Guidelines for Design Details

AASHTO/NSBA Steel Bridge Collaboration
Preface

This document is a standard developed by the AASHTO/NSBA Steel Bridge Collaboration. The primary goal of the Collaboration is to achieve steel bridge design and construction of the highest quality and value through standardization of the design, fabrication, and erection processes. Each standard represents the consensus of a diverse group of professionals.

It is intended that Owners adopt and implement Collaboration standards in their entirety to facilitate the achievement of standardization. It is understood, however, that local statutes or preferences may prevent full adoption of the document. In such cases Owners should adopt these documents with the exceptions they feel are necessary.

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AASHTO Document No: NSBAGDD-1-OL
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ALL STRUCTURAL STEEL, FOR PRINTED PROJECTS, SHALL BE ASTM A992, GRADE 50, EXCEPT THAT STIFFENERS, INTERMEDIATE AND END CHORDmembers, AND LATERAL BRACING MAY BE GRADE 36. USE ASTM A36-95 FOR ALL MATERIAL ON UNPRINTED JOBS.

ALL BOLTS FOR PRINTED STEEL SHALL BE M20-TYPE 1 (M20X2.0) WITH HIGHLY CAPACITY TESTED (HC) ALL BOLTS FOR UN-PRINTED STEEL SHALL BE M20-TYPE 3 (ROTATIONAL CAPACITY TESTED (RC)) ALL STRUCTURAL STEEL SHALL BE PRODUCED DOMESTICALLY OR DOMESTICALLY ON FEDERAL R&D PROJECTS.

FRACTURE CRITICAL MEMBERS:

DESIGN PLANS SHALL DESIGNATE EACH MEMBER OR COMPONENT THAT MUST MEET THE MATERIAL REQUIREMENTS FOR FRACTURE CRITICAL MEMBERS. THE SPECIAL PROVISIONS FOR FRACTURE CRITICAL SHALL CONFORM TO THE PROVISIONS OF THE CURRENT AASHTO FRACTURE CONTROL PLAN. THE FABRICATION MUST HAVE THE AASHTO FRACTURE CRITICAL ENGAGEMENT.

FABRICATION:

FABRICATION SHALL BE PERFORMED IN ACCORDANCE WITH THE NSRP/AASHTO COLLABORATION JDC 521-2002 "STEEL BRIDGE FABRICATION GUIDE SPEC." FABRICATIONS OF STRUCTURAL STEEL SHALL HAVE THE APPROPRIATE NSRP QUALITY CERTIFICATION.

WELDING:

1. WELDING DETAILS AND THE WELDING OPERATIONS SHALL BE IN ACCORDANCE WITH THE CURRENT EDITION OF THE AASHTO/ANSI D1.5 BRIDGE WELDING CODE. WELDING PROCEDURES SHALL BE SUBMITTED AND APPROVED PRIOR TO WELDING ON PROJECT. NON-DESTRUCTIVE TESTING SHALL BE PERFORMED AS REQUIRED BY THE CURRENT EDITION OF THE AASHTO/ANSI D1.5 BRIDGE WELDING CODE.

2. THE FOLLOWING MEMBERS ARE CLASSIFIED AS THE BRIDGE STRUCTURAL MEMBERS IN ACCORDANCE WITH THE CURRENT EDITION OF THE AASHTO/ANSI D1.5 BRIDGE WELDING CODE:
   a. EXPANSION JOINTS
   b. ORTHOGONAL STRUCTURAL MEMBERS
   c. OTHER MISCELLANEOUS MATERIAL

FIELD CONNECTIONS:

ALL BOLTED CONNECTIONS SHALL USE 7/8" DIAMETER ASTM A325 BOLTS UNLESS OTHERWISE NOTED, INSTALLED PER THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RSCC), BOLTS FOR GLI CRITICAL CONNECTIONS (SPICES, CURVED BEAM-TO-BEAM BRACING) SHALL HAVE ROTATIONAL CAPACITY TESTING (RC).

PRINTING IF REQUIRED:

STRUCTURAL STEEL SHALL BE PRINTED WITH A CORTEN SYSTEM IN ACCORDANCE WITH THE APPROPRIATE SECTION OF THE DESIGN DRAWINGS AND THE RESEARCH/NSRP DOCUMENT ON PRINTING (1006). SB-1-2006/"GUIDE SPECIFICATIONS FOR INORGANIC ZINC-RICH PRIMER BASED COATING SYSTEMS AND SB-3-2006/"STEEL BRIDGE FABRICATION GUIDE SPEC."

