SP-159010a
(Replaces SP-159010)

SPECIAL PROVISIONS FOR STEEL TRUSS FABRICATION AND ERECTION

Allamakee County
STP-009-9(84)--2C-03

Effective Date
August 1, 2023

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

159010a.01 DESCRIPTION.

This work shall consist of truss fabrication, developing, engineering, and submitting a detailed truss erection plan, erecting the truss, and monitoring and evaluation of truss erection progress. The erection plan shall include plans and procedures substantiated with appropriate erection engineering calculations.

159010a.02 GENERAL PROVISIONS.

A. Submittals.

All documents are to be submitted and reviewed electronically in accordance with project requirements. Hardcopies of documents will not be processed. If the Contractor is proposing changes to steel truss framing, expansion joints, bearings, deck drains, or any other item, the Contractor shall have these proposed changes pre-approved through the RFI or VE process as appropriate before submitting related documents for review.

B. Qualifications.

1. Erection Engineer Qualifications.

The Truss Erection Plan shall be certified by a Professional Engineer licensed in the State of Iowa, known in this document as the Erection Engineer. The Erection Engineer shall have a minimum of two other project experiences in the design of truss, arch, or cable-stayed bridges with steel framing systems and spans over 350 feet long and/or analysis and preparation of truss, arch, or cable-stayed erection plans for truss, arch, or cable-stayed bridges with steel framing systems and spans over 350 feet long. The Erection Engineer shall sign and seal the erection plan, drawings, and calculations for the proposed erection of the truss and shall be involved in evaluating, monitoring, and documenting the erection of the truss as it progresses. The Erection Engineer shall sign and seal any updates to the erection plan and corrective measures during erection.

2. Fabricator Qualifications.

Only fabricators having the AISC Quality Certification Program, “Bridge Fabricator - Advanced” with “Fracture Control Endorsement”, may be used to fabricate the steel truss structure. Prior

to fabrication, the results of the latest AISC certification review shall be made available to the Engineer for acceptance.

3. Erector Qualifications.
The contractor erecting the structural steel shall submit a project reference list verifying their experience as the erector in successful erection of at least two truss, arch, cable-stayed bridges with steel framing systems containing a span length of at least 350 feet or a steel girder bridge with a span length of at least 500 feet and at least one bridge over a navigable waterway as defined by 33 C.F.R. § 329 (2023). Only one of the two reference projects can be a steel girder with a span over 500 feet. One reference project shall have been completed within the past 10 years. The second reference project shall have been completed within the last 20 years. Provide a brief description of each project with the owner's name and current phone number.

4. Welding Procedures.

a. All welding, welder qualifications, welding procedure qualification, and inspection of welds shall be performed in accordance with Article 2408.03, B, of the Standard Specifications, AASHTO/AWS D1.5 Bridge Welding Code, and the requirements herein.

b. Prior to the start of qualifying welders, tackers, welding operators, and welding procedures, the Contractor shall organize a meeting with the Engineer to ensure that agreement has been reached regarding the details of the procedures, the sequence of welding to be followed, the handling of materials to be inspected, the status of qualifications for welders and welding operators, and the acceptance of electrodes, wire, flux, and other welding materials and equipment. It shall be the Contractor's responsibility to call this meeting at their fabricating plant at a time mutually convenient to all parties concerned.

c. One copy of the proposed welding procedures giving complete details for each type and thickness of joint to be used on the project, whether prequalified or subject to qualification tests, shall be submitted to the Engineer for acceptance prior to or at the time of submitted shop drawings. The shop drawings submitted shall indicate the welding procedure to be used for each joint. No fabrication, preparation work or welding shall commence until the fabricator receives accepted shop drawings, welder qualifications, and weld procedures.

159010a.03 FABRICATION.

A. Holes and Connections.

1. Field drilling of steel truss members is not permitted other than where specifically detailed on the plans.

2. All holes and connections to the steel truss members to accommodate bolts, brackets, conduits, junction boxes and other items related to lighting and electrical plans and erection plans shall be detailed in the shop drawings and accepted by the Engineer.

B. Edge Finish.

All exposed corners of cut edges shall be rounded to 1/16 inch radius or equivalent flat surface at a suitable angle.

C. Welding.

1. All parallel-tee and bolted built-up members are to be considered tension members.

2. Field welding of steel truss members is not permitted other than where specifically detailed on the plans.

3. Minimizing the distortion of the truss members during welding is of prime importance and is the responsibility of the Contractor. Distortion or warping due to weld shrinkage shall be controlled by the use of proper welding fabrication sequences and by use of temporary bracing or struts

if necessary. Welding fabrication sequences shall be shown on the shop drawings. Review and comment by the Engineer on the sequences does not relieve the contractor of their responsibility to fabricate the work within the requirements specified in Article 2408.03, B, of the Standard Specifications, AASHTO/AWS D1.5M/D1.5 Bridge Welding Code and these Special Provisions.

