

SECTION 401 – PREFABRICATED STEEL TRUSS BRIDGE

401.01 DESCRIPTION

This work consists of furnishings and placing a prefabricated pedestrian bridge in accordance with the bid documents. These specifications are for a fully engineered clear span bridge of steel construction and shall be regarded as minimum standards for design and construction. The Contractor's submitted bridge designs and specifications must meet or exceed those contained within this Contract Document.

401.02 REFERENCE STANDARD

AASHTO	Standard M31, M42, M53, M 133, M 168
AISC	Manual of Steel Construction:
ANSI	AWS D1.1 Structural Welding Code, AWS A 5.28, AF&PA National Design Standard for Wood Construction
ASTM	A847, A588, A242, A606, G101, A325, A490, A500, C1028-89
NFPA	Class A
UBC	Class I

401.03 DEFINITIONS

Not applicable.

401.04 MATERIALS

- A. Unpainted Weathering Steel: Bridges shall be fabricated from high strength, low alloy, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing and/or ASTM A588, or ASTM A242, ASTM A606 plate and structural steel shapes (Fy = 50,000 psi). The minimum corrosion index of atmospheric corrosion resistant steel, as determined in accordance with ASTM G101, shall be 6.0.
- B. Bolts: Field splices shall be fully bolted with ASTM A325 type 3 high strength bolts in accordance with the Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
- C. Wood Decking: Three inch (3") Thick Wood decking shall be Pressure Treated incised Douglas Fir Grade No. 1. All wood shall have minimum Fc of 1200 psi, and shall conform to AASHTO Standard M 168 for Wood Products. Preservatives and Pressure Treatment Process shall be in accordance with AASHTO Standard M 133. All pressure treated planks shall be free of arsenic and shall be partially air dried to a moisture content of 15% to 20%, All timber should be select structural dressed cut S4S (surfaced four sides), except timber decking shall be cut S1S2E with rough face placed upward to improve traction. All gaps between wood planks shall be less than ½" to meet ADA requirements.

D. Metal slip resistant strips are required on top of wood decking. They are to be placed on every other deck board. They shall be made of steel or aluminum and a minimum of 14 gauge. Surface shall have raised perforated buttons that does not exceed 3/8” in total height of plate and button. Sufficient coverage of raised button holes are required and shall not exceed 1/2” apart maximum. Sheet cut or manufactured strips are to be ADA compliant, and shall fit on wooden deck boards at a minimum width of 3 inches and a maximum width not to exceed 6 inches. Length shall not exceed the length of the wooden deck board. Raised perforated buttons shall not be cut through or compromised when constructing the strips.

1. Allowable imperfections are:

- a. All faces: Natural drying checks, Discoloration caused by weathering or chemical reaction, Maximum bow or spring of eight hundredths of an inch (0.08") per six feet (6') of timber length.
- b. On one face only: Firm sapwood, worm holes not going through to the other face, closed knots with maximum of one (1) knot per four foot (4') of timber length, Rowy grain, and Tear out.

2. Imperfections Not Allowed:

- a. Longitudinal heat cracks, Internal cracks, Soft sap wood, Splits, End splits, Ring shades, Fungi affects (blue to gray, brown to red, white to yellow, or incipient decay),
- b. Deformation (twisting or cupping) which cannot be removed using normal installation methods and tools.

3. All planks shall meet or exceed the following mechanical properties based on the two inch (2") standard as defined by the U.S. Forest Products Laboratory publications and testing data:

MC %	Modulus of Rupture	Modulus if Elasticity	Maximum Crush Strength
12 %	27,270 psi	3,030,000 psi	13,720 psi

Janka side hardness is 3, 540 lbs. At 12 % moisture content.
 Average air - dry density is 62 to 81 pcf.
 Basic specific gravity is 0.80 - 0.91.

4. Planks shall be supplied that meet or exceed the Static Coefficient of Friction for both Neolite and leather shoes in accordance with ASTM Test Method C 1028-89.

