

Steel Bridge Erection Guide Specification S10.1

Western Bridge Engineers' Seminar
Boise, Idaho
September 25, 2007

William McEleney
National Steel Bridge Alliance





Topics

Definitions
Erector Qualifications
Erection Procedures
Transportation
Material Storage
Bearings and Anchorages
Assembly
Field Connections
Inspection
Repair
Appendices / Samples



Definition

- Steel erection begins when loading for shipment at fabrication plant
- Steel erection is complete when all field connections (bolts and/or welds) are complete to the final design condition and any falsework is/can be removed



Erector Qualifications

- Requires pre-qualified erector
 - any one lift using two or more cranes/derricks/poles
 - erection with floating equipment
 - spans over navigable water or active railroad/rapid transit tracks
 - phased construction requiring lane closures combined with active lanes



Erector Qualifications

- Requires pre-qualified erector
 - girders with significant curvature
 - span $< 200'$; radius $< 1100'$
 - $200' < \text{span} < 250'$; radius $< 1200'$
 - $250' < \text{span}$; radius $< 1500'$
 - girders with significant skew
 - angle greater than 30 degrees
 - and/or primary member field splices
 - except for rolled beam bridges with no more than 1 field splice per girder line



Erector Qualifications

- Pre-qualified erector
 - Competent erection contractor
 - extensive knowledge, training and experience
 - demonstrated technical proficiency
 - ability to resolve common problems associated with the complexity of the work proposed
- Consider AISC Certification Erector
 - AISC Advanced Certified Steel Erector



Erection Procedure

- Submitted to Owner
- Drawings – site plan, utilities, crane locations, erection sequence, etc
- Calculations – temporary supports, girder stability, rigging
- Coordination – follow on operations (e.g. deck pour)
- Prepared by “qualified” P.E., i.e. with experience in steel erection



Transportation

- Contractor responsibility to coordinate delivery
- Shipping plan required
 - support, lateral bracing, tie down points



Material Storage

- Keep clean
- Store beams/girders upright
- Bolts – in covered structures
- Weld consumables – per AWS



Bearings & Anchorages

- Site survey prior to start of erection
 - anchor bolt locations, bearing seat elevations
- Block (restrain) bearings during steel erection



Lifting and Assembly

- Follow procedure
- Commentary recognizes changing jobsite conditions
- Bolting sequence
 - fill 50% of holes prior to crane release
 - distributed between web & flanges



Field Connections

- Bolted - RCSC Bolt Specification
 - permits any of 4 methods
- Welded - AWS D1.5, with some limitations



Inspection

- Installation tolerances – for rolled beam or plate girders, steel dead load only
 - Horizontal, vertical alignment
 - Web position (plumbness), from position defined by Engineer
- Bolt tensioning, per RCSC Bolt Specification
- Weld inspection



Repair

- Contractor to identify damage, propose repair



Appendices

- Rotational Capacity test procedure
 - long (normal) bolts – Appendix 1
 - short bolts – Appendix 1A
- Load Indicating Washer verification test procedure – Appendix 2

Appendix 1

Rotational Capacity Test

(Long Bolts in Tension Calibrator)

FHWA Report No. FHWA-SA-91-031, dated May 1991, Appendix A1, Procedure for Performing Rotational Capacity Test, Long Bolts in Tension Calibrator

Equipment Required:

1. Calibrated bolt tension measuring device of size required for bolts to be tested. Mark off a vertical line and line 1/3 of a turn, 120 degrees; and 2/3 of a turn, 240 degrees, from vertical in a clockwise direction on the face plate of the calibrator.
2. Calibrated torque wrench.
3. Spacers and/or washers with hole size no larger than 1/16 in. greater than bolt to be tested.
4. Steel section to mount calibrator. Flange of girder or cross frame accessible from the ground is satisfactory.

Procedure:

1. Install nut on bolt and measure stick out of bolt when 3 to 5 full threads of the bolt are located between the bearing face of the nut and bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.
2. Install the bolt into the tension calibrator and install the required number of shim plates and/or washer (one washer under the nut must always be used) to produce the thread stickout measure in Step 1.
3. Tighten bolt using a hand wrench to the snug tensions listed below –0 kips, +2 kips



Samples

- Erection Procedure checklist
- Erection Inspection checklist
- Sample Erection Procedures – straight girder, curved girder

