Better Directions Allows Increased Traffic

Overhead Signage Helps To Guide Airport Travellers

By Ronald L. Younker, P.E. and Roy Nooreyazdan

As with many major airports, traffic congestion at Washington Dulles International is an increasingly serious problem. The airport currently serves more than 15 million passengers annually with more than 1000 scheduled flights a day. And recently, one of the major airlines serving the airport recently announced a major increase in scheduled flights to the airport, which will have a tremendous impact on the airport's infrastructure.

To minimize the impact on the roadways and parking facilities, several projects have been recently funded to provide roadway and parking improvements. One of these projects, the Saarinen Circle Improvement Project, will provide for the widening of inbound lanes by one lane on a portion of both the Dulles Airport Access Road and Saarinen Circle. To efficiently guide motorists to the terminal facilities, five new overhead sign structures will span up to six lanes of traffic and a median in the ultimate configuration.

The Metropolitan Washington Airports Authority oversees the implementation of all Dulles Airport improvement projects. For the Saarinen Circle Project, Burns & McDonnell in Kansas City, Missouri was selected as the Engineer of Record, and the construction contract was awarded to Facchina Construction Company. AISC-member LB Foster Company of Pittsburgh, PA fabricated the sign structures in their Ephrata, PA, plant in addition to serving as the detailer.

The project site lies within a State Historic Preservation District, and improvements within the district are subject to review and approval by the Virginia State Historic Preservation Office (VASHPO) for compliance with rules and procedures of the National Historic Preservation Act of 1966. In order to comply with these regulations, the sign structures had a custom design to provide clean, uncluttered lines and maintain site character within this historic district. Truss verticals and diagonals were located and spaced to minimize the number of truss elements exposed to incoming traffic.

Design

The project design standard came from the 1994 AASHTO Standard Specifications For Structural Supports For Highway

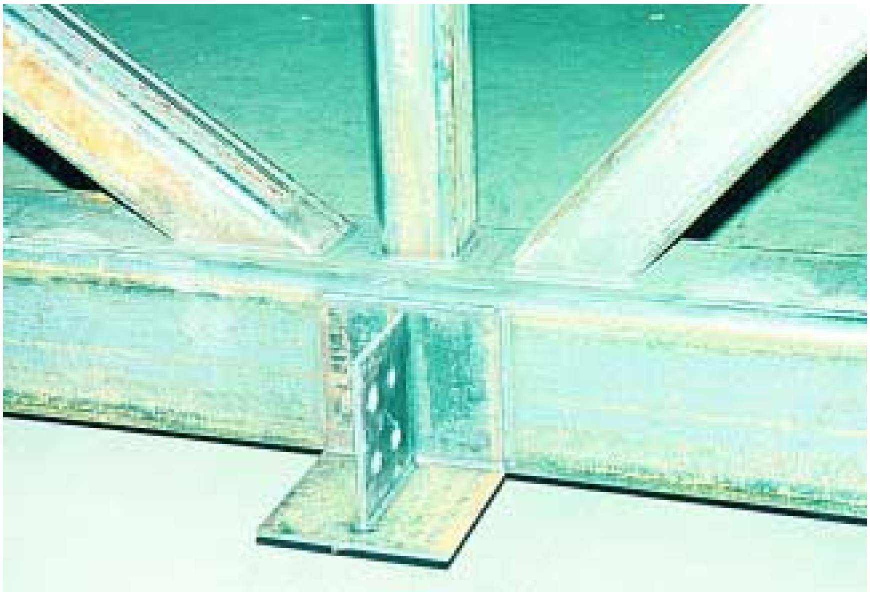
Signs, Luminaires, and Traffic Signals. Design wind loads were based on an 80-mile per hour basic wind speed with a 50-year recurrence interval. The sign structures, designed for wind loading across the full structure length, will accommodate future sign repositioning. Loads for a service walkway were not included since signage lighting will be maintained using roadway equipment. Live loads include a 3 lb. per sq. ft. ice load.

