Section 1
Overhead Sign Structure Types

A variety of overhead sign structures have been designed and can be called out for use in a construction contract. The majority of the overhead sign structures fit into one of five categories:

- Truss
- Tubular
- Box Beam Closed Truss
- Bridge Mounted
- Lightweight

The Standard Plans provide specific sheets detailing the structural components and connections of each type of overhead sign structure. The project plans may also contain sheets that supplement or override details in the Standard Plans, as applicable to each contract.

On occasion, a non-standard overhead sign structure is specified in a contract that does not fit into any of the five categories previously mentioned above. The non-standard sign structures are designed to accommodate certain site conditions or aesthetic concerns. Refer to Photo 1.1. The Standard Plans may be referenced for portions of the structural details of non-standard overhead sign structures, but the project plans will contain the majority of details for the fabrication of the structures.
1-1 Truss Overhead Sign Structures

The truss is the most common overhead sign structure in use and the most complicated type. The structure is detailed on sheets S1 through S13 of the Standard Plans. The truss, which can be designated as a one-post type or a two-post type, is composed of multiple steel members welded together. Refer to Figures 1-1.1 through 1-1.3. Each truss has four chord angles that act as the overall frame of the truss. These members contribute to the overall bending resistance in the truss by providing tension-compression couples.

Welded to the truss are vertical and diagonal angles. These members act together to transfer vertical loads and shear throughout the truss. Vertical angles tend to be in compression while diagonal angles tend to be in tension. However, due to the layout of these members as well as the lateral loads applied to them, it is not uncommon for vertical angles to be in tension or diagonal angles to be in compression.

Attached to the top and bottom chord angles of the truss are horizontally oriented angles called wind bracing. Refer to Photo 1-1.4. Typical wind bracing runs at an angle away from the chord angle and helps transfer horizontal loads and shear throughout the truss. Additionally, both the one-post and two-post type sign structures have components of wind bracing that run normal to the chord angles. A
two-post truss type is detailed with these normal members, referred to as struts, between each wind brace and at the end of any cantilevered section of the truss. For a one-post type truss, these members are called end ties and are located at the ends of the truss and adjacent to the post.

Connected to each pair of vertical and diagonal angles (a pair being comprised of a front and back angle both lying on a plane normal to the axis of the truss) is a horizontal angle referred to as a cross tie. In addition to these cross ties, two more angles called internal diagonals...
are welded to each pair of vertical angles. Refer to Photo 1-1.5. Although orientation of the internal diagonals varies by contract, they typically are oriented at an angle running from the back of the truss down to the front of the truss. These members assist in transferring the forces between the front and back of the truss as well as the top and the bottom of the truss.

The truss for a one-post truss and a two-post truss are connected to the post at two locations, but the specific connection is different for these two types. For a one-post truss, just below the location where the lower chord assembly of the truss will be supported, a flat plate (post plate) is welded normal to the post with gusset plates being welded to both the flat plate and the post. Another plate (lower juncture plate) welded to the lower chord angles of the truss, is then bolted to the post plate. This connection, referred to as the lower juncture connection, is the primary location of vertical force transfer from the truss to the post. For a two-post truss, the primary location of vertical force transfer occurs at the end of the posts near the top of the truss. At this location, a plate running normal to the truss is welded to the trusses upper chord angles. A collar fabricated for a slip fit connection to the post is welded to this plate. During field installation, this collar plate is placed around the post to
Figure 1-1.1  Truss nomenclature for one and two post trusses
Section 1 - Overhead Sign Structure Types

Figure 1-1.2  One-Post Truss nomenclature
Wind bracing (strut)
Diagonal wind bracing
Lower chord wind bracing alternates from upper chord wind bracing

Upper chord connection to post
Lower chord connection to post
Crossties

Plan
Elevation

January 2003
DIVISION OF ENGINEERING SERVICES
Section 1 - Overhead Sign Structure Types

Figure 1-1.4  Walkway nomenclature

Walkway grating
Light fixture
Safety angle
Lower chord
Hinge
Walkway bracket
Fixture mounting channels
Safety railing
Walkway grating
Light fixture
Safety angle
Hinge
Walkway bracket
Fixture mounting channels
Safety railing
Walkway grating
Light fixture
Safety angle
Hinge
Walkway bracket
Fixture mounting channels