AASHTO / NSBA STEEL BRIDGE COLLABORATION

Erection Procedure Checklist

PART 1 – DRAWING

- PLAN:**
- To scale plan of work area showing supporting structures, roads, railroads, waterways, overhead & underground utilities, adjacent structures, etc.; and framing plan with member shipping marks <match those used on shop drawings> and field splice locations if applicable
 - Location of temporary supports, falsework, holding cranes
 - Location of crane positions on plan showing pick radii
 - Elevation view of crane and member Included Not Applicable
 - Crane Support Method: barges, mats Included Not Applicable
 - Member delivery location and orientation
- DETAILS:**
- Detail and arrangement of member rigging: show sizes, capacities, and location of center of gravity of each pick
 - Falsework and temporary support details: show sizes and capacities
 - Crane capacity chart indicating crane type, lifting capacity at given radius and orientation, counterweight requirements, and boom length
 - Pick weight chart indicating weight of member, plus rigging and any attachments
 - Written procedure indicating erection sequence for primary and secondary members (crossframes, diaphragms, etc.), including the following: method of tie down of individual pieces, time and method of connections of diaphragms and lateral bracing and field splices

PART 2 – CALCULATIONS

- Calculations for load capacity and stability of temporary supports for structure: falsework, tie downs, lifting beams, spreader beams, etc.
Calculations indicating capacity of temporary crane supports: Included Not Applicable
- Calculations to substantiate structural integrity and stability of members prior to completion of bridge assembly
- Calculations indicating structural integrity of any partially bolted primary splice after release of external support system
- Calculations to substantiate structural integrity of abutments and retaining walls affected by surcharge from crane

PART 3 – ASSOCIATED DATA

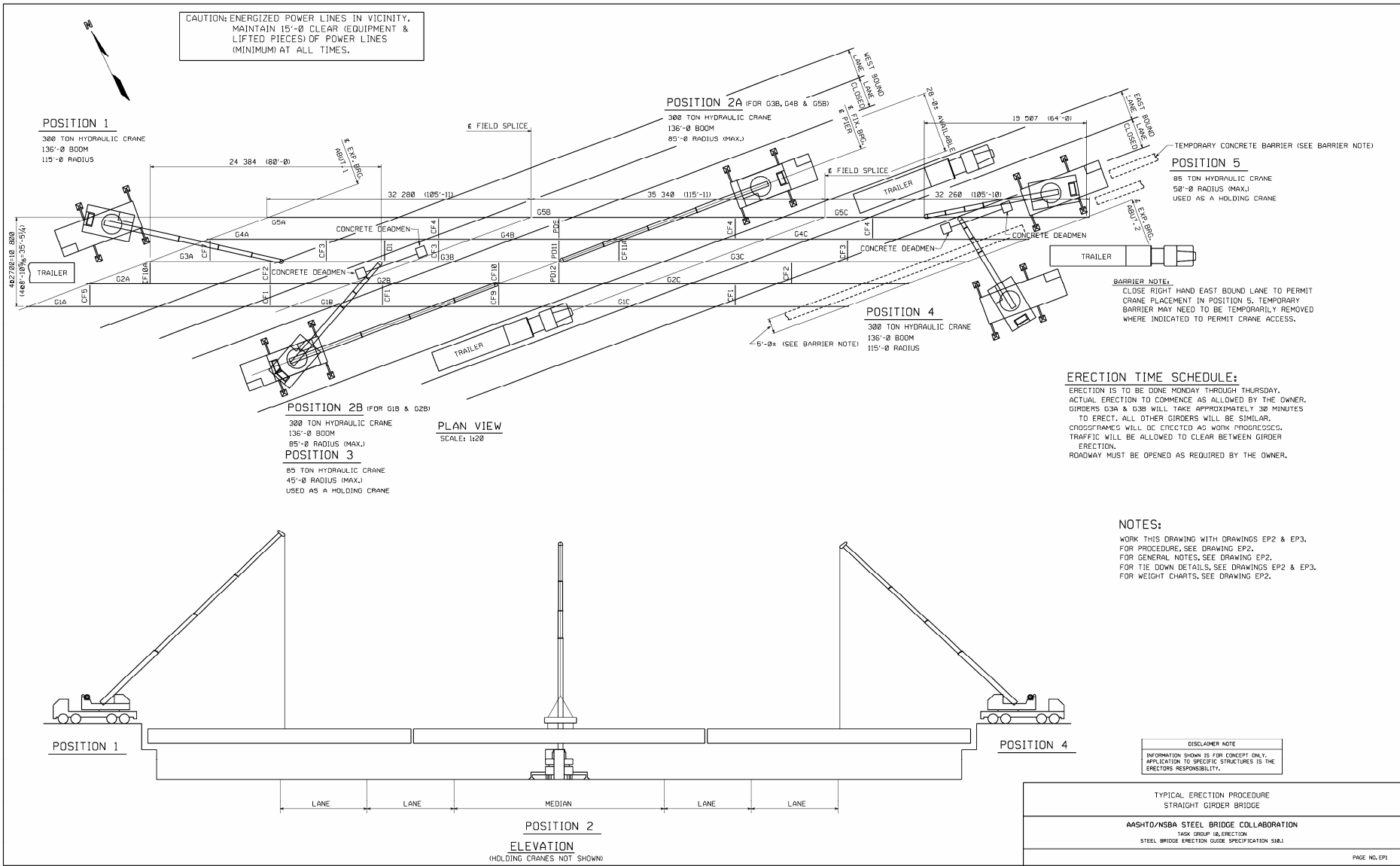
- Manufacturer's cut sheets for rigging devices: beam clamps, slings, wire rope, shackles, turnbuckles, chains, straps, etc., and pre-engineered falsework, if applicable
- Statement as to status of coordination with parallel entities requiring review: railroads, Coast Guard, Corps. Of Engineers, etc.

