

## SECTION 13557

# VARIABLE MESSAGE SIGN

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Install all Department furnished items including VMS sign assembly, VMS cabinet, and controller.
- B. Furnish, install, and test VMS tubular support structures, VMS sign assembly, sign connection hardware, catwalk, cabinet foundation, communications cable and any additional equipment required. Contractor will furnish all incidental items required to provide a complete cable connection between VMS controllers as shown in the details and specifications. Test the installed VMS and adjust the viewing angle as required.

#### 1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02466: Drilled Caisson
- C. Section 02841: W-Beam Guardrail
- D. Section 02843: Crash Cushions
- E. Section 02844: Concrete Barrier
- F. Section 03055: Portland Cement Concrete
- G. Section 03152: Concrete Joint Control
- H. Section 03211: Reinforcing Steel and Welded Wire
- I. Section 03310: Structural Concrete
- J. Section 05120: Structural Steel
- K. Section 13551: General ATMS Requirements

- L. Section 13553: ATMS Conduit
- M. Section 13554: Polymer Concrete Junction Box
- N. Section 13555: ATMS Cabinet
- O. Section 13595: ATMS Integration

### **1.3 REFERENCES**

- A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- C. AASHTO M 232: Zinc (Hot-dip Galvanized) on Iron and Steel Hardware
- D. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges
- E. AASHTO M 284: Epoxy Coated Reinforcing Bar
- F. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- G. ASTM A 36: Carbon Structured Steel
- H. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- I. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- J. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware (nuts, washers, and anchor bolts)
- K. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- L. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- M. ASTM A 563: Carbon and Alloy Steel Nuts

- N. ASTM B 766: Cadmium Coatings on Iron, Steel, and Other Metals
- O. ASTM F 436: Hardened Steel Washers
- P. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs
- Q. ANSI/AASHTO/AWS D1.5: Welding Specifications

#### **1.4 SUBMITTALS**

- A. Mill Certificates for all structural steel. Refer to Section 05120.
- B. Shop Drawings for all structure steel. Refer to Section 05120.
- C. Provide all of the following submittals as described in Section 13551:
  - 1. Contractor Furnished Material and Equipment Lists
  - 2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, and the Thirty-Day Burn-In Test
  - 3. Completion Notice
  - 4. Compliance Certificate
  - 5. Manufacturer's Equipment Documentation
  - 6. As-Built Drawings

### **PART 2 PRODUCTS**

#### **2.1 VMS FOUNDATIONS**

- A. Concrete: Class AA(AE) required. Refer to Sections 03055 and 03310.
- B. Reinforcing Steel: Refer to Section 03211
  - 1. Deformed billet-steel bars conforming to AASHTO M 284 and M 31 (Grade 60) respectively.
  - 2. Coated
  - 3. Use #5 spiral reinforcing steel conforming to AASHTO M 31 except minimum tensile strength of 58,000 psi.
- C. Anchor Bolts:
  - 1. Conform to AASHTO M 270 Grade 36 and ASTM A 307 Specifications.
  - 2. Thread and galvanize the upper 12-inch: free running nuts, by hand, for the entire length of the threads.
  - 3. Galvanize the upper 14 inches of the anchor bolts, all nuts and washers, in accordance with the requirements of AASHTO M 232.
  - 4. Hook dimension of 8 inch as shown in Standard Plans.

5. Do not weld anchor bolts to reinforcing steel.
6. Nuts: Conform to ASTM A 563 Specifications.
7. Washers: Conform to ASTM F 436 Specifications.

## **2.2 BITUMINOUS JOINT FILLER**

- A. Prefomed material: Refer to Section 03152.

## **2.3 JUNCTION BOX**

- A. Refer to section 13554.