DRAWING PRESENTATION AND APPROVAL GUIDELINES:

DESIGN DRAWINGS SHOULD BE PREPARED IN ACCORDANCE WITH THE NSRP/AASHTO "DESIGN PLAN PRESENTATION GUIDELINES" G-2 DETAIL DRAWINGS SHOULD BE PREPARED IN ACCORDANCE WITH THE NSRP/AASHTO "SHOP DETAIL DRAWING GUIDELINES" G-2 SHOP DETAIL DRAWINGS SHOULD BE REVIEWED IN ACCORDANCE WITH THE NSRP/AASHTO "SHOP DETAIL DRAWING REVIEW/APPROVAL GUIDELINES" G-2
LONGITUDINAL & TRANSVERSE STIFFENER

NOTES FOR DESIGN DRAWINGS:

1. LOCATE ALL INTERMEDIATE STIFFENERS ON OPPOSITE SIDE OF WEB FROM LONGITUDINAL STIFFENERS WHERE POSSIBLE.
   LOCATE TRANSVERSE STIFFENERS ON EXTERIOR FACE OF FIBER GIRDERS.

2. PERFORM NON-DESTRUCTIVE TESTING ON LONGITUDINAL STIFFENER BUTT WELDS PRIOR TO ATTACHMENT TO SIDER WEB. WELD NOT DETAIL AS PER DESIGNER.

3. SEE SECTION C-E FOR STRESS REVERSAL ZONE AT STIFFENERS.

NOTES TO DESIGNERS:

1. AVOID THE USE OF LONGITUDINAL STIFFENERS WHEREVER THICKENING THE WEB PLATE MIGHT BE MORE ECONOMICAL.

2. CROSSTRAIN MAY INTERFERE WITH LONGITUDINAL STIFFENER DURING ERECTION. IF SO ELIP STIFFENER AS REQUIRED.

3. USE GROOVE WELD TRANSITION AND RIBS CUT ONLY WHEN REQUIRED BY DESIGN.

4. AVOID INTERSECTING TRANSVERSE AND LONGITUDINAL STIFFENERS BY LIMITING LENGTH OF THE LONGITUDINAL STIFFENER ON THICKENING THE WEB PLATE.

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

SLABBING & STRIPPING DETAIL

NOTES TO DESIGNERS:

1. STEEL MILLS NO LONGER MILL PLATES IN WIDTHS LESS THAN 45 INCHES. THE FABRICATOR'S MILL PLATES AND NEST THEM IN ORDER TO ECONOMIZE AND REDUCE SCRAP.

2. THE ENDS OF ORDERED PLATES ARE PREPARED AND THEN WELDED TOGETHER AS SHOWN. THE INDIVIDUAL FLANGE PLATE ASSEMBLIES ARE THEN FLAME CUT TO THEIR FINISHED WIDTHS BY MULTIPLE TORCHES. NON-DESTRUCTIVE TESTING MAY BE PERFORMED PRIOR TO OR AFTER STRIPPING BUT BEFORE MILLING THE FLANGE PLATE ASSEMBLIES TO THE WEB PLATES.

3. THE COST OF SLICING THE SLAB WHICH INCLUDES HANDLING, BEVELING, SANDING, AND TESTING WOULD BE SUBSTANTIALLY LESS THAN FABRICATING EACH FLANGE PLATE ASSEMBLY INDIVIDUALLY.

4. AVOID TRIMMING THE FLANGE WIDTH IN A SINGLE GIRDING SHAPING LENGTH. VARY THICKNESS INSTEAD. THIS WILL ELIMINATE EXTENSION TABS AND RUN-OFF BARS.

5. MINIMIZE CHANGES IN FLANGE PLATE THICKNESS. IT MAY BE MORE ECONOMICAL TO ELIMINATE A FLANGE SPLICE AND EXTEND THE THICKER FLANGE. THE COST OF A SPLICE MAY EXCEED THE MATERIAL COSTS.