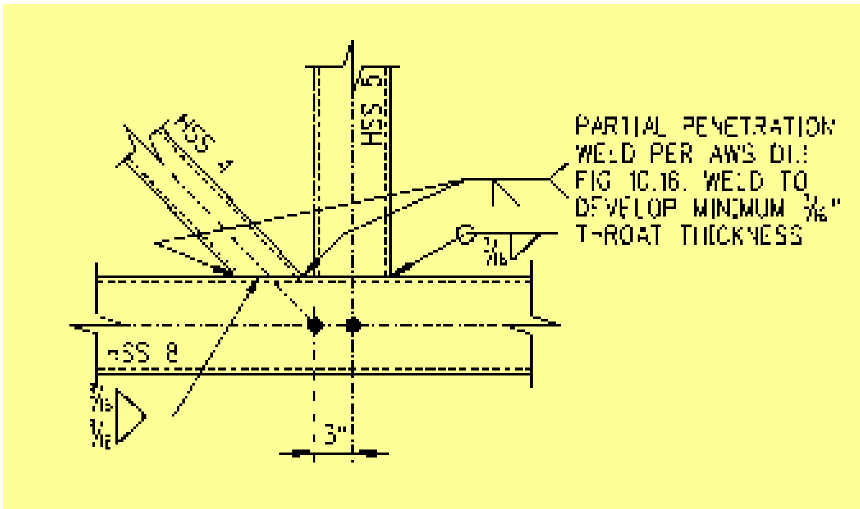
Structure clear spans measure 90', 103', 103', 82', and 54' for Signs 1 through 5 respectively. Truss pairs frame the structures that are 7'-0" deep spaced at 7'-0" on center. The supporting bents at each end are 7'-0" wide, with column heights that range from 16'-3" to 22'-4" from base plate to truss bottom chord. Signs 2 and 3 feature two middle truss panels without diagonals for partial Vierendeel truss action.

RISA-3D, is offered by RISA Technologies, analyzed the structures as a space frame. Anchor bolt patterns, due to their orientation, minimized the influence of partial base fixity, and columns were modeled with pinned bases for structure design. Due to wind loading, maximum lateral deflections were limited to height/135 parallel to signs and height/180 normal to signs. Because of nominal dead and live loads, very small vertical deflections occurred. As a result, none of the trusses were cambered.

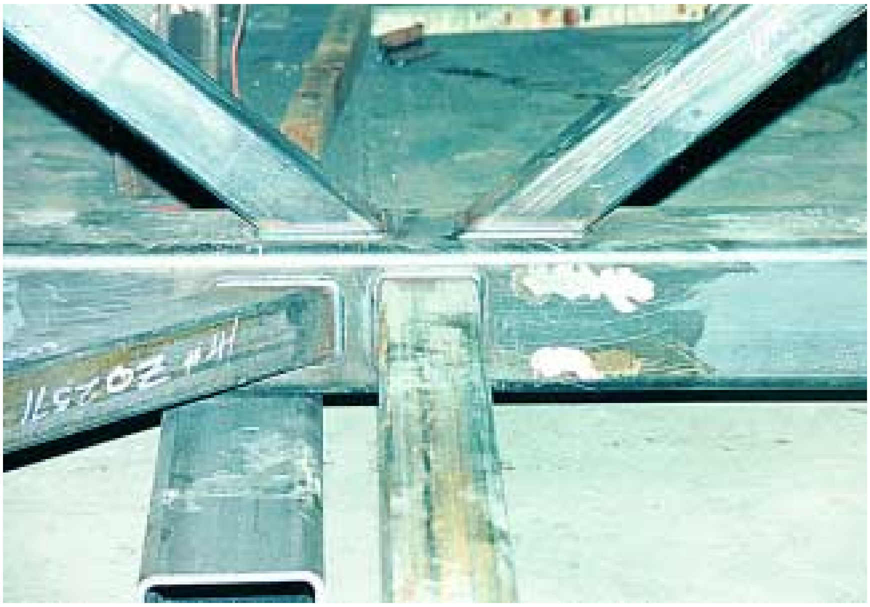
Structural tubing was selected for all truss and end bent framing members. Clean member lines and careful attention to connection detail produced the desired objectives in appearance and function. Minimum truss chord and diagonal sizes were selected for visual impact. Connection and joint design requirements mostly determined tube wall thicknesses.

All tubular shop connections are end butted welded joints designed in accordance with AWS D1.1-98.

