a. **Description.** This specification covers the fabrication of structural steel and aluminum, modifying the Standard Specifications for Construction (hereafter called standard specifications) and the referenced AWS Codes. In case of conflict between the standard specifications and AWS specifications, the standard specifications will govern.

b. **AASHTO/AWS D1.5M/D1.5:2010, Bridge Welding Code** (hereafter called **AWS D1.5**). Ensure the fabrication of structural steel bridge members and other miscellaneous structural steel elements is performed according to AWS D1.5. Any reference to prequalified joints or procedures in AWS D1.5 must be deleted. AWS D1.5 subclauses are modified as specified herein:

2.8.8: Add the following sentence to the end of the existing paragraph:

> Welds on opposite sides of a common plane must be continuous, as shown on the contract drawings, and corners ground to eliminate notches greater than 0.01 inch. Provide a smooth transition to the weld metal after grinding.

2.9.1.1: Delete the existing paragraph in its entirety and replace with the following sentence:

> Qualification tests will be required for all plug and slot welds.

2.9.3: Add the following sentence to the end of the existing paragraph:

> The maximum center-to-center spacing of plug welds must be equal to the minimum plus 1/2 inch.

2.17.5.1: Change “….subject to tensile stress shall have a smooth transition…” to read “…subject to tensile and compressive stress shall have a smooth transition…”

3.1.3: Change "...when the ambient temperature is lower than 0 degrees F..." to read "...when the ambient temperature is lower than 40 degrees F...".

3.2.1: Delete the existing paragraph in its entirety and replace with the following paragraph:

> Surfaces and edges to be welded must be smooth, uniform, and free from fins, tears, cracks, all mill scale, and other discontinuities which would adversely affect the quality or strength of the weld. Surfaces to be welded and surfaces adjacent to a weld must also be free from loose or thick scale, slag, rust, moisture, grease, and other foreign material that would prevent
proper welding or produce objectionable fumes. All edges whether welded or not must be conditioned by very shallow grinding to remove the hardened layer left by resolidification.

3.3.8:  Delete the existing paragraph in its entirety and replace with the following paragraph:

Temporary or fit-up welds must be subject to the same welding procedure specification requirements as final welds. They must be removed unless otherwise permitted by the Engineer. Any Temporary or fit-up welding must be clearly shown on the shop plans and approved by the Engineer. A procedure for removal of all temporary or fit-up welds must be submitted, in writing, to the Engineer for approval. If removed, they must be ground flush with the original surface to a surface finish of less than 125 microinches-rms, finished parallel to the direction of primary stress. Removal of temporary welds must conform to the requirements of AWS 3.3.7.3 and AWS 3.3.7.4. If temporary welding is approved, non-destructive testing of the temporary weld areas may be required by the Engineer and performed at the Fabricator's expense to ensure that no cracks or flaws have been produced in the base metal.

3.13.3:  Delete the existing paragraph in its entirety and replace with the following sentence:

Steel backing on welds must be removed and the joint must be ground smooth, unless otherwise directed by the Engineer.

3.13.6:  Delete the word “copper” from the first sentence in the first paragraph and delete the second paragraph in its entirety.

4.1.3:  Add the following sentence to the existing paragraph:

A filler metal log sheet must be available at all times for the Engineer to review.

4.2:  In this subclause all references to an ambient temperature of -20 degrees C (0 degrees F) must be changed to an ambient temperature of 5 degrees C (40 degrees F).

4.2.2:  Add the following sentence:

The maximum interpass temperature on M270 Grade 36, 50, 50W, and HPS 50W steel must not exceed 650 degrees F.

4.6.8:  The progression for all passes in the vertical position must be upward (including repairs).

4.7.6:  Add the following sentence to the existing paragraph:

Any use of backing materials or sealing by welding is subject to the approval of the Engineer and may be qualified by procedure qualification tests as directed by the Engineer.

5.2.4:  Delete the existing paragraph in its entirety and replace with the following paragraph:

Testing as specified by the standard specifications, AWS D1.5, MDOT supplemental specifications, special provisions, and contract documents is considered included in the bid price for fabricating and furnishing structural steel and therefore payment for such testing is at the Contractor's/Fabricator's expense. This includes additional testing required by the Engineer for welders, welding operators, or welding procedures.
Table 5.8: In the table under "1. Test on Plate" in the Type of Weld column, delete the Fillet Option No. 2 and accompanying referenced Figure 5.22.

5.11: Delete the subclause in its entirety.

5.11.1: Delete the subclause in its entirety.

