3.3 Surface Preparation. Spalled and loose concrete shall be removed and concrete surfaces restored to their original dimensions using substructure repair in accordance with Sec 704. The new concrete in the substructure repair areas shall cure for a minimum of 28 days before the FRP is applied. Concrete surfaces of existing or patched concrete to receive an application of FRP material shall be prepared by abrasive blasting or grinding to remove existing laitance and expose aggregate to a minimum ICRI-CSP3 concrete surface profile. All FRP contact surfaces shall have all laitance, dust, dirt, oil, curing compound, existing coatings and any other foreign matter removed that could interfere with the bond between the FRP system and the concrete. Localized out-of-plane variations, including form lines, shall not exceed the smaller of 1/32 inch or the tolerances recommended by the FRP manufacturer's recommendation. Sharp and chamfered corners shall be rounded off to a minimum radius of 1/2 inch by grinding or forming with the system's thickened epoxy. Variations in the radius along the vertical edge shall not exceed 1/2 inch for each foot of length.

3.4 Installation of FRP. The concrete and atmospheric temperatures shall be between 40°F and rising and 90°F and falling during installation of the FRP. Tension adhesion testing shall be conducted using ASTM D7234 with the strengths reaching 200 psi. Any failure shall exhibit failure of the concrete substrate before failure of the adhesive. Tension adhesion testing shall cease when strengths reach 200 psi. Any failure of the concrete substrate and/or FRP adhesion shall be repaired at the contractor's expense and as directed by the engineer. Two adhesion tests shall be performed for each bent having FRP being applied. The FRP shall be installed in accordance with the manufacturer's written recommendations and as required by the job special provisions.

4.0 Method of Measurement. Fiber reinforced polymer wrap will be measured to the nearest square foot based on the member surface area as detailed on the contract plans. No additional compensation will be given for the use of multiple layers of material to achieve design strength. Final measurements will not be made except for authorized changes during construction or where significant errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

5.0 Basis of Payment. Payment for the above described work, including all material, equipment, labor and any other incidental work necessary to complete this item, will be considered completely covered by the contract unit price for Fiber Reinforced Polymer Wrap.

H. GALVANIZED STEEL PRESS-BRAKE-FORMED TUB GIRDER (PBFTG)

1.0 Description. Steel press-brake-formed tub girder (PBFTG) elements shall be designed and manufactured according to the plans, the standard specifications and as contained herein. The Steel Press-Brake-Formed Tub Girder (PBFTG) shall be produced by an approved manufacturer by Bridge Division. The PBFTG shall be produced by the following manufacturer or approved equal:

Valmont Industries, Inc. - North American Structures
Guy C. Nelson, P.E., S.E.
Product Development Director
616-813-8514
guy.nelson@valmont.com

2.0 Design. The PBFTG shall be certified that the design 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 shall be AASHTO LRFD HL-93 or as indicated on the plans. The design live loading shall be indicated on the shop drawings submitted to the owner. The design shall be signed, sealed and stamped by a Professional Engineer in the State of Missouri.

3.0 Shop Drawings. Shop drawings of the PBFTG shall be submitted to Fabrication@modot.mo.gov for approval. Shop drawings shall be in accordance Sec 1080.3.2 and shall include the physical dimensions, methods of manufacture, structural steel dimensions, structural steel material properties, recommended installation procedure, design assumptions, design loads, and design calculations. Shop drawings shall be submitted for review at least 30 calendar days prior to fabrication. The shop drawings shall be signed, sealed and stamped by a Professional Engineer in the State of Missouri. Fabrication shall not begin until the approved shop drawings has been received from the engineer stamped For Files and Distributions, weld procedures has been approved and notification of inspection has occurred in accordance with Sec 1080.3.1.2.

