Attachment 3.8

To the Technical Requirements

Structural Design Criteria
Bridges, Gantry, Signs, High Mast Lighting, Culverts, Retaining Walls, MSE Walls and Standard Structures

SPECIFICATIONS/STANDARDS/GUIDES

A. Work Period Activities: Published version stated below. If publication date is not stated below, then the most current published version (in print or electronic media) as of the Agreement Date shall apply. In addition, all supplements, errata, revisions, and interims for those publications, whether published prior to or after the Agreement Date, shall apply.

B. Operating Period Activities: Most current published version (in print or electronic media) at the time the Work is performed. In addition, all supplements, errata, revisions and interims for those publications that are in effect at the time of the Work shall apply.

1. BRIDGE CRITERIA

1.1. Live Load Capacity

HL-93 as outlined in AASHTO LRFD Bridge Design Specification.

1.2. Load Rating

See Paragraph 7

1.3. Bridge Width and Length

Bridge width and length shall be determined by the functional classification of roadway(s) being considered and the facility or item being crossed. VDOT Office Practice Volume V, Part 2 provides geometric requirements. Precautions shall be taken in the initial design so that any future widenings of the structure, or the object being crossed, does not violate any (present or future) minimum vertical and horizontal clearances for either structure.

1.4. Future Wearing Surface Load

A minimum future wearing surface load of 15 psf shall be applied to the deck areas of the composite section.
1.5. **Construction Tolerance Load**

A minimum construction tolerance load of 20 psf shall be applied to the non-composite sections of beam/girder spans having cast-in-place slabs.

1.6. **Aesthetic/Architectural Treatment**

Refer to *IIM-S&B-72* to incorporate Context Sensitive Solutions during the planning and development of design and construction phases.

1.7. **Additional Bridge Specific Criteria**

1.7.1. Bridge “type” decisions shall be based on reducing long term maintenance costs for VDOT.

1.7.2. All beam/girder systems with a cast-in-place deck shall be designed as composite.

1.7.3. No bridge shall be designed as fracture critical.

1.7.4. The use of HPS (high performance steel) 70 ksi will be permitted. Use of 100 ksi may be considered but will require a submittal regarding fabrication techniques and subsequent approval by the State Structure and Bridge Engineer.

1.7.5. The use of HPC (high performance concrete) for prestressed concrete beams in excess of 8,000 psi will be considered but will require approval of the State Structure and Bridge Engineer. Prestressed beams shall be the approved VDOT Bulb Tee’s, AASHTO shapes will not be permitted.

1.7.6. If structural steel beams/girders are selected, the material shall be weathering steel if the conditions meet the requirements of FHWA (Federal Highway Administration) Technical Advisory “Uncoated Weathering Steel in Structures” T5140.22.

1.7.7. Fatigue prone details shall be minimized and/or not used (e.g. Cover plates on continuous rolled beam sections in the negative moment areas are not acceptable, longitudinal stiffeners are not acceptable, etc.).

1.7.8. No field welding to structural steel members, primary or secondary, shall be permitted except as allowed in Volume V of the *VDOT Office Practice*.

1.7.9. To the maximum extent possible expansion joints in deck slabs should be minimized. The use of continuous span units and jointless bridge design technologies, as outlined in *VDOT Office Practice* Volume V-Part 2, should be used in determining the bridge type.
1.7.10. Structural approach slabs, including sleeper pads, will be required for all bridges. Approach slabs shall conform to the requirements of the VDOT Office Practice Volume V-Part 2 and 3.

1.7.11. Bridge deck drainage design should be performed according to HEC 21 and applicable chapters of the Drainage Manual.

1.7.12. The design storm (100 year Frequency) shall pass under the bridge structure with a minimum of four (4) feet of freeboard (clearance) between the water surface elevation and the controlling low chord for the structure being evaluated.

1.7.13. In no case will asphaltic concrete pavement be used directly over corrugated metal forms.

2. GANTRIES, SIGNS AND HIGH MAST LIGHTING CRITERIA

Lighting, signal, and pedestal poles; sign posts; and overhead and bridge-mounted sign structures not designed to support variable message signs shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Overhead and bridge-mounted sign structures (including “butterfly” structures) designed to support variable message signs shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

3. CULVERTS, RETAINING WALLS, MSE WALLS AND STANDARD STRUCTURES CRITERIA

3.1. General

Items intended to be included in this criteria include: Retaining walls (including their foundations) not attached to bridge structures, MSE walls, culverts, buried structures, sound walls, soil-corrugated metal structure interaction systems, soil-reinforced concrete structure interaction systems, soil-thermoplastic pipe interaction systems.

3.2. Live Load Capacity, if applicable

HS-20-44 and/or Alternate Military Loading as outlined in VDOT Modification to the AASHTO Standard Specification.

3.3. Load Rating
See Section 6 below.

3.4. **Future Wearing Surface Load, applied where applicable**

A minimum future wearing surface load of 15 psf shall be applied to the deck areas of the composite section.