January 2003
Overhead Sign Structures

constitute the upper chord connection to the post. Details for the upper juncture connection for a one-post truss are similar to those for the two-post truss except that the collar is larger, gusset plates are welded to the collar, and the collar is bolted to the post. The lower chord connection to post for a two-post truss consists of two angles and two plates bolted together. The two angles run normal to and are welded to the truss on both sides of the post. Two plates (clamp plates) are then bolted to these angles such that there is a firm connection between the clamp plates and the post after installation.

When a walkway or sign illumination is required, walkway brackets are bolted to the bottom of a truss superstructure. Four members are generally connected to these brackets: a safety angle, walkway grating, handrail, and channels to be used for installing light fixtures. Refer to Figure 1-1.4. All of these assemblies are typically bolted to the walkway brackets except for the handrail hinge, which is either bolted or welded at the option of the fabricator.

1-2 Lightweight Overhead Sign Structures

This manual discusses six of the most common types of lightweight overhead sign structures, which are detailed on Sheets S14A through S20B of the Standard Plans. Refer to Photos 1-2.1 through 1-2.7. The seventh type not covered in this manual is the balanced single steel post lightweight Overhead Sign Structure. Refer to Photo 1-2.8. Sheet ES-14C contains details for a lightweight sign structure to be used only when supporting an extinguishable message sign (EMS). Each of these structures requires less material than the truss structure described above and each type has its own limitations. The primary limitation for lightweight sign structures is that they are not designed with a walkway. For this reason, these signs should not be used over freeways. The ideal location for these types of struc-
Section 1 - Overhead Sign Structure Types

Signs are on municipality roads near freeway entrances. These locations should have adequate access for maintenance vehicles, equipment, and personnel.

The Type A lightweight overhead sign structure is the only two-post lightweight sign structure. A Type A-1 has a single cross beam and is limited to a span of 9.144 meters (30 feet) and a sign panel depth of 1778 mm (70 inches). For a larger sign panel or a span up to 21.336 meters (70 feet), a Type A-2 can be used, which has been designed with a trussed cross beam for additional stiffness. In addition to the above limitations, a Type A lightweight structure has not been designed for an ‘h’ value (the distance from the bottom of the base plate to the bottom of the sign panel for lightweight structures) in excess of 6.096 meters (20 feet). Refer to Figure 1-2.2.

Both the Type B and Type C lightweight sign structures can be designed for an ‘h’ value up to 7.620 meters (25 feet) but are only of the one-post type. The Type B structure is a butterfly design (sign panel extends on both sides of the post) while the Type C structure is a cantilever design. A Type B-1 structure has been designed with a single mast arm and is
Overhead Sign Structures

Photo 1-2.4 Lightweight Type B-1.

Photo 1-2.5 Lightweight Type B-2.

Photo 1-2.6 Lightweight Type C-1.

Photo 1-2.7 Lightweight Type C-2.
only meant for smaller depth sign panels. For taller depth sign panels, the double mast arm Type B-2 has been designed. A Type C-1 is a double mast arm structure that can hold a sign up to 2540 mm (100 inches) in height and 5.182 meters (17 feet) in length. The maximum cantilever length for a Type C-1 structure is 5.486 meters (18 feet). The Type C-2 overhead sign structure can hold a slightly larger sign panel than a Type C-1, but its primary benefit is that its trussed mast arm can cantilever up to 9.144 meters (30 feet). Refer to Figures 1-2.3 and 1-2.4. A summary of the lightweight overhead sign structure types and their limitations is shown in Figure 1-2.1.

<table>
<thead>
<tr>
<th>Lightweight Overhead Sign Structure Type and Description</th>
<th>Maximum Dimensions, meters (feet), unless noted otherwise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Span</td>
</tr>
<tr>
<td>Type A Two-Post</td>
<td>Type A-1</td>
</tr>
<tr>
<td></td>
<td>Type A-2</td>
</tr>
<tr>
<td>Type B One-Post Butterfly</td>
<td>Type B-1</td>
</tr>
<tr>
<td></td>
<td>Type B-2</td>
</tr>
<tr>
<td>Type C One-Post Cantilever</td>
<td>Type C-1</td>
</tr>
<tr>
<td></td>
<td>Type C-2</td>
</tr>
</tbody>
</table>

Figure 1-2.1 Lightweight overhead sign structure type and description.