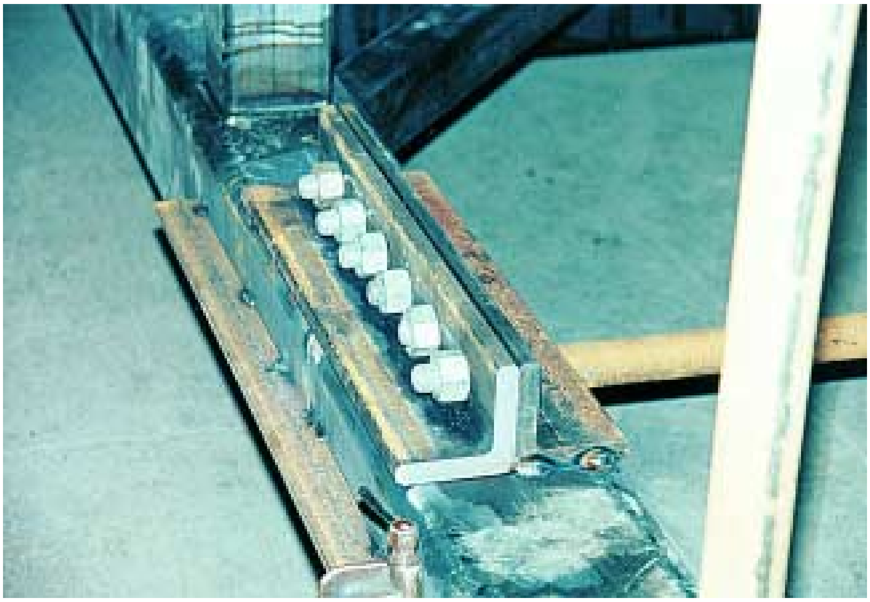




The new signage at the Dulles International Airport is designed for both function and aesthetics. For example, The bottom chord bolted end connections are hidden by a side plate so that the bottom chord will appear to match other butted joint details.



A high-level of craftsmanship was needed to meet the designer's aesthetic goals, which in turn required both careful fabrication and fit-up.



Trusses for the 82', 90' and 103' long spans were made in two sections, with a field splice in each of the four chords. After the tubing for the chord members were brought on-line, the splice locations were cleaned, bevelled and custom fitted with the backing material for the complete joint penetration welds (CJP) field welds. Alignment was achieved by using temporary "guide angles" for fit-up.

Structural tubing conforms to ASTM A500 Grade B with E70xx electrodes. Where possible, "stepped box" connection details were used. A proper setback between outside member faces allows the use of fillet welds on all exterior and 90 degree (member intersection) interior weld locations. Member sizes were selected to provide a setback large enough to place joint welds but small enough so as not to significantly reduce joint allowable punching shear stresses. Truss joints were detailed with small eccentricities at member intersections to provide space required for welder access. For connection economy, fillet welds were used whenever possible, such as at exterior and 90 degree (member intersection) interior weld locations. AWS prequalified partial joint penetration groove welds were used at heel and toe locations for diagonal to chord intersections. A complete penetration groove weld was required at only one joint detail; a highly stressed "matched box" joint detail at the strut to column connection in the end bents.

Contract drawings provide for an optional field splice in the trusses. Splices required complete penetration groove welds with nondestructive testing and inspection. The Fabricator elected to provide splices in the 82, 90 and 103' long signs. The design provides for the fully assembled trusses to be erected by placing on top of the erected end bents, and then field bolting the top and bottom chord end connections. A side plate hides the bottom chord bolted end connections so that the bottom chord will appear to match other butted joint details.

Shop Drawing Review

In order to meet project schedule, advance shop drawings were reviewed. Comments were communicated by phone and fax, with verbal approval as noted followed by the formal submittal process. Prior to the review, the Fabricator requested two changes to contract drawings. The first proposal increased some joint eccentricities at member intersections by an additional 1 ½ inches to provide required clearance for welder access. The second proposal revised the work point location for top and bottom chord end diagonals in the truss assemblies to simplify erection. Both proposals were reviewed for design impact and incorporated into final design.