## **2.4 VMS SUPPORTS**

- A. Structural Steel: General
1. Hot dip galvanize all structural steel after fabrication in accordance with AASHTO M 111. Structural steel may be metallized using electric arc sprayed zinc wire as an alternative.
  2. Welding design and fabrication: In accordance with the ANSI/AASHTO/AWS D1.5 Specifications.
  3. Use galvanized bolts, nuts, and washers in conformance with AASHTO M 232. Lock washers required on all bolts.
- B. Structural Tubing:
1. Use low carbon steel conforming to ASTM A 53 Grade B, except use chemical composition requirements of: carbon 0.25 percent, phosphorus 0.04 percent, manganese 1.35 percent, and silicon 0.05 percent. Conform to ASTM A 53 Grade B for other elements.
  2. Bolts: Conform to ASTM A 325 Specifications.
  3. Nuts: Conform to ASTM A 563 DH Specifications.
  4. Washers: Conform to ASTM F 436 Specifications. Lock washer: all bolts.
  5. Galvanize bolts, nuts, washers: AASHTO M 232.
- C. All Other Structural Steel:
1. All other shapes and plates: Conform to AASHTO M 270 Grade 36.
  2. Bolts: Conform to ASTM A 307 Specifications.
  3. Stainless Steel Bolts: Conform to ASTM F 593 Type 304 Specifications.
  4. Nuts: Conform to ASTM A 563 Specifications.
  5. Washers: Conform to ASTM F 436 Specifications. Use lock washers on all bolts.
  6. Galvanize bolts, nuts, washers: AASHTO M 232.
  7. Entire sign assembly with mounting brackets: Galvanize to AASHTO M 111.

- D. Welding design and fabrication: ANSI/AASHTO/AWS D1.5 specifications.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Type I Sign Design Criteria
  - 1. Dead Load: 4800 lb.
  - 2. Live Load: 510 lb.
  - 3. 100 mph wind load.
  - 4. Snow and ice loadings.
- B. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.
- C. Provide foundation, VMS supports, junction boxes, ground rod, grounding lug, conduit, and all additional miscellaneous items required for a complete and operational VMS.
- D. Install all wiring, conduit, and junction boxes as shown on site plans and details.
  - 1. Field locate all conduit and junction boxes to avoid drainage areas and steep slopes whenever possible.
  - 2. Protect existing conductors while installing cables and conductors.
- E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the VMS system complete.
- F. After installation, the exterior of all equipment must be free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.
- G. Restore work area to the original condition or better after work is completed.

### **3.2 CONSTRUCTION SEQUENCE**

- A. Deploy traffic control devices and/or personnel. Refer to Section 01554.
- B. Construct foundations, establishing base plate elevations in accordance with project plans.
- C. Determine design height of both vertical supports, and length of horizontal support based on the 'as-built' foundation field survey. Meet vertical clearance requirements during construction. Determine catwalk design dimensions based on survey data. Obtain Engineer's approval for all dimension changes.

- D. Fabricate structural supports and catwalk. Review shop-drawings and relate to survey information to assure consistency.
- E. Erect structure with sign.
- F. Remove shipping supports and connect all wiring and cables in a neat and orderly fashion, verify all parts are properly seated and functional and make final adjustments to sign horizontal and vertical angles. The Engineer reserves the right to order adjustments to the sign angle during the initial installation.

### **3.3 VMS FOUNDATIONS**

- A. Excavation
  - 1. Perform as described in Section 13551.
- B. Anchor Bolts:
  - 1. Provide anchor bolt template during installation of anchor bolts. Fabricate the bolt template of 1/4-inch thick minimum steel plate, similar to anchor plate details. Match drill to each base plate.
- C. Earthwork
  - 1. Place compacted embankments prior to drilling.
  - 2. Drill caisson forms 6 inches minimum below ground surface. Refer to Section 02466. Place compacted backfill before erecting post.
- D. Bituminous filler at concrete joints. Refer to Section 03152.
- E. Barrier
  - 1. Locate all foundations and poles within traffic barriers per Sections 02841 and 02844 and/or Crash Cushions per Section 02843.

### **3.4 VMS SUPPORTS**

- A. Structural Tubing:
  - 1. Provide hand holes for tubular overhead frame on one side only.
  - 2. Locate inserts at the bottom of the mast arm where shown on the Standard Plans. Weld 1 1/2-inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized plugs.
  - 3. Rack post as necessary during sign erection using leveling nuts to level the sign panels. At final position wrench tighten both top and bottom anchor bolt nuts against the base plate.