Another primary difference between the Types A, B, and C lightweight sign structures is the connection of the arms to the post. The connection for a Type A lightweight structure has horizontal flat plates welded to both the arm and the post and then connected to the mast arm with a single bolt. The connection for both a Type B and C lightweight structure is a bolted connection using four bolts. These bolts are used to connect structural steel angles welded to the post to either structural steel angles or flat plates welded to the mast arm. The location of the angles welded to the post on a Type B lightweight overhead structure are in the front to allow the mast arm to butterfly while the location of the angles on a Type C structure are on the cantilevered side.
Figure 1-2.2 Typical maximum dimensions for Lightweight Type A.

NOTE:
1. Provide 5.5m min clearance to low point, either bottom of sign or bottom of light fixture mounting brackets.
Section 1 - Overhead Sign Structure Types

**SINGLE MAST ARM SERIES**

**TYPE B-1**

**DOUBLE MAST ARM SERIES**

**TYPE B-2**

**NOTE:**
1. Provide 5.5m min clearance to low point, either bottom of sign or bottom of light fixture mounting brackets.

*Figure 1-2.3 Typical maximum dimensions for Lightweight Type B*
NOTE:
1. Provide 5.5m min clearance to low point, either bottom of sign or bottom of light fixture mounting brackets.

Figure 1-2.4  Typical maximum dimensions for Lightweight Type C.
The specific location for a sign panel often determines which types of lightweight structures are appropriate for each contract. The Designer may specify certain signage (such as an arrow) to be placed on a sign panel over a specific location. This design may make certain lightweight sign structure types impossible to use due to their dimensional limitations. Wide shoulders, sidewalks, or bike lanes are other common items that inhibit the use of many of these lightweight structure types. Lightweight overhead sign structures are cost effective, but they are not intended for all signage purposes.

1-3 Box Beam Closed Truss Overhead Sign Structures

There are two different designs for the box beam overhead sign structure that may be encountered in the field. The newer closed truss design is detailed on Sheets S39 through S40M in the Standard Plans. The superstructure details for this structure are very similar to those for the truss structure described in Section 1-1, “Truss Overhead Sign Structures,” except that this structure has ribbed sheet metal bolted across the front and back end of the truss and cover plates on the ends. This combination of ribbed sheet metal and cover plates completely cover the entire superstructure except for the top and bottom of a box beam closed truss where its internal components are visible. The superstructure for the older version of the box beam sign structure is not similar to that of...
the truss overhead sign structure. In this design, the ribbed sheet metal is designed as a structural member instead of an aesthetic covering. Many maintenance and serviceability problems were encountered with this structure resulting in its design standards being replaced with the newer version described above.

The post for the box beam closed truss overhead sign structure in no way resembles that for the truss overhead sign structure described earlier. In this structure, the post consists of either flat or bent plates welded together into a cruciform shape or a shape with multiple closed cells. Refer to Figure 1-3.1. In a one-post box beam closed truss, the truss is connected to the post by a bolted connection. Depending on the post type, the connection for a two-post type can be detailed as a slip fit connection, bolted connection, or bearing connection.

Due to the complexity of this structure and its many components, this overhead sign structure is the most expensive to fabricate. Once installed, maintenance is difficult due to the many welds and the fact that the majority of the superstructure is enclosed with ribbed sheet metal and cover plates. Additionally, box beam closed trusses are typically used for its aesthetic appeal and tend to be painted. It is difficult to maintain the paint in good appearance and prevent rust on these structures. For these reasons, box beam closed truss overhead sign struc-
1-18

Section 1 - Overhead Sign Structure Types

1-4 Tubular Overhead Sign Structures

The tubular overhead sign structure consists of multiple segments of Extra Strong and Standard pipe sizes spliced together. Sheets S40N through S40U contain details for both a one-post and two-post type tubular sign structure. Posts for these structures can either be vertical or slanted at an angle off vertical. Each post, whether vertical or slanted, will have a radial bend at the top so that the mast arm is horizontal. Refer to Figures 1-4.1 and 1-4.2. Care needs to be taken by the Contractor such that the member is not damaged and material properties are not altered when forming this bend.1 Other than this radial bend, a tubular overhead sign structure is a fairly simple design with few members.