6. IF DIFFERENT FLANGE PROWS ARE NEEDED FOR RIDGID CURVED GIRDER, VARY WIDTHS INSTEAD OF THICKNESS.

TYPICAL GIRDER DETAILS - II
& FLANGE SLABBING AND STRIPPING DETAILS

ARASHTO/NSBA STEEL BRIDGE COLLABORATION
TASK GROUP 1 SUBTASK - GROUP 14
GUIDELINES FOR DESIGN DETAILS

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NOTES FOR DESIGN DRAWINGS:

1. DETAILS SHOWN FOR 1/2 IN DIAMETER HIGH STRENGTH BOLT. DIMENSIONS WILL VARY FOR OTHER BOLT DIAMETERS.

2. BOLT SPACING SHOWN ARE PREFERRED MINIMUMS.

3. EDGE DISTANCES SHOWN ARE MINIMUM BOLTS ON SHOULDER OR GAS CUT EDGES PLUS AN ADDITIONAL 1/8 IN MATERIAL. THIS WILL PROVIDE A TOLERANCE FOR PUNCHING, DRILLING AND REMOVAL.

4. ALL SPlice PLATES SHALL BE DETAILLED WITH DIRECTION OF ROLLING PARALLEL TO STRESS DIRECTION.

5. ALL SPlice PLATES ARE SUBJECT TO CHARY A-WATCH REQUIREMENTS.

NOTES TO DESIGNER:

A. AVOID USING R//A BOLTS.

B. AVOID STICKED BOLT MANNERS.

C. VERIFY INSTALLATION CLEARANCE, REFER TO THE AISI MANUAL OF STEEL CONSTRUCTION, "BOLT CLEARANCE TABLES".

D. VERIFY THAT BOLT SPACING FOR FLANGE SPICES AND WEB SPICES DO NOT EXCEED BOLT SPACING REQUIREMENTS.

E. MAKE INSIDE SPICE PLATES SYMMETRICAL. USE A PREFERRED EDGE FOR 1/2 BOLTS. DO NOT SPECIFY MINIMUM EDGE DISTANCES. REFER TO LRFD FOR MINIMUM EDGE DISTANCE CRITERIA.

F. NORMALLY MINIMUM GAP BETWEEN END OF MEMBERS IS 1/2 IN. FOR DEEP CORNERS AT THE FABRICATOR'S REQUEST, THE GAP MAY BE GREATER AS LONG AS MINIMUM EDGE DISTANCE IS MAINTAINED.

G. FILL MAY BE REQUIRED AT FLANGE AND WEB SPICE. USE 1/2 MINIMUM THICKNESS, CVN NOT REQUIRED FOR FILLS. FILLS CAN BE OR 30.

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STANDARD BOLTED FIELD SPICES

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TASK GROUP 1, SUBTASK - GROUP 14
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PREFERRED INTERMEDIATE "X" TYPE CROSSFRAME

SEE NOTES A THRU M

NOTE 1

NOTE N

NOTE Q

NOTE R

NOTE S

NOTE T

NOTE U

NOTE V

NOTE W

NOTE X

NOTE Y

NOTE Z

NON-PREFERRED "KNOCK-DOWN" TYPE CROSSFRAME

(4 SEPARATE SHIPPING PIECES)

USE THIS TYPE OF CROSSFRAME SPARINGLY.

NOTE 1

NOTE 2

NOTE N

NOTE Q

NOTE R

NOTE S

NOTE T

NOTE U

NOTE V

NOTE W

NOTE X

NOTE Y

NOTE Z

FIELD WELDED "KNOCK-DOWN" TYPE CROSSFRAME

IN STATES THAT PREFER FIELD WELDED CROSSFRAMES THIS METHOD IS PREFERRED, PROVIDING NOTES 1 THRU 4 ARE INCORPORATED.
END CROSSFRAME DETAIL

- Use plate connection for additional notes and preferred connection details.
- Modify the distance between the bottom chord flange and the lower diaphragm component when lower chord trigger is used. Indicate modifications on the design drawings.
- See preferred connection plate detail on page 100 for welding.
- Tolerances are not necessary.
- Place channel on inner side of plates to keep plates in one plane for welding. Plate close to channel may be welded to channel prior to assembling in field.
- Show bolts only for all bent plates.
- At expansion joints, orient channel flanges and outstanding angle legs away from joint to avoid debries and corrosion.
- Design dowels for wheel load reactions if deck bends down to top strut.
- Design to allow fabricator to choose option.
- Use single members where possible. Avoid double members angles, channels, etc. Double members cannot be properly painted.
- Keep these dimensions the same as for the crossframe members.
- On skewed end crossframes, the geometry of the crossframe angles varies due to the end connection plate distortion caused by the bend load camber. Slotted holes or field welding may be required.