4. No temporary or permanent welds, if not shown on the plans or permitted in the specifications, shall be made without specific written authorization by the Engineer. Tack welds on fills shall not be permitted.

5. Tack welds which will be fully incorporated into a final weld are allowed at the discretion of the fabricator.

6. Permanent tack welds shall be placed back no less than 3 inches from the ends of the final welds so that the final welds are not started or ended on a tack weld.

7. Temporary tack welds used for fitting purposes shall not be used. If temporary tack welds are deemed necessary, they shall be submitted by the Contractor for acceptance by the Engineer.

8. Under no circumstances shall temporary tack welds be used on any high performance steel (HPS).

9. Miscellaneous and inadvertent arc strikes on the steel shall be avoided. If such strikes occur, they shall be ground flush and tested for cracks using either liquid penetrant or magnetic particle testing. The Engineer shall be informed about all damages that gouge over 1/8 inch and a repair detail shall be submitted to the Engineer for acceptance.

10. Minor repairs to submerged arc welds will be permitted by manual welding with low hydrogen electrodes. Appropriate preheat shall be applied prior to such welding.

11. Any cracks which develop in the base metal shall only be repaired with a procedure accepted by the Engineer.

12. Butt welds shall not be allowed in gusset plates. Gusset plates shall be cut from a single plate.

13. Butt welds in the plates of the tension truss chords, diagonals, and verticals shall be staggered with minimum 6 foot spacing between butt welds in any plate of the member.

14. Butt welds in the flanges and webs of the compression truss chords, diagonals, and verticals and floor beams shall be staggered with minimum 6 foot spacing.

15. The location of all butt welds shall be detailed in the shop drawings and accepted by the Engineer.

16. Grinding of welds shall be in the direction of final stress.

17. Except as may be more stringently specified elsewhere, welded connections in the truss shall be tested as follows:
- **a.** 100% of all butt weld splices in the web and flanges of the floor beams shall be tested by ultrasonic and radiographic testing.
- **b.** 100% of all butt weld splices in the webs and flanges of the tension truss chords, diagonals, and verticals shall be tested by ultrasonic and radiographic testing.
- **c.** 50% of each butt weld splice in the webs and flanges of the compression truss chords, diagonals, and verticals shall be tested by ultrasonic and radiographic testing. If unacceptable discontinuities are found in the first 50% of joint, the entire length shall be tested.

d. In the web and flange splices of the compression truss chords, diagonals, and verticals, the maximum center-to-center spacing for radiographs shall be two times the length of the radiograph.

e. Fillet welds and partial penetration groove welds (and other welds which due to type or location cannot be tested by ultrasonic testing) shall be tested by magnetic particle testing in accordance with the requirements of Article 6.7.6 of AASHTO/AWS D1.5M/D1.5 Bridge Welding Code. 100% of each weld length shall be tested until quality control has been established to a level of acceptability per AASHTO/AWS D1.5M/D1.5 Bridge Welding Code as determined by the Engineer. If quality control level is acceptable, then 30% of each weld length shall be tested (10% at each end of a weld and 10% at random lengths and spaces in between). If the 30% testing reveals defects unacceptable to the Engineer, 100% testing shall be reinstated until acceptable quality control has been again established. This procedure shall be repeated as often as may be considered necessary by the Engineer.

18. If any unacceptable defects are found in any test length of weld, the full length of the weld or 5 feet on either side of the test length, whichever is less, shall be tested. Welds requiring repair shall be retested after repairs are made.

D. Shop Erection.

1. The truss shall be fabricated with geometric angles and shall use full chord or progressive chord assembly meeting or exceeding the following criteria.

a. Full Chord Assembly: The full length of each chord (upper and lower) for each truss is assembled with geometric angles at the joints. Chord connection bolt holes are drilled/reamed while members are assembled. The truss web member (vertical and diagonal member) connections are drilled/reamed to steel templates set by relating geometric angles to the chord lines. At least one end of each truss web member shall be milled or scribed at right angles to its long axis. The templates at both ends of the member shall be positioned accurately from the milled end or scribed line.

b. Progressive Chord Assembly: Adjacent chord sections are assembled in the same way as specified for Full Chord Assembly but assembled in stages longitudinal over the full length of the truss. The first stage shall include at least five adjacent panels of chord. After the first stage has been completed, each subsequent stage shall be assembled to include three panels of chord of the previous stage and two or more panels of chord at the advancing end. The previous stages shall be repositioned if necessary and pinned to ensure accurate alignment. The Span 3 end of the truss shall have a minimum of seven adjacent panels of chord assembled at one time (all of Span 3 assembled).

c. All members entering a joint shall be adjusted to the final geometric angle before drilling/reaming is started.

d. The final geometric angle is the angle of the deflected structure as determined from the final geometry defined in the plans.

e. It is noted that upper and lower chords cannot be connected during shop assembly at more than one point.

f. The Contractor shall submit their proposed method for obtaining the correct geometric angles between truss members to the Engineer for acceptance at the time shop drawings are submitted.

g. If the Contractor uses computer numerically controlled drills to drill full size holes for the truss connections, the same assembly procedures shall be followed to prove and record the geometry and accuracy of the fit and matching for connecting holes with bolts fully entered in each hole. Any inaccuracies and out of tolerance are the Contractor's responsibility to correct through refabrication of members or plates.