5.12.4: Add the following sentence to the end of the subclause:

Nonstandard joints, as determined by the Engineer, must be "mocked-up" to duplicate joints used in production.

5.13: Delete the subclause in its entirety.

5.13.1: Delete the subclause in its entirety.

5.13.2: Delete the subclause in its entirety.

5.20: In this subclause additional test specimens cannot be cut from the same procedure qualification test plate. Any other references within this code to cutting from the same procedure qualification test plate must be deleted.

5.21.4: In the first sentence of this subclause, change "...remaining in effect indefinitely..." to read "...remaining in effect for 3 years...".

5.23.1: Add subsection 5.23.1(5) to read as follows, "All pipe welding qualification tests will be accepted based on plate welding tests for applicable positions and 5.23.1.2 for unlimited thickness and 5.23.1.3 for limited thickness."

5.23.1.5: Delete the existing paragraph in its entirety and replace with the following paragraph:

Plug Weld Qualification Tests for Plug Welds Only. The joint must consist of a diameter hole the same size as that used in production in a plate the same thickness as that being welded. Backing must be of the same thickness and material as that to be used in production. In addition, Ultrasonic Testing (UT) must be required for plug weld qualification and must meet the requirements shown in Table 6.3. Conduct macroetch test according to subclause 5.27.6.

5.23.2.4(2)(b): Delete this subclause and accompanying referenced Figure 5.27.

5.27.1: In this subclause add the following requirements for visual inspection to the existing paragraph:

No discontinuities exceeding 1/8 inch measured in any direction on the surface.

Summation of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch cannot exceed 3/8 inch.

5.27.6.1: In this subclause add the following requirements to the existing requirements:

(7) No discontinuities exceeding 1/8 inch measured in any directions on the surface.
(8) Summation of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch cannot exceed 3/8 inch.

5.27.6.2(3): Change "...in excess of 1/4 inch..." to read "... in excess of 1/8 inch...".

6.3.1: Add the following sentence to the existing paragraph:

Approved weld procedures are to be posted where work and welding are being performed.

6.4.3: Add the following at the end of the existing paragraph:

...or the contract documents.

6.6.5: Delete the existing paragraph in its entirety and replace with the following paragraph:

If nondestructive testing (NDT), not specified in the original contract agreement, is subsequently requested by the Engineer, the Contractor must perform any requested testing or must permit any requested testing to be performed. Any cost related to subsequent testing requests must be paid for by the Engineer if testing does not result in a rejectable defect. However, if such testing should disclose any deficiencies which require repair work, all costs associated with the original and subsequent NDT must be paid for by the Contractor/Fabricator.

6.7.7: Add the following at the end of the existing paragraph:

PT inspection must be performed at the ends of all CJP (butt, corner, and T) weld terminations for primary members.

6.19.8: Remove reference to Table 6.4.

6.20.1: Add the following at the end of the existing paragraph:

All discontinuities found by UT must be recorded on the NDT report.

6.26.1.5: Add the following at the end of the existing paragraph:

Cross frames and diaphragms attached to connection plates or stiffeners of horizontally curved girders are considered primary members. Fillet welds attaching connection plates or stiffeners to the web of horizontally curved girders that carry loads from cross frames or diaphragms are considered part of the primary member.

6.26.2.1: In the first sentence, change "For welds subject to tensile stress under any condition of loading..." to read "For all welds under any condition of loading...".

6.26.2.2: Delete this subclause in its entirety and referenced Figure 6.9. See subclause 6.26.2.1 as modified herein and Figure 6.8.

6.26.3.1(1): Change "Welds subject to tensile stress under any condition of loading..." to read "Welds under any condition of loading...".
6.26.3.1(2): Delete this subclause in its entirety and referenced Table 6.4. See subclause 6.26.3.1(1) as modified herein and Table 6.3.

6.26.3.3: Change “Table 6.4” to “Table 6.3” and change “actual web thickness” to “nominal web thickness”.

12.4.5: Add the following to the paragraph:

The supplementary requirements of AASHTO M270 (ASTM A709) for fracture critical impact tests are required for zone 2. The Charpy test pieces shall be coded with respect to heat/plate number and that code shall be recorded on the mill-test report of the steel supplier with the test result. If requested by the Engineer, the broken pieces from each test (three specimens, six halves) shall be packaged and forwarded to the MDOT, Operations Field Services – Structural Fabrication Unit.

12.6.5.1: Add the following to the paragraph:

Electrodes for Shielded Metal Arc Welding shall be E7018, E8018, E9018, E10018, and E11018.