1 Standard Specifications Section 56-1.03 “Posts for tubular sign structures shall be formed to the radii shown on the plans...by methods which will not crip or buckle the interior radius of the pipe bend, and which will not change the physical characteristics of the material.”

Figure 1-3.1 Post cross sections for a box beam closed truss type structure as detailed in the 1999 Standard Plans.

Structures are only designed in very rare situations when requested by a specific district or agency. However, there are currently many box beam closed truss overhead sign structures in operation throughout the State (both the older design and the newer design) as they were more frequently used in the past.
NOTES

1. The maximum sign panel overlap onto the post elbow shall not exceed 1.83 m from the field splice.
2. When several sign panels are to be installed with a space between the panels, the space shall be as small as possible and 610 mm maximum.
3. All posts between base plate and field splice are extra strong pipe. All mast arms are standard pipe.

Figure 1-4.1 Diagram from Sheet S40P from the Standard Plans

Figure 1-4.2 Diagram from Sheet S40Q from the Standard Plans
1-5 Bridge Mounted Overhead Sign Structures

Various types of bridge mounted overhead sign structures have been designed for use when requested by the District Designer. Bridge mounted structures have their own design standard. Except for Standard Plan Sheets S9, S10, and S11 that contain some details for walkway brackets and safety cables that may be connected to a bridge mounted structure, none of these standards have been incorporated into the Standard Plans. Thus, the Designer is required to incorporate detail sheets into the project plans specifying the structural details for bridge mounted overhead sign structure.

There are two common methods used for attaching a sign structure to a bridge. If the bridge and barrier rail are already constructed, a new sign structure is commonly attached with a resin capsule type anchorage. If either the bridge or barrier rail is currently under construction, the Contractor can opt to use an alternative cast-in-place system. Bridge mounted overhead sign structures are typically attached to the barrier rail, edge of deck, exterior girder, and the soffit of the bridge.

Most bridge mounted sign structures are constructed using carbon steel structural tubing and/or structural steel angles. Steel angles are typically used as a vertical support for mounting the sign panel and attaching any walkway brackets. For sign structures parallel with the edge of deck, an additional steel angle is usually used as a compression member between the lower anchorage on the bridge and the mounting bracket. Refer to Photo 1-5.1. If the sign structure is skewed, a carbon steel structural tubing system is used. Refer to Photo 1-5.2.

Care needs to be taken when classifying a sign structure attached to a bridge or barrier rail as an overhead sign structure compared to a roadside sign. One such example is at a highway separation where one direction of travel is above another. Commonly, a small sign panel is detailed by the District Designer on a steel pipe attached to either the barrier rail or bridge superstructure. Refer to Photo 1-5.3.
Overhead Sign Structures

1 - 21

Photo 1-5.2 Carbon steel structural tubing behind a skewed bridge mounted sign structure.

Although this sign may be above the traveled way for the bottom highway, current practice is to not classify this as an overhead sign. The project plans should be used to determine which sign structures are overhead sign structures and which are roadside signs. This can be done by one of two methods. In the project plans, there are typically two separate quantity tables for overhead sign structures and roadside signs. Each sign can be looked up by its name or number in these two tables to determine its classification. Also, the project plans will include a section that shows the layout of each sign on a plan view of the site. Here, each sign is called out at its appropriate location. The name or number of each sign is typically encircled by a different shape for overhead sign structures and roadside signs. One method of calling out signs is to designate overhead sign structures by encircling its name/number with a triangle while the name/number for roadside signs are encircled by an oval. Refer to Figure 3-1.2.

Photo 1-5.3 A 'J-pole' sign structure mounted to the side of a bridge - typically not classified as an overhead sign.