2. Within the requirements for progressive assembly of Article 2408.03, J, of the Standard Specifications, the full floor system (including lower chords, floor beams, stringers, diaphragms, lower lateral bracing, and their connections) shall be assembled as a unit in the shop.

3. Individual portal frames shall be fully assembled in the shop (including portal bracing, verticals or diagonals, top struts, floor beams, and their connections).

4. All truss work points for cambered shape of each truss shall be surveyed, recorded, and submitted to the Engineer for acceptance. All shipments shall be held until the Engineer has accepted the fabricated geometry. If high strength bolts are used for shop fit-up, they shall be discarded and new bolts shall be used to erect the truss in the field. Thermal corrections shall be accounted for in all recorded geometry. Acceptance shall not relieve the Contractor of the responsibility and liability to comply with meeting the final geometry and tolerances at end of construction.

E. Tolerances.

In addition to the requirements of Section 2408 of the Standard Specifications, Materials I.M. 563, Materials I.M. 564, and the AASHTO/AWS D1.5 Bridge Welding Code, the following tolerances are specified for the truss structure. All measurements shall be corrected to 50°F baseline temperature to compare against tolerances.

1. The tolerances specified herein are combined tolerances for fabrication and erection to satisfy design requirements. Meeting these tolerances does not guarantee or address fit-up tolerances related to specific means and methods of construction.

2. Truss Chords, Diagonals, and Verticals Members:
   - **a.** Straightness within each member: ± 3/8 inch
   - **b.** Length: ± 1/8 inch each member
   - **c.** Straightness (out of plane) in any portion of a truss plane after assembled: ± 3/8 inch per 100 feet
   - **d.** Cumulative straightness (out of plane) for an entire truss plane assembly between piers: ± 3/4 inch
   - **e.** Cumulative camber (in plane) for an entire truss plane assembly between piers: ± 3/4 inch

3. Floor Beams:
   - **a.** Sweep: ± 1/2 inch
   - **b.** Total length: ± 1/4 inch
   - **c.** Camber: ± 3/8 inch

4. Truss Bracing and Struts:
   - **a.** Straightness (out of plane) each field section: ± 3/8 inch
   - **b.** Length: ± 1/4 inch each field section
   - **c.** Camber: ± 1/4 inch each field section

5. Cumulative total length tolerance for entire truss assembly:
   - **a.** From Pier 1 to W. Abut: +/- 1/2 inch
   - **b.** From Pier 1 to Pier 2: ± 1 inch
   - **c.** From Pier 1 to Pier 3: +/- 1 1/2 inch

6. For bearing sole plates in contact with truss integral node bottom plates apply the following tolerances for flatness:
   - **a.** 1/32 inch in 12 inches, and
   - **b.** 1/16 inch tolerance overall.

159010a.04 ERECTION PLAN AND PROCEDURES

The erection plan and procedures shall be certified by a Professional Engineer licensed in the State of Iowa meeting the qualifications of Article 159010a.03, B, 1.

A. Overview.

1. The erection plan refers in a general context to the combination of engineering drawings and erection procedures, including erection sequence, engineering calculations, lifting plans, geometry control and survey plans, corrective action plans, etc., describing and specifying the erection (i.e., the field-installation and member-placement) of the steel truss bridge.

2. The erection procedures shall describe the specific sequence, methods, equipment, and other directives developed by the Erection Engineer that the Contractor is to follow in erecting the steel truss bridge. All aspects of the erection plan shall be fully integrated and shall together describe and specify all aspects of how the steel truss bridge is to be erected, including, but not limited to, sequence of erection, monitoring and hold points, methods or techniques to be used, equipment to be used, and materials to be used along with any temporary works or other devices necessary.

3. The erection plan shall address all requirements for erection of the steel truss bridge into the final designed configuration and be supported by engineering calculations. Any and all written review comments provided by the Engineer shall be addressed to the Engineer's satisfaction prior to the start of erection. As a minimum, the erection plan shall include consideration of all items described in Articles 159010a.04, B, C and D.

4. The erection plan, including all drawings, calculations and procedures, shall be submitted as one package or in smaller stand-alone working packages, subject to the limitations of Article 1105.03 of the Standard Specifications, for review and acceptance by the Engineer. The complete erection plan, including compilation of any/all smaller stand-alone working packages, must be reviewed and accepted by the Engineer prior to starting the steel erection. Review, acceptance and/or comments by the Contracting Authority or its designated representatives shall not be construed to guarantee the safety or final acceptability of the work or compliance with all applicable specifications, codes, or contract requirements, and shall neither relieve the Contractor of the responsibility and liability to comply with these requirements, nor create liability for the Contracting Authority or its designated representatives. Changes to the erection plan in the field must be approved by the Erection Engineer and formally documented and submitted to the Engineer for acceptance prior to proceeding.