4.0 Materials. Materials used shall meet the requirements of the current version of AASHTO LRFD Bridge Construction Specifications:

4.1 Structural Steel. Steel used shall meet AASHTO M270. All primary steel material used in the main girders, including all splice plates, shall be AASHTO M270, ASTM A709 Grade 50 T2 steel and charpy v-notch tested for non-fracture critical components, Zone 2. Other requirements:

4.1.1 Charpy Impact Requirements (Zone 2): ASTM A673 and A370
4.1.1.1 less than or equal 2” thick: 15 ft-lbf @ 40° F
4.1.1.2 over 2 to 4” thick: 20 ft-lbf @ 40° F
4.1.2 Silicon content:
4.1.2.1 To 1-1/4” thick: 0.06% maximum
4.1.2.2 Over 1-1/4” to 6”: 0.15% to 0.40% (Aim for 0.15% to 0.25%)
4.1.3 Mill analysis and test report required
4.1.4 Plate tolerances shall be in accordance with Sec 1080.3.3.5.5
4.1.5 Carbon Equivalent:
4.1.5.1 0.45% max. per the following formula:
CE= C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15
Comments:
- ASTM A572 Gr. 50/55 may be substituted via Engineering and Customer Approval.

4.2 Shear Connectors. Shear connectors shall be in accordance with Sec 1037 and shall be installed prior to galvanization.

4.3 Galvanization. Galvanizing shall be in accordance with Sec 1081.20.

4.4 High Strength Fastener Assemblies. High strength fastener assemblies shall be in accordance with Sec 1080.2.5.

5.0 Steel Fabrication. Fabrication and inspection shall be in accordance with Sec 1080.3 and as specified herein. PBFTG shall be manufactured by an AISC Certified Bridge Fabricator - Intermediate (IBR). Shipping of fabricated material shall be in accordance with Sec 1080.3.5.

5.1 Welding. Any welding performed shall be in accordance with Sec 1080.3.3.5. No welding will be allowed except where specifically shown on approved shop drawings.

5.2 Bolt Holes. All bolt holes required shall be drilled 1/8" larger than the fastener size.

5.3 Cold-Bending. Structural steel shall be cold bent per the current AASHTO LRFD Bridge Construction Specifications, except as noted below:
5.3.1 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.

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

5.5 Handling. The PBFTG handling shall be by a method approved by the manufacturer and engineer.
5.5.1 Holes shall not be drilled in the PBFTG for lifting or handling.

5.6 Product Marking. The interior of each PBFTG shall be clearly marked with the following information 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.
5.6.1 Assembly part number.
5.6.2 Customer order number.
5.6.3 Shop order number.

6.0 Tolerances. All PBFTG shall 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”

TYPE OF PART	DIMENSION	ALLOWABLE DEVIATION FROM NOMINAL
	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

7.0 Weld Testing and Inspection. Testing and inspection of welds shall be in accordance with below. Ultrasonic testing acceptance or rejection criteria shall be based on Tension Stress Table.

7.1 Primary Members
7.1.1 100% penetration groove welds loaded in shear with FCAW: 100% Visual, 100% Ultrasonic Test
7.1.2 Fillet & PJP Groove welds welded with FCAW: 100% Visual, 100% Magnetic Partial Test
7.2 Secondary Members
7.2.1 Fillet & PJP Groove welds welded with FCAW: 100% Visual
7.3 Other
7.3.1 Stud welds
7.3.1.1 Shift Start Bend Test
7.3.1.2 100% Visual Inspection (in accordance with AWS D1.5 Clause 9.8)
7.3.2 Weld repairs
7.3.2.1 Primary or secondary member weld repair shall use FCAW
7.3.2.2 Stud weld repair shall use SMAW
7.3.2.3 Additional NDT shall be performed on repaired welds
7.3.2.4 Additional NDT shall be provided 2” beyond the defect in all direction

8.0 Installation.

8.1 Handling and Storing Materials. Structural steel material shall be stored on platforms, skids, or other supports above high-water elevations. Materials shall be maintained free of dirt, oil, or other contaminants and protected from corrosion. Structural steel members shall be padded in storage at points of contact. Trough sections shall be pitched to provide drainage. Long members shall be supported at frequent intervals to prevent deflection. Members shall be handled, stored, and braced in the erected position to avoid distortion, unless otherwise authorized by the engineer.

8.1.1 Fabricated structural steel members and primary components of main members shall be handled with clamps or plate hooks that do not leave nicks, gouges, or depressions. Damage to main members shall be repaired using methods approved by the Fabrication Operations Engineer. Damage consistent with the delivery of structural steel shall be repaired in accordance with Sec 1080.3.3.5.5. Chains or chokers shall not be used for handling structural steel, unless placing a protective shield (softener) between the chain or choker and the structural steel.