END CROSSFRAMES

ARASHTO/NSBR STEEL BRIDGE COLLABORATION

Task Group 1 Subtask - Group 1.4
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END DIAPHRAGM

INTERMEDIATE DIAPHRAGM

ALTERNATE DETAIL

TABLE-1

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<td>25 to 22</td>
<td>C 35 x 33.9</td>
<td>4</td>
</tr>
<tr>
<td>24 to 24 Depth</td>
<td>C 30 x 35</td>
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NOTES TO DESIGNERS:
A. CONSTANT AT EACH STRINGER, DIMENSION BASED ON REQUIRED SLAB MACHINING DEPTH.
B. MID DEPTH OF DIAPHRAGM AND STRINGER TYPICAL AT EACH STRINGER FOR SLOPING DIAPHRAGM.
C. AT EXPANSION JOINT, ORIENT CHANNEL FLANGES AWAY FROM JOINT OPENING.
D. MINIMUM MEDIAN AS PER AASHTO/NSBA FABRICATION 9.2.1

DISCLAIMER NOTE
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ROLLED SHAPE & BENT PLATE DIAPHRAGMS

ARASHTO/NSBA STEEL BRIDGE COLLABORATION
TASK GROUP 1, SUBTASK - GROUP 14
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GENERAL GEOMETRY FOR STEEL TUB GIRDERS

KEEP THE HORIZONTAL DIMENSION BETWEEN TUB SIZERS WITH TOP MT's CONSTANT AND RADIUS TUBS FOR THE REQUIRED BRIDGE CROSS SLOPE. AGE, SEE NOTE 6. THIS MAY RESULT IN THE TOP LENGTH OF THE EXTERNAL DIMENSIONS BEING DIFFERENT DUE TO CHANGES IN THE SUPER ELEVATION BUT WILL KEEP THE TUB SIZER CENTERLINES RELATIVE TO THE HORIZONTAL CONTROL LINE.

FRAMING PLAN GEOMETRY

1. BASIC INFORMATION REQUIRED:
- STATIONS AT PC, SC, PT, T, BRG, ETC.
- AZIMUTHS, BENDS IN OR SKIN ANGLED OF TUB / BRG.
- STATION AT CROSS SLOPE OF LINE WIDTH CHANGES.

2. SPACE CROSSFRAMES ALONG OF LONGEST SIZER FOR MAX. SPACING.

3. LOCATE FIELD SPLICES HEADING TO EACH TUB AND FROM PIER.

4. CROSSFRAME LOCATION BASED ON DESIGN, TRY TO KEEP LATERAL BRACING AT AN ANGLE BETWEEN 30 DEGREES TO 45 DEGREES TO UB WEB.

CROSS SECTION GEOMETRY

5. ROTATE TUB SIZER WITH CROSS SLOPE.

6. MAINTAIN CONSTANT TRUSSING, SHOE FOR ALL SIZERS ON A STRUCTURE.

7. MAINTAIN A CONSTANT DIMENSION FROM THE TOP OF DECK TO THE TOP OF THE WEB PLATE, SHOW THIS DIMENSION ON DESIGN DRAWINGS.

8. ALL TRANSVERSE SIZER LOCATIONS SHALL BE LOCATED HORIZONTALLY. DO NOT CONTROL THE CROSS LOCATIONS ALONG THE DECK.

9. USE A SINGLE BEARING ON CURVED AND OR SKINNED STRUCTURES, TO ALLOW FOR TRANSVERSE NOTATION OF TUB. NOTE BEARING DESIGN MUST ACCOMMODATE THIS NOTATION.

BASIC GEOMETRY - STEEL TUB GIRDERS

ARSHTO/NSBA Steel Bridge Collaboration

Task Group 1, Subtask - Group 14

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TYPICAL BRACING SCHEMES

NOTES TO DESIGNER

1. WHEN POSSIBLE, BOLT LATERAL BRACING DIRECTLY TO FLANGES.
2. KEEP LATERAL GUSSET PLATES RECTANGULAR.
3. USE INDIVIDUAL GUSSET PLATES FOR EACH LATERAL BRACE WHERE POSSIBLE.
4. BRACING CONNECTIONS TO THE FLANGES ARE MORE ECONOMICAL, THAN CONNECTIONS TO THE WEB, SINCE THEY INVOLVE FEWER COMPONENTS. AND BETTER FROM A DESIGN VIEWPOINT, SINCE IT PROVIDES A MORE DIRECT LOAD PATH.