5. Should, due solely to the Contractor's erection plan, members, connections, supports, or any part of the structure require greater dimensions, properties, or capacities than those shown on the plans, these substitutions shall be provided at no additional cost to the Contracting Authority and shall be subject to the acceptance of the Engineer. Substitution of any part of the structure with lesser dimensions, properties, or capacities will not be permitted.

6. The Erection Engineer shall be onsite to review erection setup and progress prior to and during all critical operations of the erection, including at the start of any new operations, during any jacking, stressing, or releasing operations, during lifting or moving of assembled panel sections, during main span closure of the truss span, and as requested by the Engineer to witness or resolve erection or geometry challenges or discrepancies.

B. Erection Engineering Calculations.

1. Appropriate erection engineering calculations to substantiate the structural adequacy and stability of the bridge system for each step of the steel erection shall be performed to substantiate the erection plan and procedures. The calculations shall include, but not necessarily be limited to:
   - **a.** The expected bearing, shear, compression, and tensile forces, moments and stresses in the truss as produced with the Contractor's proposed sequence and method of erection.
   - **b.** Minimum and maximum vertical and horizontal reactions at all permanent and temporary support locations.
   - **c.** Design of any temporary foundations required to support falsework.

d. Design of all falsework and temporary bracing and subsequent temporary connections to the permanent structure.
e. Verification that the permanent structure is not overstressed during erection, including any forces applied to the permanent piers or adjacent structures.

2. At a minimum and as appropriate, erection engineering calculations shall conform to the following specifications:
a. AASHTO LRFD Bridge Design Specifications, 9th Edition
b. Guide Design Specifications for Bridge Temporary Works, AASHTO, 2nd Edition, 2017 with 2020 Interims
c. Guide Specifications for Wind Loads on Bridges During Construction, AASHTO, 1st Edition, 2017

3. The Erection Engineer shall provide structural calculations of the truss confirming final forces and stresses, including any locked-in stresses resulting from erection, within the truss members are within the acceptable tolerance for unfactored camber axial loads in final condition provided in the plans and provide revised camber and erection geometry based on the actual sequence of erection. The Erection Engineer shall update and resubmit their calculations if changes in erection procedures are made during erection or if adjustments are made to meet tolerances during erection to confirm final forces and stresses from erection within the truss members meet contract requirements.

4. Special wind concerns: Wind studies have been performed for the maximum cantilever erection stage in the conceptual erection sequence shown in the plans and indicate that vortex induced motions are not expected during construction. Deviations in configuration and loading from the conceptual erection sequence shown in the plans may warrant re-evaluation of the wind effects at the Contractor's expense.

5. Signed and sealed erection engineering calculations to substantiate the structural adequacy and stability of the erected structure and any associated temporary works and/or temporary components at all stages of erection prior to and at project completion shall be included in the erection plan and procedures submittal.

C. Erection Plan and Procedures.

1. The erection plan shall be complete in detail for all phases, stages, and conditions anticipated during erection. The erection plan shall include structural calculations and supporting documentation necessary to completely describe and document the means, methods, temporary support positions, and loads necessary to safely erect the truss in conformance with the contract documents and as outlined herein. The erection plan shall address and account for all items pertinent to the truss (structure) erection and its individual structural components (elements) including such items as sequencing, falsework, temporary shoring and/or bracing, structure and element stability, crane size, positioning, rigging pads, shoring and movement, means of access, pick points, structure and element shape, permissible deformations and roll, interim/final plumbness, element placement and connections, bolting and anchor bolt installation sequences and procedures, and blocking and anchoring of bearings. The Contractor shall be responsible for the stability of the partially erected structure during all phases of the truss erection.

2. The truss camber axial loads provided in the plans are for the unfactored axial loads in the truss members in final condition after erection and placement of all permanent loads at the end of construction. Camber loads are based on approximate theoretical weights of members and the conceptual erection sequence shown in the plans. Actual camber loads for fabrication shall be determined by the Contractor based on actual weights of members and components from shop drawings and the Contractor's proposed erection sequence. Camber loads shall be developed assuming trusses are pin connected with no offsets or secondary bending effects.

Camber load calculations shall be submitted to the Engineer for review and acceptance prior to submittal of shop drawings which incorporate these camber values. The Erection Engineer's erection sequence shall consider this fabrication geometry and its effects in fit up during erection.

3. Methods and procedures for verifying and correcting any discrepancies in the surveyed truss work point locations measured during fabrication (see Article 159010a.03, D) and during erection (see Article 159010a.04, D) shall be addressed in the erection plan and procedures.