8.1.2 Handling stresses shall be minimized on beams during transportation, storage, and erection. One-point pickup shall be used so overhang does not exceed the values specified below. The distances specified below between hooks for a two-point pickup shall not be exceeded.

Rigging Requirements					
Beam Size	**U12**	**U18**	**U24**	**U30**	**U33**
Overhang for one point or two-point pickup, maximum	20’	25’	30’	35’	45’
Distance between hooks for two-point pickup, maximum	40’	50’	60’	70’	90’

8.2 Shipping. The owner shall be provided with copies of the bill of lading as directed by the engineer.

8.2.1 The weights shall be shown of individual members on the statements. Structural members shall be loaded, transported and unloaded using trucks or railcars, without stressing, deforming, or otherwise damaging members. A protective shield shall be placed between the chain or chain binder and main members during shipping, to prevent gouging the flange edges or damaging the coating.

8.3 Erection. Proposed equipment and erection methods shall be reviewed by the engineer before beginning work. Material intended for the finished structure shall not be used for erection or temporary purposes, unless otherwise shown on the plans or approved by the engineer.

8.3.1 The engineer’s review/approval does not relieve the contractor of the responsibility for the safety of the method or equipment.

8.3.2 Bearing pads shall be positioned with a full, uniform bearing on the substructure concrete. Bearing pad positions shall be adjusted to compensate for temperature at the time of erection.

8.3.3 Beams shall be positioned on the substructure. Bearing pads shall be shimmed to provide full bearing contact with the bottom of the beam. Beams shall be rigidly blocked in place before beginning deck and diaphragm forming.

8.4 Assembly. Parts shall be assembled according to the plans and approved shop drawings. Structural steel shall not be damaged during erection. Rust, loose mill scale, dirt, oil or grease, and other deleterious material shall be cleaned from bearing surfaces and surfaces in permanent contact before assembly. High-Strength bolt installation shall be in accordance with Sec 712.7.

8.5 Repair of Field Damaged Galvanized Surfaces. Exposed underlying steel or coating thickness less than 50% of the specified thickness of 3.9 mils is considered damage. Repair of galvanizing shall be in accordance with Sec 1081.20.

9.0 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 Structural Steel, Furnished and Fabricated.....	Lbs.
PBFTG Structural Steel, Erection……..	Lump sum

PBFTG Structural Steel, Furnished and Fabricated includes all labor, equipment, and material necessary to design, manufacture and deliver the Galvanized Steel Press-Brake-Formed Tub Girder (PBFTG) and shall include bearing pads, sole plates, shear developers, bolts, washers, welding, welding materials, and hardware as required.

PBFTG Structural Steel, Erection includes all labor, equipment, and material necessary to erect, connect and install all items included in the pay item for PBFTG Structural Steel, Furnished and Fabricated.

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

I. SPECIAL CHANGE ORDER AND VALUE ENGINEERING CONSIDERATION

1.0 Description. Increased Federal Share has been approved by FHWA for an innovative technology or practice. The Commission will receive an additional five percent (5%) Federal Share of the overall contract value due to innovations within the following pay item(s):

Pay Item Number	Pay Item Description	Innovation
7129901	PBFTG Structural Steel, Erect	New type of bridge girder
7129911	PBFTG Structural Steel, Furn and Fab	New type of bridge girder

Due to the increased federal share, the project components related to the innovation(s) described above must be constructed with the materials, quantities, methods and innovations as shown on the project plans and specifications. If the contractor requests materials, quantities, methods or innovations other than those included in the plans and specifications, the request must be reviewed and approved by the Commission and FHWA. Approved changes to the innovation items above shall be at no additional cost to the Commission and shall not increase the contract time.

2.0 Consideration of Change Orders and Value Engineering Change Proposals (VECP). Change ordering and/or value engineering the pay item(s) listed in section 1.0 of this job special provision jeopardize ability for the Commission to receive an additional Federal Share for the overall contract value. Special consideration should be given to the change order value for removing such item(s) from the contract ensuring that the benefit outweighs the cost.

3.0 Contacting Financial Services. If it is determined that the proposed change order and/or VECP outweighs the additional overall five percent (5%) Federal Share value, the engineer shall notify the MoDOT project manager.