprights, footings and trusses that support overhead signs, digital message signs, or changeable message signs shall be designed for the effects of torsion. Torsion shall be considered from dead load eccentricity of these attachments, as well as for attachments such as walkways, supporting brackets, lights, etc., that add to the torsion in the assembly. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

Uprights, footings and trusses that support overhead mounted signs, digital message signs, or changeable message signs shall be designed for the proposed sign wind area and future wind areas. The design shall consider the torsion induced by the eccentric force location of the center of wind force above (or below) the center of the supporting truss. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

Fabricate all overhead sign assemblies, including footings in accordance with the details shown in the approved shop drawings and with the requirements of these specifications.

Fabricate the span and cantilever supporting structures using tubular members of either aluminum or steel, using only one type of material throughout the project. Sign support structures that are to be attached to bridges may be fabricated using other structural shapes.

Horizontal components of the supporting structures for overhead signs may be of a truss design or a design using singular horizontal members to support the sign panels. Provide permanent camber in addition to dead load camber in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Indicate on the shop drawings the amount of camber provided and the method employed in the fabrication of the support to obtain the camber.

Use cantilever sign structures that meet the following design criteria:

1. Do not exceed an L/150 vertical dead load deflection at the end of the arm due to distortions in the arm and vertical support, where L is the length of the arm from the center of the vertical support to the outer edge of the sign.

2. Do not exceed an L/40 horizontal deflection at the end of the arm due to distortions in the arm and vertical support, as a result of design wind load.

Attach the overhead sign assemblies to concrete foundations by the use of galvanized anchor bolts with galvanized nuts, flat washers, and lock washers. For cantilever structure use a minimum of eight anchor bolts. Provide anchor bolts that have an anchor plate with nut at the end to be embedded in concrete.

Fabricate attachment assemblies for mounting signs in a manner that allows easy removal of sign panels for repair.

Provided adequate supporting frames for mounting the lighting luminaires in the positions shown in the plans or approved shop drawings for all overhead sign assemblies to be illuminated.

(E) Maintenance Walkways

When plans require maintenance walkways, provide maintenance walkways with an open, skid-resistant surface, and safety railings on all overhead structures unless specifically stated otherwise in the plans. Requirements for design and fabrication of the walkways are shown in the plans. Provide a walkway that is continuous and extends from 3 feet (1m) outside the edge of pavement over the shoulder to the farthest edge of any sign on the structure. If a sign is to be located such that it extends more than three feet outside the edge of pavement, extend the walkway for the full length of that sign. Provide walkways with a safety railing along the front side that can be folded, when not in use, to a horizontal position that will not obscure the signs.

To accommodate lighting luminaires, (when required by the plans), extend supports for the walkways in front of the walkway and railing. If external ballast is required, make provisions adjacent to the walkway and between the walkway and sign to accommodate ballast boxes for lighting circuits in a manner readily accessible from the walkway. Provide ballast box, brackets, and fastening devices which will withstand the loading requirements for the walkway, and mount so that the top of the box will be flush with the top of the walkway.

The walkway sections are to be connected rigidly where sections join to avoid an uneven walking surface. Attach the walkway directly to the walkway brackets.

Install a 4-inch x 4-inch (100mm x 100mm) safety angle in back of and parallel to the walkway and extend it the entire length of the walkway, except in the area occupied by ballast boxes. Design the safety angle to withstand a loading in keeping with the walkway.

Fabricate folding safety railing in lengths not exceeding 10 feet (3m) and install for the full length of the walkway. Join each folding safety railing post to walkway supports through a hinge support of appropriate design that will rotate freely. Provide a hinge support that has a locking or latching device and holds the railing in a steady manner, free of movement while in the raised position. Maximum allowable displacement from vertical at the top of the railing will be 1 inch (25mm).

Install fixed safety railing along the sign side of the walkway from the beginning of the walkway to the edge of the first sign. Provide fixed safety rails between signs when they are greater than 12 inches (304.8m) apart. Provide one fixed safety rail below any sign having a clearance between the bottom of the sign and the walkway grating of greater than 24 inches (609.6m) and less than 42 inches (1066.8m). Provide two fixed rails when the clearance between the bottom of a sign and the walkway exceeds 42 inches (1066.8m).

Provide a walkway in which the open ends have a galvanized steel coil safety chain attached on one end near the top of the safety railing, and on the other end to the walkway hanger, or other fixed member of the structure. When the railing is folded, the chain must not hang below the walkway bracket.

Where offsets in the walkway and safety railing are necessitated by variable luminaires offsets, provide safety chains between the offset handrail sections.

(F) Footings

Anchor Bolts

Materials used in steel anchor bolts shall conform to AASHTO (M 314), and have a design yield strength not to exceed 55, 000psi.

Design footings for the combined effects of dead and wind loads and may be either spread type or pole type. Design spread footings for a maximum soil bearing of 3 ksf (145 kilopascal), unless otherwise allowed by the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". If, in the judgment of the Engineer, the soil in a given footing excavation is not adequate for 3 ksf (145 kilopascal) bearing pressure, or any other bearing pressure noted on approved footing drawings, changes to the footing design may be required to meet actual soil conditions at no cost to the Department.

Perform all excavation and backfill necessary for footing construction to the elevations and dimensions shown in the revised plans or as directed by the Engineer.

Thoroughly compact all backfill in 6 in (152.4mm) layers. Remove all excavated material that is not needed from the site.

Construct footing excavations for overhead sign assemblies which conform to the applicable provisions of Section 410. Make sure that the sides of the excavation for pole-type footings

conform as nearly as practicable to the required dimensions. Place concrete for pole-type footings against undisturbed soil. If, in the judgement of the Engineer, significant discontinuities in the required configuration of the excavation for pole-type footings are created by the removal of boulders, or as a result of other causes, backfill the excavation and compacted as provided for in Section 410. Re-excavate the footings to the proper dimensions. Obtain approval prior to the use of shoring, if shoring is necessary to stabilize the sides of excavation for pole-type foundations.

Construct footings for overhead sign assemblies in accordance with Section 825. Construct all footings of Class A concrete. Where rectangular forms are used, use forms that have a chamfer strip at all corners for at least that distance protruding above ground level. Use chamfers which measure one inch along the diagonal face. Securely brace anchor bolts positioned in the form, and hold in proper position and alignment. Provide a rubbed finish on concrete surfaces to be exposed above finished ground in accordance with Subarticle 825-6(D). Do not erect overhead sign assemblies on footings until the concrete has reached a minimum compressive strength of 3,000 psi (20.7 Megapascal). Determine concrete compressive strength by nondestructive test methods, or by compressive strength tests made in accordance with AASHTO T22 and T23. Furnish equipment used for nondestructive tests and obtain Engineer approval.

Fill the space between the top of the footing and the bottom of the base plate and neatly finish with a non-shrinking and non-metallic grout approved by the Engineer.

COMPENSATION

The work covered by this section will be paid for at the contract lump sum for each Overhead Sign Assembly "_____". Such price will be full compensation for all work covered by this specification includes all design, fabrication, construction, transportation, and erection of the complete overhead sign structure, supporting structure, hardware, lighting support brackets, and footings; preparing and furnishing shop drawings; and attaching the signs to the overhead sign structure.

Payment will be made under:
Overhead Sign Assembly at Sta. "_____" .....Lump Sum