4. The sequence and manner for installing or moving the truss to the final position and transferring loads to the permanent bearings as well as the sequence and provisions for casting the deck slab shall be addressed in the erection plan and procedures.

5. Details of the disposition and use of special erection equipment, falsework, jacking equipment, temporary bracing, etc., including all loads or reactions from such equipment applied to the structure during erection and sequences and timings of these effects in accordance with the erection plan and procedures shall be included.

6. A conceptual erection sequence representing the sequence of construction considered in the design of the truss superstructure has been included as part of the plans. The erection plan shall contain an erection sequence which may be similar to the conceptual erection sequence shown in the plans or may be an alternative sequence subject to limitations noted below. Utilization of the conceptual erection sequence shown in the plans as presented is not mandatory, but select steps in the conceptual erection sequence shown in the plans, as outlined in item 7 below, substantially impact loads within the truss in its final condition and are considered essential to achieve acceptable locked-in forces in the truss as designed, for any erection sequence proposed. If the Contractor elects to use the conceptual erection sequence shown in the plans, the Erection Engineer shall ascertain the practicality for their means and methods and shall assume complete responsibility for the erection sequence proposed in the erection plan and procedures. The Erection Engineer shall provide structural calculations of the truss confirming final forces and stresses, including any locked-in stresses resulting from erection, within the truss members comply with the unfactored camber axial loads in final condition acceptance range provided in the plans and provide revised camber and erection geometry based on the actual sequence of erection. Final forces and stresses within the truss members exceeding the acceptance range on the plans shall be subject to review and acceptance by the Engineer and require the Erection Engineer to provide calculations substantiating the variances in the final forces and stresses and provide reasonable explanations for why they may differ from the forces and stresses on the plans for review and acceptance by the Engineer.

7. At a minimum, the following steps and relative sequence, as indicated in the conceptual erection sequence shown in the plans, are considered essential to be included in the Contractor's erection sequence for purposes of achieving acceptable locked-in forces in the truss, as designed:

- **a.** Stage 4 – Simply supported truss span configuration shown with continuity and top bracing connection released.
- **b.** Stage 5 – Pour concrete deck in Spans 1 and 3 with continuity and top bracing connections released.
- **c.** Stage 6 – Install permanent continuity, including top bracing connection at top of Pier 2, prior to pouring concrete deck in Span 2.
- **d.** Stage 7 – Install permanent continuity including top bracing connection at top of Pier 1 and install in-plane bracing members as noted at Pier 1 and Pier 2 prior to adding remaining loads for final bridge configuration.
- **e.** Floor beam to stringer connection bolts in longitudinally slotted holes shall not be tightened until immediately prior to deck pours.

8. The following details, items, and considerations pertinent to the design of the permanent bridge related to the conceptual erection sequence shown in the plans are noted for information and consideration by the Contractor in developing their erection plan and procedures:

- **a.** Alternate erection methods and procedures to get to the simply supported truss span configuration shown in Stage 4 of the conceptual erection sequence shown in the plans are considered to be feasible to not substantially affect the final design loads in the structure. It is the responsibility of the Erection Engineer to satisfy the Engineer that such alternate erection methods and procedures satisfy contract criteria.
- **b.** Effects on the structure for cantilever erection beyond or additional loads than those shown in Stage 3 of the conceptual erection sequence shown in the plans have not been evaluated by the design engineer.
- **c.** Wind effects on the cantilever erected structure at Stage 3 of the conceptual erection sequence shown in the plans prior to lifting the center piece were analyzed and evaluated by the Wind Consultant for stability and deemed sufficient. Variations in configurations and loads may warrant re-evaluation of the wind effects at the Contractor's expense.
- **d.** The conceptual erection sequence shown in the plans assumes temporary tie downs at each truss plane at the West Abutment and Pier 3 for cantilever erection of the main span. Temporary tie downs, if used, shall be designed by the Erection Engineer and may include temporary anchors to engage the weight and uplift capacity of the foundations at the West Abutment and Pier 3. Tie down anchor connections to the truss, if any, shall be bolted and/or bearing type connections and any additional bolt holes shall be detailed in the truss shop drawings. Erection Engineer shall refer to the Geotechnical Report for uplift capacity of the foundations. Uplift reactions from the conceptual erection sequence shown in the plans are shown in the bearing tables on the plans. Capacity of foundations and truss members as designed have been confirmed to satisfy the uplift reactions on the plans, when used in conjunction with an acceptable tie-down connection designed by the Erection Engineer. Tie downs, if used, are likely to require minor adjustments to the gusset plate dimensions at the West Abutment and Pier 3 to attach or bear on the gusset plates. A possible tie down configuration could include transverse beams bearing on the top of the gusset plates over the bearing anchored by post-tensioned (PT) bars extending down into the shafts at the West Abutment or pier concrete at Pier 3. Consideration should be given to longitudinal movement requirements at the tie down system both for temperature and other environmental effects and main span closure.
- **e.** The conceptual erection sequence shown in the plans assumes permanent bearings in place during erection with bearings at Pier 2 temporarily blocked (restrained longitudinally) during cantilever erection with ability to slide for making closure of the main span. If permanent bearings are used during erection, it is the Contractor's responsibility to protect the permanent bearings from damage during erection. Temporary bearing supports may be used with permanent bearings installed later.
- **f.** Stressing of PT bars in Stages 2A and 2B of the conceptual erection sequence shown in the plans compensate for rotation and reduce stress during release of temporary continuity connections in Stage 4. Cantilever erection sequences shall consider the stressing of the PT bars at this stage or other means to limit locked-in effects on the completed structure.
- **g.** PT bar, bearing plate, and jack assemblies shown in the plans for temporary continuity stressing, connections, and release are conceptual. It is the responsibility of the Erection Engineer to design the final assemblies and any necessary supports for the members and jacking operations during erection, if used. Temporary PT bars, plates, jacking assemblies shown in the plans are not included in the steel quantities of the truss and, if used, are to be incidental to the pay item for Structural Steel.
- **h.** No welding to the permanent truss members will be allowed.
- **i.** Any temporary bolt holes for erection shall be filled and fully tensioned with new galvanized A325 bolts or F3148 bolts meeting project requirements after removal of temporary erection attachments.
- **j.** See plans for additional truss superstructure construction notes and assumptions considered as part of the conceptual erection sequence shown in the plans in the design of the truss.

