STANDARD SPECIFICATION

GALVANIZED STEEL PRESS-BRAKE-FORMED TUB GIRDER (PBFTG) COMPLETE BRIDGE SOLUTION

a. Description. Design, load rate, and manufacture the Galvanized Steel Press-Brake-Formed Tub Girder (PBFTG) Complete Bridge Solution product according to the plans, the standard specifications and as contained herein. A manufacturer approved by the owner must produce the PBFTG Complete Bridge Solution product. The PBFTG shall be produced by the following manufacturer or approved equal:

Valmont Industries, Inc. - North American Structures
valmontbridgesales@valmont.com
800-533-5103

b. Design. Certify that the design of the PBFTG is in accordance with current AASHTO LRFD Bridge Design Specifications and as supplemented by the Standard Specifications for Bridge Construction, and any applicable structural specifications. Design live loading must be AASHTO LRFD HL-93 or as indicated on the plans. The design live loading must be indicated on the shop drawings submitted to the owner. The design must be sealed by a state-licensed Professional Engineer.

c. Shop Drawings. Furnish the Department with shop drawings of the PBFTG for approval. Include in the shop drawings the physical dimensions, methods of manufacture, structural steel dimensions, structural steel material properties, recommended installation procedure, design assumptions, design loads, and design calculations. Submit the shop drawings for review at least 30 calendar days prior to fabrication. The shop drawings must be sealed by a state-licensed Professional Engineer. Do not begin fabrication until written approval of the shop drawings has been received from the Engineer of Record.

d. Materials. Use materials meeting the requirements of the current version of AASHTO LRFD Bridge Construction Specifications:

1. **Structural Steel**. Use AASHTO M270, ASTM A709 Grade 50 T2 steel. The primary steel material used in the main girders, including all splice plates, shall be charpy v-notch tested for non-fracture critical components, Zone 2. Other requirements:
   A. ASTM A 709 Grade 50 T2
   B. Charpy Impact Requirements (Zone 2)
      - ASTM A673 and A370
      - less than or equal 2” thick
        - 15 ft-lbf @ 20° F
      - over 2 to 4” thick
        - 20 ft-lbf @ 20° F
   C. Frequency per Plate-
   D. Silicon content:
      - To 1-1/4” thick: .06% maximum
      - Over 1-1/4” to 6”: 0.15% to 0.40% (Aim for 0.15% to 0.25%)
   E. Mill analysis and test report required
   F. Plate tolerances to ASTM A 6
   G. Carbon Equivalent:

- 0.45% max. per the following formula:

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$

Comments:

- ASTM A572 Grd. 50/55 may be substituted via Engineering and Customer Approval.

2. **Shear Connectors.** Cold finished carbon steel shafting shall conform to AASHTO M 169 (ASTM A108). Grades 10160 through 10200, inclusive, shall be furnished unless otherwise specified in contract documents.
   A. Weld shear studs to steel surfaces and perform preproduction test as required in AASHTO/AWS D1.5 (2015).
   B. Shear connectors are to be installed prior to galvanization

3. **Galvanization.** Coating weight, surface finish, appearance, and adhesion shall conform to requirements of AASHTO M111, ASTM 123 Other requirements:
   A. Acceptable repair methods:
      - Repair shall be performed following ASTM A780 Annex A2. Repair Using Paints Containing Zinc Dust or Annex A3. Repair Using Sprayed Zinc (Metallizing).
   B. Repair Methods NOT allowed:
      - Repairs shall not be performed following ASTM A780 Annex A1. Repair Using Zinc-Based Alloys.
   C. Inspection requirements:
      - Inspection and testing of hot-dip galvanized coatings shall follow the guidelines provided in the American Galvanizers Association publication "Inspection of Products Hot-dip Galvanized after Fabrication".
      - Sampling, inspection, rejection and retesting for conformance with requirements shall be according to AASHTO M111, ASTM A123.
      - Coating thickness shall be measured according to AASHTO M111 and AASHTO M232 as appropriate.
   D. Bolted Connection Surface Condition. Per AASHTO LRFD Design Specifications 8th Edition, Slip Resistance surface conditions shall be Class C (Ks=0.30) for hot-dip galvanized surfaces.
      - No other surface preparation is required for galvanized faying surfaces.

4. **High Strength Bolts.** Use AASHTO M 164, ASTM F3125 Grade A325 High Strength Bolts, nuts, and washers.
   A. Type 1 Galvanized bolts shall be used as described in AASHTO M164.