12.7.5: Add the following to the end of the paragraph:

Evidence must include third-party CWI witnessing the test and RT film available for the owner’s review. If this evidence cannot be provided all costs associated with the procedure qualification must be at the contractor’s expense.

12.8.2: Add the following to the paragraph:

The Engineer must witness all welding and test plates must be submitted to the owner for testing.

Delete any reference in this subclause to requalification on an annual basis.

12.15.2.2: Add the following to the paragraph:

The minimum post heat time for production and repair welds shall be one hour.

12.17: Add the following after the first paragraph:

Repair drawings shall contain two lines for the Inspector’s signature. Signature on the first line shall indicate the Inspector has examined the discontinuity(s) and agrees that the repair drawings accurately describe the discontinuity(s). When repairs are completed, signature on the second line shall indicate acceptance of the completed repair and the specified nondestructive tests. Discontinuities shall be drawn as they appear from visual inspection and nondestructive testing (NDT).

12.17.6: Add the following to the subclause:

The repair procedures shall include the welding procedure specification. Procedures qualified by test for the fabrication need not be qualified by test for the specific method of repair unless otherwise ordered by the Engineer.
(14) If stress relief heat treatment is required, it shall be completely described. Tests shall be performed to determine the effect of the heat treatment on both weld and base metal properties before the procedure is approved. Final acceptance NDT shall be performed after stress relief is complete.

(15) Repairs in tension butt welds shall be examined by ultrasonic (UT) and radiographic (RT) test methods. Repairs to all other groove welds shall be examined by UT. Fillet weld repairs shall be examined by magnetic particle testing (MT). RT shall conform to clause 6 and may be performed as soon as the weldment has cooled to ambient temperature. UT shall also conform to clause 6 and MT shall conform to ASTM E 709. Final acceptance testing by MT and UT shall not be performed until the steel weldments have been cooled to ambient temperature for at least the elapsed time indicated as follows:

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inches or less</td>
<td>24 hours</td>
</tr>
<tr>
<td>over 2 inches</td>
<td>48 hours</td>
</tr>
</tbody>
</table>

All repair welding and nondestructive testing shall be performed as described in the approved repair procedure.

Approved critical repair procedures shall be retained as part of the project records.

12.18: Add this subclause to the code:

The Owner reserves the right to perform random NDT QA tests of welds, whether or not previously found acceptable by QC. If a weld is found to contain rejectable indications in QA then the following NDT shall be performed by and at the expense of the Fabricator: Two consecutive welds of the same type preceding the defective weld shall be tested. If any two consecutive welds are found by QC to contain rejectable indications, four consecutive welds made to the same welding requirements shall be tested by QC. All such testing shall be witnessed and verified by QA. All rejectable indications disclosed shall be repaired and reinspected by NDT at the Fabricator’s expense.

The QA witnessing and verification of QC testing will be carried out in a timely manner, so as not to interfere with production.

The Fabricator/Erector shall maintain documentation of all visual and NDT for timely review and confirmation by the Engineer. Two copies of all documentation shall be submitted to the Engineer upon completion of the project.

12.19: Add this subclause to the code:

For welding procedure qualification, the test plate shall be according to the AASHTO Guide Specifications for Fracture Critical Steel Bridge Members with the following applying to the notes for Figure 1:

Delete notes 1, 3, 4, and 7 in the AASHTO guide specifications and replace them with the following:

1. “T” is equal to the maximum thickness to be welded, except as provided herein. When
the thickness to be welded exceeds 2 inches, "T" shall be the maximum depth of bevel, or 2 inches, whichever is the greater amount. The minimum thickness test plate shall be 1 inch in the event that the maximum thickness to be welded is less than 1 inch.

3. The minimum preheat and interpass temperature shall be according to Table 12.3, 12.4, or 12.5 as applicable.

4. Welding procedure test plates shall be witnessed by the Engineer. Test plates shall be sent to the Owner for machining and testing.

7. The reduced section tension specimen shall be according to Figure 5.10 except that "T" is equal to the test plate thickness.

Table 12.2: Delete Note a.

Ensure shop fabrication of structural steel members (e.g. steel sign support structures, tower lighting units, CCTV towers, traffic signal mast arms and poles, drainage components, expansion dams, curb plates, bearings, railings and other miscellaneous structural steel members as determined by the Engineer) is performed according to AWS D1.1. Fabricators may qualify under the provision of AWS D1.5 if approved by the Engineer.

For tubular fracture critical members follow AWS D1.5 (clause 12) and the latest LRFD Guide Specification for Design of Pedestrian Bridges.

Any reference to prequalified joints must be deleted. See subclause 4.2.1 as modified herein.