FORCE IN POUNDS

<u>SHOE MATERIAL</u>	<u>DRY</u>	<u>WET</u>
Neolite	0.73	0.69
Leather	0.55	0.79

5. For transverse wood decking, wheel loads shall be assumed to act on one plank only. The wheel loads shown in Section 401.07.B Vehicle Loads shall be distributed on the plank along a length equal to the tire print width (W). The plank shall be designed for shear and bending in accordance with the bridge's designed support conditions. For design, the following unfactored allowable values shall be used:

Allowable Bending	=	3700 psi
Allowable Shear	=	320 psi
Modulus of Elasticity	=	3,000,000 psi

- E. Concrete Decking: The Bridge Manufacturer shall provide 20 gage (minimum) stay-in-place 3" minimum thick galvanized steel rib decking with steel side and end dams. Concrete decks shall have a broomed finish at 90 degrees to the sides of the bridge. Metal decking shall be secured with fasteners or welds as recommended by the decking manufacturer and confirmed by the structural bridge designer.

1. For Pedestrian bridges with 10000 lbs or less loading, Upper longitudinal reinforcement in the concrete portion of the decking shall be designed above the stay in place steel formwork ribs when the thickness of the concrete is 3 inches and greater. Welded wire fabric reinforcement is allowed when the concrete thickness above the stay in place steel rib formwork is at the minimum accepted thickness of 2 inches to less than 3 inches. Concrete reinforcing bars shall be placed 2" min clear to top surface, and 1" min clear to all other surfaces or forms. Consideration of composite action from the metal form is prohibited. Concrete and reinforcement in troughs is to be considered as contributing to the strength of the deck. 3" minimum thick Metal rib forms used when pouring the concrete decking shall be designed for a minimum construction live load of either 20 psf or a 200 lb point load. Dead load deflection due to wet concrete shall be limited to whichever is smaller L/180 and 3/4". Bridge slab concrete shall be 3500 psi normal weight concrete. Aspects of concrete work, including but not limited to material properties, mix designs, plant and field quality control, and rebar placement including support and tying, shall be governed by AASHTO unless specified otherwise. Reinforcing bars shall conform to AASHTO M31, M42, or M53, grade 60 and shall be epoxy coated.
2. For bridges with loadings greater than 10000 lbs, the concrete deck must be designed per AASHTO LRFD Bridge design specifications latest edition, be structurally reinforced,

and not less than 7 inches in thickness including its wearing surface. Vehicular rated bridges may also have wearing surface made of asphalt, as long as the deck surface meets the design requirement from AASHTO LRFD Bridge design specifications latest edition.

3. Concrete surfaces shall be constructed with a cross-slope of 1% with a maximum of 1.5% unless camber is at least 1% or longitudinal grade is at least 1%. Concrete deck shall have appropriate contraction joints. Minimum twenty-eight (28) day strength for the deck concrete shall be four thousand five hundred pounds per square inch (4,500 PSI) SHA Mix #6 and must include synthetic fibers.

TABLE 902 A (MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS)

PORTLAND CEMENT CONCRETE MIXTURES M I X N O. 6

SPECIFIED ACCEPTANCE COMPRESSIVE STRENGTH psi - 4500

COMPREHENSIVE STRENGTH ACCEPTANCE TEST AGE days - 28

STD. DEV. psi - 675

CRITICAL VALUE psi - 4770

MIN CEMENT FACTOR lb/yd² - 615

COARSE AGGREGATE SIZE M43 / M195 – 57, 67

MAX WATER/CEMENT RATIO by wt - 0.45

SLUMP RANGE in. 2-5

TOTAL AIR CONTENT % 5-8

CONCRETE TEMP. °F. 50-80

- A. When concrete is exposed to water exceeding 15 000 ppm sodium chloride content, Type II cement shall be used. In lieu of Type II cement, a Type I cement may be used in combined form with an amount of up to 50 percent replacement with slag cement, or an amount of up to 25 percent replacement with Class F fly ash. The Contractor shall submit to the Engineer the proposed mix proportions and satisfactory test results according to C1012 showing a sulfate resistance expansion not exceeding 0.10 percent at 180 days.
- B. The temperature of Mix No. 6 when used for other than superstructure work as defined in TC-1.03 shall be 50 – 95 F.
- C. Type A or D admixture shall be added to bridge, box culvert, and retaining wall concrete.
- D. Nonchloride Type C admixtures may be used when approved by the Engineer.
- E. Other Slump Requirements: When a high range water reducing admixture Type F or Type G is specified, the slump shall be 4 to 8 in. When synthetic fibers are specified, the slump shall be 5 in. maximum. When concrete is to be placed by the slip form method, the slump shall be 2-1/2 in. maximum. When the absorption of the coarse aggregate is greater than 10 percent, the slump shall be 3 in. maximum.