AVOID X BRACING
REQUIRES MORE PIECES, HOLES, BOLTS, AND UNNECESSARILY STIFFENS GIRDER.

DO NOT USE THIS DETAIL
1. ANGLE BETWEEN BRACING AND GIRDER SHOULD NOT BE LESS THAN 30° DEGREES, 45° DEGREES IS AN IDEAL ANGLE.
2. TIES CAN BE USED TO DROP BRACING PLANE BELOW THE FORMWORK SUPPORTS. HOWEVER, IT MAY BE MORE ECONOMICAL, TO CUT FORMWORK AROUND THE BRACING MEMBERS. ANOTHER OPTION WOULD BE TO INCREASE THE HRAUNCH DIMENSION AND RAISE THE FORMWORK SUPPORT ANGLES, SEE SKETCH.

OPTIONAL HRAUNCH DETAIL
THIS DETAIL APPLIES TO STAY IN PLACE FORMS. DESIGNER TO INVESTIGATE IF SLIP FORMS CAN BE USED.

LATERAL BRACE BOLTED TO FLG
(PREFERRED - NOTE 1)

CONNECT CF TOP STRUT WHEN HEADC

LATERAL BRACE @ NARROW FLG
LATERAL BRACE & CF @ NARROW FLG

TUB GIRDER LATERAL BRACING

ARASHTO/NSBA STEEL BRIDGE COLLABORATION
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VALUES SHOWN ARE IN INCHES (NOTE 1)

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Do not provide geometric camber for tub girders since this information is normally given in a vertical plane and a tub is normal to the cross slope. The camber diagram for each web is based on a modified conical shape in the plane of the web plate, which is not in a vertical plane.

TUB GIRDER CAMBER DIAGRAM

Show Camber Data Along E Tub

NOTES FOR DESIGN DRAWINGS:

1. Cambers can be given in fractions, decimal of a foot or decimal inches. State clearly if dimensions are in feet or inches.

2. Camber information is shown for a tub girder.
Typical crossframe details for tub girder bridges

1. The bottom flange extension is required for flux support and the welding machine tracking. 1" min. Most fabricators prefer 1.5" min.

2. A gap of 3/16" is preferred. Designers to check 4 to 6" requirement. The gap at the bottom allows the web to flange welding to be made without interruptions. However, this detail may vary depending on the fabricator's equipment and procedures. Extending the stiffener to the flange without the use of the plates is acceptable.

3. Weld to flange whenever fatigue stress range permits. If required for fatigue, use a bolted tee plate. See detail "TP".

4. Fillers can be used to drop bracing plane below the formwork supports. However, it may be more economical to modify formwork around the bracing members.

5. Assembly bolts must not interfere with welding.

Usual assembly sequence

A. Web, top flange and stiffeners are usually fabricated as a sub-assembly prior to fitting to the bottom flange.
B. The crossframe is built in a jig as a sub-assembly, fit-up and welded. Note that all welding is made from inside. Bolted crossframes are preferred by most fabricators which minimizes rolling tubs to get proper position for welding.
C. The crossframe sub-assembly is then bolted to the web/top flange sub-assembly which will control shape for the final girder assembly.
D. The web/top flange sub-assembly with the crossframe bolted in place is then fitted to the bottom flange plate which has been blocked to its cambered shape. The web to bottom flange plate welds are then made.

Disclaimer note

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GENERAL NOTES

1. All structural steel shall be ASTM A572 unless otherwise noted.

2. All bolted connections shall be slip-critical.

3. Top flanges and webs of pier cap and diaphragm sec. flange critical, and shall meet the requirements of Chapter 12 of AASHTO/AISC 360-05.

4. Design top and bottom flanges of pier cap to be parallel, to ease in longitudinal gusset, this will eliminate using bevelled fillet plates.

CROSS SECTION GEOMETRY

5. Rotate tube gussets with cross slope.

6. Maintain constant thickness of web for all gusset on structure, vary distance between tubes if deck width requires.

7. Maintain constant distance from top of deck to top of web plate, show this dimension on design drawings.

8. All transverse gusset locations shall be located horizontally. Do not control the gusset locations along the deck.

9. Bearing stiffeners may be vertical or normal to flanges.

NOTES TO DESIGNERS

10. Avoid full penetration welds of plates or stiffeners to flanges.

11. See price no. 187 for additional applicable notes for access openings, bolt spacing, edge distances, welding, etc.

12. See page no. 187 for drilled holes notes.