3.5. **Construction Tolerance Load, applied where applicable**

A minimum construction tolerance load of 20 psf shall be applied to the non-composite sections of beam/girder spans having cast-in-place slabs.

4. **ADDITIONAL DESIGN CONSTRAINTS FOR BRIDGES, GANTRIES, SIGNS, HIGH MAST LIGHTING, CULVERTS, RETAINING WALLS, MSE WALLS AND STANDARD STRUCTURES**

4.1. **Corrosion Resistant Reinforcement**

4.1.1. Corrosion resistant reinforcing steel shall be used at all locations susceptible to corrosion due to deicing chemicals. Epoxy coated rebar shall not be used. When choosing corrosion resistant reinforcing steel, precautions shall be made to prevent any decomposition due to dissimilar metal properties. Acceptable types of corrosion resistant reinforcing steel includes; stainless steel, stainless clad and MMFX-2. The bars (MMFX-2) should meet the specification of ASTM A1035; however, a maximum allowable design stress should be limited to 75 ksi.

4.1.2. Corrosion Resistant Reinforcement shall conform to the requirements of one of the following standards:

   i. ASTM A1035 – 05 Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement

   ii. ASTM A955 - 06a Standard and Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

   iii. AASHTO Designation: MP 13M 13-04, Standard Specification for Stainless Steel Clad Deformed and Plain Round Steel Bars for Concrete Reinforcement

4.2. Plain deformed reinforcing bars shall conform to ASTM A615 Grade 60.

4.3. No timber elements will be acceptable.

4.4. Bridges and structures shall utilize low permeability concrete in accordance with current VDOT Special Provision S217BG0-0708.
4.5. Railings for each bridge or structure shall be crash tested and approved as FHWA/NCHRP Test Level-4.

5. MINIMUM PLAN REQUIREMENTS FOR BRIDGES AND OTHER SIMILAR STRUCTURES

5.1. Plan numbers will be assigned by Central Office Structure and Bridge.

5.2. Plan sets should contain sheets which are arranged and detailed as outlined in the VDOT Office Practice.

5.3. A summary table of moments, shears, reactions and stresses for primary load carrying members shall be included on the plans.

5.4. Additional Minimum Plan Requirements for Bridges

i. Dead load deflections shall be computed and shown on the drawings.

ii. Camber diagram shall be shown on the drawings.

iii. The sequence of concrete deck placement operations for beams or girder construction shall be given for continuous structures and all erection stress shall be computed where necessary for design.

6. LOAD RATING, WHERE APPLICABLE

6.1. Details

The Concessionaire shall perform structural load ratings for each structure in accordance with I&IM S&B 27.6, AASHTO’s Manual for Condition Evaluation of Bridges; and NBIS Subsection 650.301. The Concessionaire shall perform load ratings on bridge superstructures using the Load Factor Rating method for NBIS rating for the AASHTO design vehicle, for blanket permit vehicle (90K and 115k), and Virginia’s Legal Load vehicles as specified in the I&IM S&B.

All load ratings for structures other than steel curved girders/beams shall be performed using the As-Designed/As-Built drawings and AASHTOWare VIRTIS software. Horizontally curved bridges with curved longitudinal steel members shall be evaluated using DESCUS software with rating capability. All other load ratings (post tensioned box girders, culverts, pipes, etc.) shall be generated by hand calculations or by use of software approved by VDOT.

The Concessionaire shall prepare and deliver to VDOT a load rating report for each structure. Each report shall contain a completed copy of VDOT’s current load rating summary sheet referencing the controlling structural element(s) sealed and signed by a
professional engineer licensed in Virginia, rating assumptions, pertinent analysis calculations and VIRTIS, DESCUS or other approved computer input as appropriate. In addition, a CD-ROM containing the load rating input files for VIRTIS, DESCUS or other approved computer programs shall be delivered to VDOT with the report.

6.2. Reports

6.2.1. As-Designed Structures

Load rating of the proposed structure shall be submitted to VDOT after design is complete and prior to construction of each structure in accordance with I&IM S&B 27.6 or the latest revision and Volume VII-15-29.19 thru 29.22 of the Manual of the Structure and Bridge Division.

6.2.2. As-Built Structures

Load rating of the As-Built structure shall be submitted to VDOT not later than ninety days after completion of the bridge in accordance with I&IM S&B 27.6 or the latest revision and Volume VII-15-29.19 thru 29.22 of the Manual of the Structure and Bridge Division.

6.3. Load Restrictions

No structure shall be placed into service if a Load Restriction (Posting) is required based upon the load rating analysis. The Concessionaire is responsible for all remedial measures to make corrections to the design or As-Built structure.

7. UNITS

U.S. Customary Units

8. STANDARD DETAILS

Standard details are available on the S&B website. These standards shall be used to maximum extent possible in the development of plans.