9. The erection plan shall also include, but not necessarily be limited to:

a. Plan of Work Area.

1) A plan of the work area showing the proposed bridge,
2) The permanent support structures (piers and abutments),
3) Roads,
4) Railroad tracks, including construction clearance envelope,
5) Waterways including location and dimensions of all navigational channel(s) and any navigational clearances which must be respected during construction. Document in accordance with the USCG permit limitations and the Special Provisions for Maintenance of Navigation any temporary river traffic shut down for floating in the truss or other operations, as relevant. Include details, dimensions, and locations of floating equipment and temporary works,
6) Overhead and underground utilities,
7) Structures and conditions that may limit access (consideration of clearance requirements over roadways or railroads),
8) Staging and material storage areas documenting the proposed locations, limits, and remediation of the areas,
9) Right-of-way and property lines,
10) Restricted areas,
11) Information, plans, etc. regarding maintenance of traffic requirements, lane or road closures, restrictions, durations, etc. necessary to protect public safety for all erection operations over or adjacent to live traffic, and
12) Any other site or work area information that may be pertinent to the steel erection.

b. Erection Sequence.

The erection plan and procedures shall indicate the erection sequence for all primary members (including indication of any attached secondary members), noting the use of temporary support conditions, such as holding crane positions, temporary supports, falsework, etc. The erection sequence shall be shown in illustrative views of the bridge for each erection stage, highlighting the structural components to be erected, their weights and center of gravity locations, lifting crane locations for primary member picks, and any temporary support conditions that are necessary during the particular stage. The illustrative views shall be accompanied with a written narrative of the procedure to be followed by the steel erector, which shall state items such as structural components to be erected, use of temporary supports, use of temporary bracing, hold cranes, etc. Member reference marks, when reflected on the erection plan and procedures, should be the same as used on shop drawings.

c. Crane Information.

1) The erection plan and procedures shall show the location of each crane to be used for each primary member to pick, the crane type, crane pick radius, crane support methods (crane mats, barges, work trestles, etc.), and the means of attachment to the members being lifted or supported.
2) The erection submittal shall include capacity charts or tables that address and demonstrate the adequacy of each crane configuration, boom length, counterweight configuration, outrigger configuration, and pick weight required to do the proposed work including any restrictions or reductions in capacity required based on the barge for barge mounted cranes. The erection plan and procedures shall also indicate any potential above- or below-ground obstructions or restrictions to crane operations (such as existing structures, utilities, etc.).
3) In the event that the submitted cranes are not available at the time of construction, the Contractor can propose alternative cranes, subject to review and acceptance by the Erection Engineer and the Engineer. The submittal package for alternative cranes shall include capacity charts or tables that address and demonstrate the adequacy of each crane configuration, boom length, counterweight configuration, outrigger configuration, and pick weight required to do the proposed work; however, resubmittal of the full erection plan is not required.

4) Any plans associated with crane supports (such as crane mats, barges, work trestles, etc.) shall also be included. When applicable, manufacturers' certification documents or catalog cuts for pre-engineered devices or equipment may be used to meet this requirement; these items shall be included in the submittal and shall be subject to review and acceptance by the Engineer. Calculations for crane supports (crane mats, barges, work trestles, etc.) shall be included in the submittal.

d. Primary Member Crane Pick Information

The submittal shall include the lifting weight of the primary member picks, including all rigging and pre-attached elements (such as cross-frames or splice plates). It shall also include the approximate center of gravity locations for the primary member picks of non-symmetric girders and assemblies.

e. Lifting Devices and Special Procedures

1) The erection plan and procedures shall include the details, weight, capacity, and arrangement of all rigging (beam clamps, lifting lugs, etc.) and all lifting devices (such as spreader and lifting beams) required for lifting primary members. The submittal shall also specify details for rigging and lifting devices bolted to permanent members, including the capacity, as well as methods, time, and responsibility for removal. Lifting devices will not be allowed to be welded to permanent members.