Table 3.2: Add the following general note to the table:

The ambient air temperature in the vicinity of the weld must not be less than 40 degrees F.

3.2.1: Delete this subclause in its entirety. See requirements herein under modifications to AWS Clause 4.

3.5.2: Delete this subclause in its entirety and eliminate all references within AWS D1.1 to alternate methods for establishing minimum preheat and interpass temperatures.

3.6: Delete the existing subclause in its entirety and replace with the following paragraph:

All welding procedure specifications to be used must be prepared by the Manufacturer, Fabricator, or Contractor as written procedure specifications, and submitted to the Department. A suggested form showing the information required in the procedure specification is given in Annex E.

3.6.1: Delete this subclause in its entirety. See subclauses 4.2.1 and 3.6 as modified herein.

3.7.1: Delete the existing subclause in its entirety and replace with the following paragraph:

The progression for all passes in the vertical position must be upward including repairs.

3.9.3: Add the following sentence to the existing paragraph:
Qualification tests must be required for all skewed T-Joints.

3.12: Add the following sentence to the existing paragraph:

Qualification tests must be required for all partial joint penetration groove welds.

4.2.1: Delete the existing subclause in its entirety and replace with the following paragraph:

Welding procedures must be qualified prior to use, by tests as prescribed in Part B of this clause. No welding must be done on any project until shop welded procedure qualification tests described in Part B of clause 4 demonstrate the performance of the wire-flux combination when welding with shop equipment using the shop welding procedure specification and representative samples of the wire, flux, and plates or shapes to be used in production. The type of procedure qualification test(s) run by the fabricator must be determined by the Engineer. Welds for procedure qualification must be made according to the shop welding procedure specification, including observance of preheat and interpass temperatures, using representative samples of the electrodes, flux, and base metal to be used in production. The Department will maintain records of procedures qualified by each shop, so that it will not be necessary to requalify for each new contract, as long as the qualified procedure remains controlled within the limitation of variables specified in Part B of clause 4, and provided that the welding machines, type of steel, and range of thickness are not changed. As an alternate to plate thickness procedure qualification, the Engineer may require tests run for procedures using actual joints used in production. Procedures are good for 3 years. The Engineer may require a retest of welding procedures whenever the Engineer feels it is warranted.

4.2.1.3: Delete the existing subclause in its entirety and replace with the following paragraph:

Charpy impact tests and all weld metal tensile tests are required for all groove weld procedure test plates. Additional plate lengths are required for these tests. This requirement is for all plate thicknesses, except that for less than 3/8 inch plates all weld metal tensile test is not required; however, root and face bend tests are. Specimens tested for impact values must have a minimum value of 20 ft-L at 0 degrees F. All weld tensile specimens must have values not less than those shown in Table 3.1 with elongation in 2 inch gage length not less than 22 percent.

4.2.3.1: In the first sentence of this subclause, change "...remaining in effect indefinitely..." to read "...remaining in effect for 3 years...".

4.2.3.2: In the first sentence of this subclause, change "...to perform tack welding indefinitely..." to read "...to perform tack welding for 3 years...".

4.9.5: In this subclause additional test specimens cannot be cut from the same procedure qualification test plate. Any other references within this code to cutting from the same procedure qualification test plate must be deleted.

Table 4.11: In the table under the Type of Test Weld column, delete the Fillet Option 2 and accompanying referenced Figure 4.33.

4.12.3: In this subclause delete all reference to prequalified consumables. All consumables for fillet welds must be tested.
Add the following sentence to the last paragraph in the subclause:

The deposited weld metal must be tested by the Charpy impact test and must produce a minimum of 20 ft-L at 0 degrees F.

4.13.4.1(3)(f): Change "1/4 inch" to "1/8 inch" in the first sentence.

4.13.4.1(3): In this subclause add the following requirements to the existing requirements:

(g) No discontinuities exceeding 1/8 inch measured in any direction on the surface.

(h) No discontinuities exceeding 3/8 inch - Sum of the greatest dimensions of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch.

4.30: Delete this subclause in its entirety and replace with subclause 5.23.1.5 of AWS D1.5 and as modified in section b herein.

4.31.2.1(1) & (2): Delete these subclauses in their entirety and replace with subclause 5.23.1.5 of AWS D1.5 and as modified in section b herein.

4.31.2.3: In this subclause add the following requirements to the existing requirements:

(5) No discontinuities exceeding 1/8 inch measured in any direction on the surface.

(6) No discontinuities exceeding 3/8 inch - Sum of the greatest dimensions of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch.