- B. All Other Structural Steel:
1. Use one sign-mounting bracket at each sign Z bracket. See sign fabricator's drawings for number and location of Z brackets.
  2. Pre-tension steel rod to 11,000 lbs.
  3. During sign erection, rake post as necessary with the use of leveling nuts to make the variable message sign level. At final position wrench tighten both top and bottom anchor bolt nuts against base plate.
  4. Sign placement on horizontal member may be adjusted up to 3/8 inches upward for VMS platform to match catwalk elevation.
  5. Refer to ASTM A 36: Standard Specification for Carbon Structural Steel, and AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
- C. Earthwork:
1. Place and compact backfill prior to erecting supports.

### **3.5 VMS CABINET**

- A. Cabinet Foundation
1. Concrete: A(AE) required: Refer to Sections 03055 and 03310.
  2. Trowel finish and level top surfaces prior to cabinet installation. Level top surfaces of cured concrete by grinding.
- B. Bolts, Nuts, and Hardware
1. Furnish and install 3/4-inch x 8-inch anchor bolts to secure cabinet. Cabinet anchor bolts: minimum pullout strength 11,000 lb.
  2. Expansion anchor bolts to secure framing strut to foundation: 1/2 inch diameter embedded 6-inch minimum in foundation, with shear capacity of 2500 lbs and tension (pullout) capacity of 2600 lbs. Locate expansion anchors a minimum of 3 inches from any edge of concrete.
  3. Provide stainless steel, galvanized, or zinc plated bolts, nuts, and hardware.
    - a. Steel as specified. ASTM A 307.
    - b. Galvanized as specified. ASTM A 123 and ASTM A 153.
    - c. Zinc plated as specified. ASTM B 766.
  4. Provide all bolted connections with lock washers, nuts, or other approved means to prevent the connection nuts from backing off.
  5. For framing struts, provide commercially available 12-gauge, u-shaped stainless steel product with 1/2 inch diameter pre-drilled holes, to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation. Provide strut with cross-section dimensions 1 7/16 inch x 1 7/16 inch minimum.
  6. Verify bolt pattern and foundation dimensions prior to foundation construction.

- C. Conduit
1. Install all conduit in base of cabinet in a 12-inch x 18-inch rectangle centered in the cabinet base. Conduit may be aligned in an alternate pattern than is shown in the plan. Refer to the plans for the number, size, and orientation of all conduits entering the junction boxes.
  2. Conduit (typical) from cabinet to Type I junction box  
One-1 1/2 inch from cabinet to disconnect  
One-1 1/2 inch from disconnect to Type I junction box
  3. Conduit (typical) from cabinet to Type II junction box  
Two-3 inch  
Four-2 inch
  4. All exposed conduit: metallic.
  5. Install bushings on metallic conduit ends at the top of concrete bases if wire or cable is installed. Install end bells on non-metallic conduit if wire or cable is installed.
  6. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit 3 inches above the concrete base.
  7. Refer to Section 13553.
- D. Install cabinet to allow maintenance personnel facing the front door of the cabinet to also view the VMS display. Place the cabinet so the Type II junction box is located adjacent to the front doors of the cabinet.
- E. Disconnect and Transformer
1. Install struts as per Section 13555.
  2. Install disconnect and transformer on the side of the cabinet that faces away from the nearest traffic. If wall blocks access to disconnect, then install the disconnect and transformer on the opposite side of the cabinet.
  3. Install 0.67-inch spacers with each expansion anchor between the foundation and disconnect/transformer. Maintain a 0.67-inch gap between the disconnect/transformer and the foundation.
  4. Ground the transformer to the control cabinet ground terminal.
  5. Install disconnect and transformer per manufacturer's instructions.
- F. Identify all field terminals.
- G. Junction box installation. Refer to Section 13554.

### 3.6 TESTING AND ACCEPTANCE

- A. Successfully complete the following tests:
1. Cable and Conductor Test: Obtain UDOT's newest version of the ATMS Cable and Conductor Test from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
  2. Local Field Operations Test: Obtain UDOT's newest version of the Variable Message Sign Local Field Operations Test form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
    - a. Conduct the Local Field Operations test after the Cable and Conductor test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.
    - b. Verify physical construction has been completed in accordance with the plans and specifications and that the connecting cabling has been properly installed.
    - c. Furnish all equipment, appliances, and labor necessary for the test.
  3. Acceptance Tests: Refer to Section 13595.

END OF SECTION