5. **Bar Reinforcement for Structures**. Deformed bars, must meet the requirements of ASTM A 706 or of ASTM A 615, ASTM A 616, ASTM-96a, or ASTM A 617-96a for Grade 60 steel bars, unless otherwise required.

6. **Portland Cement Structural Concrete.** Produce and furnish concrete proportioned for the grades of concrete required in the plans and contract specifications. The minimum concrete compressive strength shall be as shown on the shop drawings. In the absence of a state-specific standardized concrete grade, the following requirements shall be met:

A. Design and Proportioning of Concrete Mixtures. Design a concrete mixture meeting the following requirements:
    - Air content of 5.0 percent to 8.0 percent, when installed in areas subject to freeze-thaw conditions.
    - 28-day compressive strength as shown on the plans.
    - Slump from ¾ inch to 2½ inches if not using water-reducing or retarding admixtures.
    - Chemical admixtures must be approved by the Engineer.
    - At least 564 pounds of cementitious material per cubic yard of concrete
    - Provide cementitious material with fly ash content no greater than 25 percent of the total weight of the cementitious material. Provide slag cement content no greater than 40 percent of the total weight. If using fly ash and slag cement in the same mixture, do not exceed 15 percent fly ash and 25 percent slag cement.

B. Portland Cement – Provide Type I, Type II, or Type III Portland cement meeting the requirements of ASTM C 150.

C. Aggregate – Provide aggregate materials in accordance with the contract specifications.

D. The concrete for the precast elements shall be air-entrained when installed in areas subject to freeze-thaw conditions, composed of Portland cement, fine and coarse aggregates, admixtures and water. Air-entrained concrete shall contain 6 ± 2 percent air. The air-entraining admixture shall conform to AASHT0 M154.

e. Steel Fabrication. PBFTG shall be manufactured by an AISC Certified Bridge Fabricator - Intermediate (IBR).

1. **Welding.** Any welding performed shall meet the requirements of AASHTO/AWS D1.5.
    A. No welding is allowed except where specifically shown on approved shop drawings.

2. **Bolt Holes.** All bolt holes required shall be drilled 1/8" larger than the fastener size.
3. **Cold-Bending.** Cold bend structural steel per the current AASHTO LRFD Bridge Construction Specifications, except as noted below:
    A. The minimum bend radii for cold-bending (at room temperature), measured concave to the face of the plate, shall be taken as 5.0 times the thickness of the base plate material.

4. **Inspection Hatch Opening.** Provisions shall be made to ensure interior visual inspection and drainage of girders.
    A. Inspection hatch cover shall rotate to allow entry.

5. **Handling.** Handle the PBFTG by a method approved by the manufacturer and Engineer.
    A. Do not drill holes in the PBFTG for lifting or handling.

6. **Product Marking.** Clearly mark the following information on the interior of each PBFTG with a steel ID tag seal welded to the member, or other means approved by the Engineer, at a location easily visible through the inspection hatch.
    A. Assembly part number.
    B. Customer order number.

C. Shop order number.

f. Tolerances. All PBFTG must meet the tolerances specified below.

TYPE OF PART	DIMENSION	ALLOWABLE DEVIATION FROM NOMINAL
PLASMA CUT PBFTG PLATE (PRIOR TO BENDING)	1. -WIDTH	+/- 0.13”
	2. -LENGTH (0’ – 144”)	+/- 0.06”
	3. -LENGTH (Greater than 144”)	+/- 0.13”
	4. -SQUARENESS (0’ – 144”)	+/- 0.13”
	5. -SQUARENESS (Greater than 144”)	+/- 0.25”
	6. -LAYOUT LINES FOR BENDING	+/- 0.13” in the flat
PRESS BRAKE BENDING	7. FLAT PATTERN	
	8. -LAYOUT LINE VERIFICATION	+/- 0.13” in the flat
	9. -BEND LOCATION	+/- 0.13” after forming
	10. FORMED ANGLES	+/- 1.00°
COMPONENT PARTS	11. -WIDTH or LENGTH	+/- 0.13” in the flat
	12. -LENGTH	+/- 0.13” in the flat
	13. HOLE LOCATION	+/- 0.03”
	14. BOLT HOLE SPACING	+/- 0.03”
	15. DRILL HOLE SIZE	+0.03”, -0”
	16. THERMAL CUT HOLE SIZE	+0.03” long, +0.06” wide
	17. INSPECTION ACCESS PORTAL	+/- 0.25”
	18. SOLE PLATE FLATNESS AFTER WELDING	+/- 0.06”
PBFTG ASSEMBLY	19. LINEAR DIMENSIONS AND ASSEMBLY COMPONENTS (unless noted otherwise on the drawing)	+/- 0.06”
	20. HOLE LOCATION	+/- 0.03”
	21. BOLT HOLE SPACING	+/- 0.03”
	22. DRILL HOLE SIZE	+0.03”, -0”
	23. THERMAL CUT HOLE SIZE	+0.03” long, +0.06” wide
	24. SLOTTED HOLE SIZE	+ 0.13”
	25. BOLTED SPICE GAP AT ENDS	+ 0.13”, - 0.19”
	26. STUD START LOCATION	+/- 0.06”
	27. CAMBER (LENGTH 0” TO 600”)	+ 0.25”
	28. CAMBER (FOR EVERY 120” IN EXCESS OF 600”)	Additional + 0.13”
	29. ANGLE FROM SQUARE	+/- 1 degree
	30. STUD TO STUD SPACING	
	Longitudinal	+/- 0.13”
	Across	+/- 0.25”
	31. STUD ANGULARITY	+/- 2 degrees