4. Testing of concrete is required per MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS section 902.10.08. Acceptance of concrete decking bridge slab will only be allowed after proper testing results of compression break results are provided to MNCPPC CM and meet the criteria of section 902.10.09 of the MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS. Price

adjustments will be made in accordance with section 902.10.10 of the MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS.

401.05 SUBMITTALS

In order to avoid delay to the project, immediately after receiving the signed contract, the Contractor, must submit the following documentation to M-NCPPC Construction Manger. Pending final approval no fabrication or other action shall be initiated by the contractor for this item of work until directed in writing by M-NCPPC.

- A. Submittal Drawings: Schematic drawings and diagrams shall be submitted to M-NCPPC Construction Manager for review after the Notice-to-Proceed has been issued for the individual contract. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done related to the bridge. All relative design information, but not limited to, member sizes, bridge reactions, and general notes shall be clearly specified on the drawings. Drawings shall have cross reference details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer who is licensed in Maryland.

- B. Structural Calculations: Structural calculations for the bridge superstructure shall be submitted by the bridge manufacturer. All calculations shall be signed and sealed by a Professional Engineer who is licensed in Maryland. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. The calculations shall include the following:

All documentation to insure the proposed bridge will be in compliance with these specifications. This shall include:

- 1. Representative drawings
 - 2. Splicing and Erection procedures
 - 3. Warranty information
 - 4. Inspection and Maintenance procedures
 - 5. AISC Shop Certification
 - 6. Welder Qualifications
- All AISC allowable stress checks for axial, bending, and shear forces in the critical member of each truss member type (i.e. top chord, bottom chord, floor beam, vertical, etc.).
 - Checks for the critical connection failure modes for each truss member type (i.e. vertical, diagonal, floor beam, etc.). Special attention shall be given to all welded tube on tube connections. See section 401.07.B Welded Tubular Connections for design check requirements.
 - All bolted splice connections.

- Main truss deflection checks.
- U-Frame stiffness checks (used to determine K factors for out-of-plane buckling of the top chord) for all connector or pratt truss bridges.
- Deck design.

NOTE: The analysis and design of triangulated truss bridges shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity must be considered.

- C. Welder certifications in compliance with AWS standard qualifications tests.
- D. Welding procedures in compliance with Section 401.07.B.

401.06 QUALITY ASSURANCE

Manufacturers: Qualified manufacturers must have at least five (5) years’ experience of manufacturing these types of structures.

A. Approved MNCPPC Manufacturers:

Continental Bridge Alexandria, MN 1 800 328-2047	Steadfast Bridge Co. Ft. Payne, AL 1 800 749-7515	Wheeler Lumber, Inc. Bloomington, MN 800 328 3986
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Note: Continental Bridge and Steadfast Bridge Co. are DBA: Contech Engineering Solutions LLC.

- B. Any proposed bridge manufacturers other than the three MNCPPC approved, must have at least five (5) years’ experience in designing, manufacturing, erecting and supplying these types of structures, and a minimum of five (5) successful bridge projects of similar construction, each of which has been in service at least three years. List the location, bridge size, owner, and a contact for reference for each project. MNCPPC will evaluate and verify if the Manufacture is acceptable before any design or contract is commenced.
- C. The Commission will evaluate and verify the accuracy of all submittals.
- D. Bridge(s) shall be fabricated by a manufacturer who is currently certified by the American Institute of Steel Construction to have the personnel, organization, experience, capability, and commitment to produce fabricated structural steel for the category “Simple Steel Bridges” as set forth in the AISC Certification Program. Quality control shall be in accordance with procedures outlined for AISC certification.