2) As necessary, the submittal shall provide special lifting/handling procedures for any primary member with potential stability or slenderness issues.

3) The erection plan and procedures shall address transport of assembled components on barges, SPMT's, etc.

f. Bolting Requirements

The submittal shall indicate the bolting requirements for field splices and connections for each stage of erection. Before tightening permanent bolts in field connections, adjust and maintain the connections at correct relative grade and alignment with respect to the calculated target geometry for that stage of erection. Blocking and Falsework requirements of Article 2408.03, R, 1, of the Standard Specifications need not apply to this truss.

g. Bearing Blocking and Tie-Down Details

The submittal shall indicate blocking and/or tie-down details for the bridge bearings, and associated force demands as necessary.

h. Load Restrictions

Restrictions regarding wind speed, construction dead and live loads, jacking loads, and any other applicable loading restrictions shall be included in the submittal, as necessary.

i. Temporary Supports

1) The submittal shall include the location and details of temporary support structures and bracing. If the temporary support is prefabricated (selected from a supplier's catalogue), the type and capacity shall be defined in the submittal, as necessary; lateral capacity as well as vertical capacity requirements shall be considered as appropriate. If the temporary support is to be constructed by the Contractor, a complete design with full details, including member sizes, connections, and bracing elements shall be provided in the submittal in accordance with Article 2408.03, L, of the Standard Specifications. In either case, details regarding the upper grillage and temporary bearing assembly (i.e., details of how the structure will bear on the temporary support), including the top of falsework (bottom of structural steel) elevations, shall also be included in the erection plan and procedures. In addition, all foundation requirements for temporary support structures shall be provided in the submittal.

2) The submittal shall indicate the location of hold cranes that are used to provide temporary support to the steel assembly and the associated crane loads. The hold crane type, capacity, boom lengths, pick radius, and means of attachment to the girders shall also be indicated in the submittal.

3) The submittal shall include the location and details for temporary tie-downs that are required to facilitate the steel erection, as well as the associated tie-down loads. At a minimum, the details shall include the tie-down, attachment devices, and anchoring devices.

4) The submittal shall clearly indicate when, and under what conditions, any temporary supports or holding cranes may be released in the erection sequence, and if they may be left in place while subsequent erection proceeds.

5) The submittal shall clearly indicate appropriate restraint of members from twisting and/or layover at supports. Members should be restrained from twist and/or layover at supports unless the need for such restraint is demonstrated to be unnecessary by appropriate analysis in the erection engineering calculations.

j. Jacking Devices.

The submittal shall indicate jacking devices that will be required to complete the steel erection. Their location, type, size, and capacity shall be indicated, as well as their intended use, sequence of engagement, load level, jack pressure table, and any other key parameters of their operation. Jacking devices shall be calibrated within 30 days prior to beginning use and every 6 months thereafter at a minimum. Jacking device calibration records shall be submitted to the Engineer for acceptance prior to use and after every calibration.

D. Geometry Control and Survey Plan.

1. The Contractor shall be responsible for conceiving and implementing a system of monitoring work points that allows for accurate verification of all truss work points during each stage of erection and comparing their relative relationship with the dimensions measured during shop erection (see Article 159010a.03, D). The geometry control and survey plan shall instruct how relationship between shop and field measurements are to be correlated and shall document target geometry as well as permissible deviations from target geometry for each stage throughout construction to maintain work within tolerances, as well as potential corrective actions to control or bring elements back into tolerance. The Contractor shall record the station, offset and elevation of the work points for each survey and submit to the Erection Engineer for their review and confirmation that work is proceeding per plan. The Erection Engineer's review shall be submitted to Engineer for review and acceptance. Any geometry discrepancies identified during survey shall be addressed by the Erection Engineer with proposed corrective action for review and acceptance by the Engineer prior to proceeding. Discrepancies that result in changes to locked-in forces due to as-built fabrication and construction deviations shall be tracked and documented by the Erection Engineer with revisions to the erection plans, procedures, and calculations as applicable, and are subject to review and acceptance by the Engineer prior to proceeding. All surveys shall be performed in the early morning hours to limit the differential effects of the sun. The following shall be considered minimum requirements for survey scope and frequency:

a. On both sides of the structure at each location surveyed.
b. As truss erection progresses to the next panel point.
c. Prior to and after removal of any temporary supports.
d. Prior to and after lifting any center closure segments.
e. After closure of the completed truss steel and prior to release of temporary continuity connections.
f. After release of temporary continuity connections and prior to Span 1 and Span 3 deck pours.
g. After Span 1 and Span 3 deck pours and prior to installing permanent continuity at top of Pier 2.
h. After Span 2 deck pour and prior to installing permanent continuity at top of Pier 1.
i. After all superstructure steel has been erected, all temporary bracing has been removed and the structure is resting on its final bearing supports.
j. After all dead loads have been placed on the structure.
k. The Engineer may request additional surveys at no additional cost to the Contracting Agency, should the Contractor's erection sequence vary substantially from the conceptual erection sequence shown in the plans.