g. Weld Testing and Inspection. Test steel and provide inspection in accordance with below:

1. Primary Members
   A. 100% penetration groove welds loaded in shear with FCAW, GMAW or SMAW
      - 100% Visual, 100% Ultrasonic Test
   B. Fillet & PJP Groove welds welded with FCAW, GMAW, or SMAW
      - 100% Visual, 100% Magnetic Partial Test
2. Secondary Members
   A. Fillet & PJP Groove welds welded with FCAW, GMAW, or SMAW
      - 100% Visual
3. Other
   A. Stud welds
      - Shift Start Bend Test
      - 100% VT (in accordance with AWS D1.5 Clause 9.8)
   B. Weld repairs
      - Additional NDT shall be performed
      - NDT shall go 2" beyond the defect in all direction

h. Structural Concrete. This work consists of constructing concrete portions of bridges.

1. Portland Cement Structural Concrete. Produce and furnish concrete proportioned for the grades of concrete required in the plans and contract specifications.
2. Removable Concrete Forming. Construct forms true to the lines shown on the plans. Construct mortar-tight forms with net sections capable of withstanding impacts during placement and of supporting the weight of concrete through curing. Ensure constructed forms remain true to shape. Countersink bolts and rivet heads on the inside face of the forms.
3. Design clamps, pins, or other connecting devices to hold forms rigidly to rigidly hold forms together and allow removal without damage to the concrete.
4. Maintain metal forms free of rust, grease, or other material that may discolor concrete.
5. Bridge Deck Finishing Equipment. Provide transverse finishing capable of finishing concrete from bulkhead to bulkhead.
6. Permanent Metal Deck Forms. Use ASTM A 653 coating designation G210, Grade 50 steel, to fabricate permanent deck forms. Galvanize fasteners in accordance with AASHTO M 232.
7. Design forms, form supports, and attachments to carry construction loads and dead loads.

i. Installation.

1. **Handling and Storing Structural Steel Materials**. Store structural steel material on platforms, skids, or other supports above high-water elevations. Maintain materials free of dirt, oil, or other contaminants and protect from corrosion. Pad structural steel members in storage at points of contact. Pitch trough sections to provide drainage. Support long members at frequent intervals to prevent deflection. Handle, store, and brace members in the erected position to avoid distortion, unless otherwise authorized by the Engineer.
   A. Handle fabricated structural steel members and primary components of main members with clamps or plate hooks that do not leave nicks, gouges, or depressions. Repair damage to main members using methods approved by the Engineer. Repair damage consistent with the delivery of structural steel in accordance with ASTM A6/A6M and AWS D1.5. Do not use chains or chokers for handling structural steel, unless placing a protective shield (softener) between the chain or choker and the structural steel