Schedule/Shop Preparations

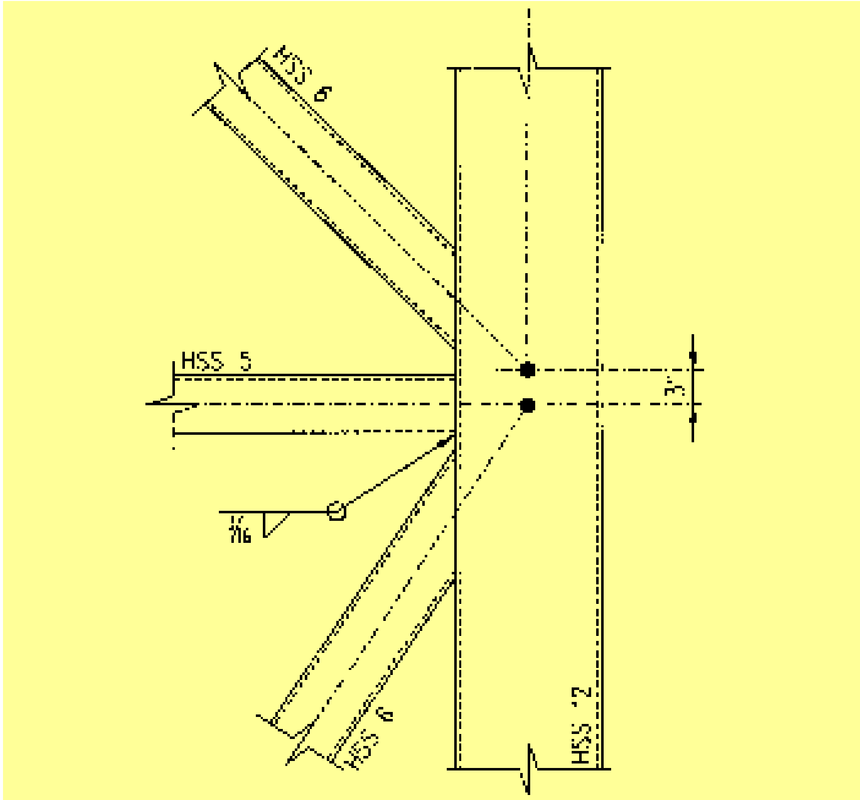
The purchase order for the trusses was issued to the Fabricator on March 30, 1999, with delivery of the first two trusses scheduled for May 10, 1999. An advance bill of materials was issued for the structural tubing order. With the Engineer's approval, truss diagonals and struts were cut to length, weld areas prepared for welding, and made ready for truss assembly while the shop drawings were being reviewed.

Immediately after verbal approval of the shop drawings, review comments were incorporated and shop fabrication started.

Fabrication

Trusses for the 82', 90' and 103' long spans were made in two sections, with a field splice in each of the four chords. After the tubing for the chord members were brought on-line, the splice locations were cleaned, bevelled and custom fitted with the backing material for the complete joint penetration welds (CJP) field welds. Alignment was achieved by using temporary "guide angles" for fit-up.

Top and bottom chord members were centered, and locations marked for each vertical and diagonal. Diagonals were checked for location, tacked in place, and then welded. The rear face of the truss was fabricated in the same manner. The front and rear trusses were lifted, and temporarily braced to form the 7'-0" by 7'-0" box section. Top and bottom chord bracing and sway braces were



positioned, tack welded, and then fully welded for a completed subassembly.

Fabrication of the end bents started with the attachment of the base plates. The two columns were then centered, and center to center dimensions checked at top and bottom. Procedures for bracing installation resembled those used for the trusses.

Fit-Up

The assembled end bents mated with the fully assembled truss sections connected with the temporary splices. Fit-up, bolt alignment, and control dimensions were checked and confirmed. Welding inspection occurred, and the bents and truss sections were disassembled for shipping to the paint shop in Pittsburgh, PA.

Painting

The coating system consisted of 3 shop-applied coats. Applications of a zinc rich primer, an intermediate coat of epoxy, and a finish coat of aliphatic urethane followed an SSPC SP-10 surface preparation. The paint met the requirements of a Class A coating for ASTM A325 bolting.

The first truss was unloaded and placed on the shop blast racks within an hour of delivery. Two men using manual blasters prepped the truss. After inspection and acceptance of the blasting, the truss was transported to the painting rack. The truss was primed with the inorganic primer and inspected. The intermediate coat was applied, cured and inspected, followed by application of the finish coat. Blasting and painting personnel worked around the clock, saving two days elapsed time on each truss.

Erection

Erection coordinated closely with fabrication, painting, and shipping schedules. The large jigs used during fabrication were made available and used for mating and assembly. The truss splices contained complete penetration welds, underwent an ultrasonic test, and had the coatings touched up. The signage panels and lighting fixtures were mounted, and the entire assembly traveled a short distance for installation over the roadways. The end bents were already in place when the truck delivered the trusses. Protective slings lifted the trusses, coaxed them into position, and bolted them. The truss installation took place during early morning hours with no delays to airport traffic.

Completion

The overhead sign support structures were designed, fabricated and erected in a short time period to meet an aggressive project schedule. Team efforts included accelerated agency approvals, shortened design and fabrication periods, and carefully scheduled erections plans. These cooperative efforts paid off as evidenced by the successful installation of the sign structures. The trim uncluttered lines of the structures will provide a nice "frame" of the terminal backdrop for incoming roadway traffic for years to come.

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