2. All erection equipment, deck formwork and other items that affect the deflected shape of the structure shall be removed from the structure for the duration of these surveys or compensated for in the deflection calculations performed by the Erection Engineer.

3. Maintain a log of construction surveys for the erection, including all adjustments required to correct and/or normalize alignments and elevations. Record the time, temperature, and location of all construction loads for each entry. Sign each entry and submit to the Erection Engineer for signature prior to submitting to the Engineer.

159010a.05 SUBMITTALS.

The Contractor shall provide the following submittals for review by the Engineer:

A. The first deliverable shall be a list of submittal packages the Contractor is planning to provide along with the dates they will be submitted. The list of submittal packages shall be provided a minimum of 14 days prior to submittal of any of the packages below.

B. The Engineer shall be allotted review duration for the first review of a submittal as specified below. The Engineer shall be allotted review duration for each resubmittal as specified in Article 1105.03.E of the Standard Specifications.

C. Truss shop drawings shall be submitted a minimum of 75 days before the start of fabrication of the respective element. The Engineer shall have 45 days for the first review of a drawing, Truss shop drawings may be submitted in smaller working packages provided information related to sections of the truss submitted are complete for items being reviewed and a logical interface between packages is maintained.

D. Truss fabrication and welding certifications and procedures shall be submitted a minimum of 75 days before the start of fabrication of any element of the truss. The Engineer shall have 45 days for the first review of the certifications and procedures.

E. Truss shop erection setup and procedures shall be submitted a minimum of 75 days prior to the erection in the shop. The Engineer shall have 45 days for the first review.

F. Truss tolerance verification procedures for fabrication and erection shall be submitted a minimum of 75 days prior to fabrication and erection respectively of elements affected. The Engineer shall have 45 days for the first review.

G. The erection plan, procedures, drawings, and calculations shall be submitted a minimum of 90 days before the start of erection of any elements of the truss superstructure. The Engineer shall have 45 days for the first review . Components of the erection plan related to erection site preparation shall be submitted a minimum of 60 days prior to beginning prepping the site for construction. The Engineer shall have 30 days for the first review. The erection plan, procedures, drawings, and calculations may be submitted in smaller working packages provided information related to sections of the plan and procedures are complete for items being reviewed and a logical interface between packages is maintained.

H. The geometry control and survey plan shall be submitted a minimum of 75 days before the start of erection of any elements of the truss. The Engineer shall have 45 days for the first review.

I. A communications plan shall be submitted a minimum of 75 days before the start of erection of any elements or transport of the truss. The communications plan shall include the authority to stop erection or transport, communications hardware, communications approach, and coordination with third parties such as the US Coast Guard. The Engineer shall have 45 days for the first review.

159010a.06 CONSTRUCTION.

A. The Contractor is completely responsible for protection of the structural integrity of the truss structure from fabrication to final acceptance. Any damage to any part of the structure during erection shall be repaired or replaced by the Contractor, to the satisfaction of the Engineer at no additional cost to the Contracting Authority.

B. The Contractor shall be responsible for maintaining temporary work/staging areas.

C. Any damaged painted/coated areas of the structural steel shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

D. Changes in the accepted erection plan and procedures shall not be allowed unless approved and signed by the Erection Engineer and accepted in writing by the Engineer.

E. Upon completion of construction operations and Engineer acceptance of final superstructure placement, all temporary attachments shall be removed and bridge coatings restored, all equipment shall be removed, and all existing ground lines and site conditions modified by the Contractor to facilitate construction activities shall be restored to the undamaged existing condition prior to construction unless accepted otherwise by the Engineer.

F. The Contractor shall coordinate all restrictions to river traffic with the U.S. Coast Guard in accordance with Special Provisions for Maintenance of Navigation.

G. The Contractor shall coordinate all work adjacent and over the railroad with the railroad in accordance with Developmental Specifications for Construction or Maintenance Work on Railroad Right-of-Way (Dakota, Minnesota, & Eastern Railroad Corporation DBA Canadian Pacific).

159010a.07 METHOD OF MEASUREMENT.

No~~ne~~ measurement will be made.

159010a.08 BASIS OF PAYMENT.

A. All costs of furnishing, submitting, and revising the Truss Erection Plan shall be included under lump sum bid item Truss Erection Plan.

B. ~~This work shall not be paid for separately but~~ All work not included under the bid item Truss Erection Plan shall be included in the ~~pay~~ bid item for Structural Steel.