2. **Handling, Storage, and Transporting Complete Bridge Solution.** Handle and store products to prevent damage. Keep beams upright. When moving a product, lift by devices shown on the plans, unless the Engineer approves alternate lifting devices and procedures. Apply equal loads to each pair of lifting devices. The Contractor is responsible for proper handling, lifting, storing, transporting, and erection so that products may be placed without damage. The products may be moved for storage or placement after concrete curing has been completed.
    A. Ensure segments are stored, lifted and/or moved in a manner to prevent torsion and other undue stress. When moving a segment, lift it by the devices detailed on the shop drawings.
    B. The Contractor must not ship and erect the segments until the concrete meets the 28-day strength requirement.
    C. Use battens to hold beams off the ground over the full length. Place battens in from the beam ends no greater than 1½ times the depth of the beams, or 3 feet, whichever is less.
    D. Support stockpiled beams across the full width on two battens, each greater than 4 inches wide. Do not support beams at more than two points.
    E. Support beams during transport the same as stockpiled beams, except the Contractor may use trucks with two rear bolsters.
3. **Shipping.** Provide the owner with copies of the bill of lading as directed by the Engineer.
    A. Show the weights of individual members on the statements. Mark weights on the member if greater than 6 tons. Load, transport, and unload structural members using trucks or railcars, without stressing, deforming, or otherwise damaging members. Place a protective shield between the chain or chain binder and main members during shipping, to prevent gouging the flange edges or damaging the coating.
    B. Pack bolts, nuts, and washers of each size separately. Store and ship pins, small parts, and packages of bolts, washers, and nuts in clean, moisture-proof boxes, crates, kegs, or barrels. Limit the gross weight of each package to 300 pounds. Provide a list and description of contents on the outside of each shipping container.
4. **Erection.** Before beginning work, obtain the Engineer's approval for proposed equipment and erection methods. Do not use material intended for the finished structure for erection or temporary purposes, unless otherwise shown on the plans or approved by the Engineer.
    A. The Engineer's approval does not relieve the Contractor of the responsibility for the safety of the method or equipment.
    B. Position bearing pads with a full, uniform bearing on the substructure concrete... Adjust bearing pad positions to compensate for temperature at the time of erection.
    C. Position beams on the substructure. Shim bearing pads to provide full bearing contact with the bottom of the beam. Rigidly block bridge units in place before beginning deck and diaphragm forming. Remove lifting devices.
5. **Assembly.** Assemble parts according to the plans and approved shop drawings. Do not damage structural steel or concrete during erection. Clean rust, loose mill scale, dirt, oil or grease, and other deleterious material from bearing surfaces and surfaces in permanent contact before assembly
    A. **Bolted Splice Assembly.** Assemble individual spliced members of each PBFTG one time.
        - High-Strength Bolted Connections. A high-strength bolt assembly consists of one high-strength bolt, one heavy hex nut, one hardened circular washer, and one lock washer where required. Provide a high-strength bolt assembly for each hole in the connection of structural joints.

- Install a hardened circular washer under the end of the high-strength bolt assembly (head or nut) rotated during tightening. Additionally, install hardened circular washers to cover oversized holes where required in the outer plies of the structural joint.
- Bolts used in bottom flange field splices must be positioned with the head on the bottom side of the bottom flange and the nut on the top side of the bottom flange. Likewise, bolts in the fascia member must be positioned with the head on the outside (fascia) of the structure and the nut on the interior side of the structure.
- Tighten all permanent bolts using the turn-of-nut (TON) method per Research Council on Structural Connections (RCSC) requirements for slip critical connections.
- Provide heavy, semi-finished, hexagonal nuts with one circular washer for each bolt. Lubricate galvanized nuts with a lubricant with a visible dye. Supply two washers for oversize holes, one under each element. Supply 5 percent more high strength steel bolts of each size and length than required.
- Protect fasteners from dirt and moisture on the project. Remove only the number of fasteners required to be installed and tightened during a working shift. Lubricant must not be removed from fasteners. Visible corrosion or contamination is a cause for rejection of the fasteners.

6. **Repair of Field Damaged Galvanized Surfaces.** Exposed underlying steel or coating thickness less than 50% of the specified thickness or thickness equivalent is considered damage.
   A. Thickness equivalent is 2.3 ounces of zinc per square foot equals 3.9 mils.
   B. Use zinc-based solder, zinc-rich primer, or zinc metallizing in accordance with ASTM A780/A780M.

j. Measurement and Payment. The completed work will be measured and paid for at the contract unit price using the following contract item (pay item):

Contract Item (Pay Item)	Pay Unit
PBFTG Complete Bridge Solution, Furn and Fab….....	LSUM
PBFTG Complete Bridge Solution, Erect…….	LSUM

PBFTG Complete Bridge Solution, Furn and Fab includes all labor, equipment, and material necessary to design and manufacture the prefabricated bridge superstructure products and shall include bearing pads, sole plates, shear developers, bolts, washers, welding, welding materials, and hardware as required.

PBFTG Complete Bridge Solution, Erect includes all labor, equipment, and material necessary to erect the fabricated bridge superstructure product.

The Contractor is responsible for ordering and obtaining position dowels or anchor bolts in accordance with the details in the plans.