4.31.2.3(4)(c): Change "... in excess of 1/4 inch..." to read "... in excess of 1/8 inch...".

Table 5.1: Delete and replace with Table 4.6 of AWS D1.5.

5.2.2.1 & 5.2.2.2: Delete the existing subclauses in their entirety and replace with the following sentence:

Base metal for weld tabs, backing, and spacers must be the same steel as that to be welded.

5.3.2.2: Delete the last sentence of this subclause and replace with subclause 4.5.2.2 of AWS D1.5.

5.3.2.3: Delete this subclause in its entirety and replace with subclause 4.5.2.1 of AWS D1.5.

Table 5.8: Delete Table 5.8 in its entirety and replace with Table 707-1 in subsection 707.03 of the standard specifications.

5.12.2(1): In this subclause change "...when the ambient temperature is lower than 0 degrees F..." to read "...when the ambient temperature is lower than 40 degrees F...".

5.14: Delete this subclause in its entirety and replace it with the last paragraph in subsection 707.03.C.2.a of the standard specifications.
5.18.2(1): Delete this subclause and replace with subclause 3.3.8 of AWS D1.5 as modified in section b herein.

5.26: Add the following sentences to the end of the existing paragraph:

Written weld repair procedures must be approved by the Engineer prior to any weld repairs. For weld repairs, preheat is mandatory as specified in Table 3.2 as modified herein.

6.1: Delete this subclause in its entirety and replace with subclause 6.1 of AWS D1.5.

6.3.3: Add the following sentence to the end of the existing paragraph:

Approved weld procedures are to be posted where work and welding are being performed.

6.6.5: Delete this subclause in its entirety and replace with subclause 6.6.5 of D1.5 as modified in section b herein.

6.9: In this subclause add the following requirements to the existing requirements:

No discontinuities exceeding 1/8 inch measured in any direction on the surface.

No discontinuities exceeding 3/8 inch - Sum of the greatest dimensions of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch.

6.12.2.1: In the title of this subclause, change "Cyclically Loaded Non-tubular Connections in Tension" to read "Cyclically Loaded Non-tubular Connections".

6.12.2.2 & Figure 6.3: Delete this subclause in its entirety and referenced Figure 6.3. See AWS 6.12.2.1 as modified herein and AWS Figure 6.2.

6.13.2(1): Change "Welds subject to tensile stress..." to read "All welds under any condition of loading...".

6.13.2(2) & Table 6.2: Delete this subclause in its entirety and referenced Table 6.2. See AWS 6.13.2 (1) as modified herein and Table 6.3.

6.20.2: In the third sentence of the paragraph, replace the word “painted” with the word “coated”.

6.26.3: Replace the word “paint” with “coatings”.

d. AWS D1.2/D1.2M:2003, Structural Welding Code – Aluminum (hereafter referred to as AWS D1.2). Ensure shop fabrication of structural aluminum is in accordance with AWS D1.2.

3.3.2: In the first sentence, change "...remaining in effect indefinitely..." to read "...remaining in effect for 3 years...".

3.5.3: Delete this subsection in its entirety and replace with the following sentence:

Radiographic examination may not be used in lieu of the bend test performance requirements.
3.6.3: Add the following requirements to the existing requirements:

(8) No discontinuities exceeding 1/8 inch measured in any direction on the surface.

(9) No discontinuities exceeding 3/8 inch - Sum of the greatest dimensions of all discontinuities exceeding 1/32 inch but less than or equal to 1/8 inch.

3.11: Delete this subsection in its entirety. See subsection 3.5.3 as modified herein.

3.15.3: Add the following paragraph to this subsection:

Additional test specimens may be designated to qualify a welding procedure when deemed necessary by the Engineer. These additional tests will normally relate to the actual joint or structural detail being welded.

3.16: In this subsection additional test specimens cannot be cut from the same procedure qualification test plate. Any other references within this code to cutting from the same procedure qualification test plate must be deleted.

3.21.6.3: Delete this subsection in its entirety and replace with the sentence:

Radiographic examination may not be used in lieu of the bend test for qualification testing of welders or welding operators.

3.23: In the first sentence, change "...remaining in effect indefinitely..." to read "...remaining in effect for 3 years...".

4.8: Add the following paragraph to the end of the existing paragraph:

Where preheat is needed, the temperature of preheat must not exceed 500 degrees F for non-heat-treated alloys. The use of preheat must be an integral part of the procedure specification which must be tested to qualify the welding procedure.

5.6.5: Delete this subsection in its entirety and replace it with Clause 6.6.5 of AWS D1.5 and as modified in section b herein.