PROJECT DESCRIPTION _____

COMPLETED BY _____

<RECTOR COMPANY NAME> <QUALIFIED INDIVIDUAL NAME>

CAUTION: ENERGIZED POWER LINES IN VICINITY. MAINTAIN 15'-0" CLEAR (EQUIPMENT & LIFTED PIECES) OF POWER LINES (MINIMUM) AT ALL TIMES.



POSITION 1
300 TON HYDRAULIC CRANE
136'-0" BOOM
115'-0" RADIUS

POSITION 2A (FOR G3B, G4B & G5B)
300 TON HYDRAULIC CRANE
136'-0" BOOM
85'-0" RADIUS (MAX.)

POSITION 5
85 TON HYDRAULIC CRANE
50'-0" RADIUS (MAX.)
USED AS A HOLDING CRANE

POSITION 2B (FOR G1B & G2B)
300 TON HYDRAULIC CRANE
136'-0" BOOM
85'-0" RADIUS (MAX.)
POSITION 3
85 TON HYDRAULIC CRANE
45'-0" RADIUS (MAX.)
USED AS A HOLDING CRANE

PLAN VIEW
SCALE: 1:20

POSITION 4
300 TON HYDRAULIC CRANE
136'-0" BOOM
115'-0" RADIUS

BARRIER NOTE:
CLOSE RIGHT HAND EAST BOUND LANE TO PERMIT CRANE PLACEMENT IN POSITION 5. TEMPORARY BARRIER MAY NEED TO BE TEMPORARILY REMOVED WHERE INDICATED TO PERMIT CRANE ACCESS.

ERECTION TIME SCHEDULE:

ERECTION IS TO BE DONE MONDAY THROUGH THURSDAY. ACTUAL ERECTION TO COMMENCE AS ALLOWED BY THE OWNER. GIRDERS G3A & G3B WILL TAKE APPROXIMATELY 30 MINUTES TO ERECT. ALL OTHER GIRDERS WILL BE SIMILAR. CROSSFRAMES WILL BE ERECTED AS WORK PROGRESSES. TRAFFIC WILL BE ALLOWED TO CLEAR BETWEEN GIRDER ERECTION. ROADWAY MUST BE OPENED AS REQUIRED BY THE OWNER.

NOTES:

WORK THIS DRAWING WITH DRAWINGS EP2 & EP3. FOR PROCEDURE, SEE DRAWING EP2. FOR GENERAL NOTES, SEE DRAWING EP2. FOR TIE DOWN DETAILS, SEE DRAWINGS EP2 & EP3. FOR WEIGHT CHARTS, SEE DRAWING EP2.

DISCLAIMER NOTE
INFORMATION SHOWN IS FOR CONCEPT ONLY. APPLICATION TO SPECIFIC STRUCTURES IS THE ERECTOR'S RESPONSIBILITY.

TYPICAL ERECTION PROCEDURE STRAIGHT GIRDER BRIDGE
AASHTO/NSBA STEEL BRIDGE COLLABORATION TASK GROUP 1A, ERECTION STEEL BRIDGE ERECTION GUIDE SPECIFICATION 518.1
PAGE NO. EPI



www.steelbridges.org

Bill McEleney
mceleney@nsbaweb.org
401.943.5660



Bill McEleney

mceleney@nsbaweb.org

401.943.5660