401.07 CONSTRUCTION

A. General Design Features.

1. Span. The bridge span shall be as specified in the bid documents. The span shall be a straight line dimension measured from each end of the bridge structure.
2. The bridge minimum width shall be as specified in the bid documents. The minimum width shall be measured from the inside face to the inside face of the rubrails.
3. Gaps. No gaps in the horizontal surfaces including decking and abutments shall exceed ½”.
4. Truss Type. Pedestrian bridges (10,000 lbs. or less loadings) shall be designed as a Connector (Contech) or Pratt Truss (Wheeler) with one (1) diagonal per panel and square end vertical members. All end vertical members, unless specified otherwise, shall be plumb. Interior vertical members shall be perpendicular to the chord faces. The distance from the top of the decking to the bottom of the lowest beam member of the bridge shall be minimized as much as possible and shall be approximately equal to or less than twelve inches (12”).
 - a. Bridges may be designed utilizing an underhung floor beam (top of floor beam welded to the bottom of the bottom chord) or in an H-Section configuration where the floor beams are placed up inside the trusses. The floor beam location shall be determined by the bridge manufacturer.
 - b. The distance from the top of the deck to the top and bottom truss members shall be determined by the bridge manufacturer based upon structural and/or shipping requirements.
 - c. The distance from top of the deck surface to the top chord shall not be less than forty two inches (42”).
5. Member Components. All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing without perforation holes.

To provide lateral support for the top flange of open shape stringers (W-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

Floor beams, stringers, and bracing components under the deck shall have welded endplates so they are fully closed at each end.

Vehicular bridges (20,000 lbs or greater) shall have sides made with weathered steel,

having a truss design similar to Pedestrian bridges indicated above, and have attachments added as identified in item 5 shown below. Side impact attenuation design shall only be considered in special circumstances as identified by Parks. In this special circumstance, every opportunity shall be made to make the sides of the bridge have a truss like appearance.

6. Attachments

- a. Safety Rails: Horizontal safety rails shall be placed on the structure up to a minimum height of three feet six inches (3'-6") above the deck surface. Safety rails shall be placed so as to prevent a four inch (4") sphere from passing through the truss. Safety rails shall have a "v" shape, where the point of the "v" faces to the inside or outside of the structure at the bridge manufacturers option, and be welded to the structure. Safety rails placed on the inside of the truss shall have their ends sealed and ground smooth so as to produce no sharp edges.

The safety rail system shall be designed for an infill loading of two hundred pounds (200 lbs.), applied horizontally at right angles, to a one (1) square foot area at any point in the system.

- b. Toe Plate: The bridge shall be supplied with a one quarter inch by six inch (1/4" X 6") steel toe plate mounted to the inside face of both trusses. The toe plate shall be welded to the truss members at a height adequate to provide a two inch (2") gap between the bottom of the plate and the top of the deck or the top of the bottom chord, whichever is higher. The span of the toe plate (from center to center of supports) shall not exceed five feet eight inches (5'-8").
- c. Cover End Plates: The bridge shall be supplied with a one quarter inch by six inch (1/4" thick X 6" wide) steel cover end plate mounted at each end to the truss that covers the gap between the end of the bridge and the end of the abutment. This plate shall be set so that it rests on the top of the decking and top of the abutment and span the entire width of the bridge between the toe plates.
- d. Rubrails and/or Handrails: The bridge will be supplied with a nominal five quarter inch by six inch (5/4" X 6") Recycled Plastic Lumber such as Trex or equal. Rubrails shall be attached flush to the inside face of the bridge truss verticals and fastened with two carriage bolts at each support location. The span of the rubrail from centerline to centerline of support shall not exceed six feet six inches (6'-6"). The top of the rubrail shall be two feet ten inches (2'-10") above the top of the deck (measured at the outside edge of the deck).

Camber: The bridge shall have a vertical camber dimension at midspan equal to one hundred percent (100%) of the full dead load deflections plus one percent (1%) of the full length of the bridge. The maximum horizontal deck slopes of 5% or greater are not allowed. Cross slope shall not exceed 1.5%

6. Elevation Difference: The bridge abutments shall be constructed at the same elevation on both ends of the bridge unless otherwise specified on the design drawings.

B. Engineering:

Structural design of the bridge structure(s) shall be performed by or under the direct supervision of a licensed professional engineer and done in accordance with recognized engineering practices and principles. The engineer shall be licensed to practice in Maryland and sign and seal all design drawings.

Governing Design Codes / References. Structural members shall be designed in accordance with recognized engineering practices and principles as follows: Use the Latest Editions of :

AASHTO LRFD Guide Specifications For the Design of Pedestrian Bridges
AASHTO LRFD Bridge Design Specifications

Wood: American Institute of Timber Construction (AITC), the U.S. Forest Products Laboratory, and the American Forest & Paper Association (AF&PA). Sawn lumber shall be designed in accordance with the ANSI/AF&PA NDS, “National Design Standard for Wood Construction”, as published by the American Forest & Paper Association or the Timber Construction Manual as published by the American Institute of Timber Construction (AITC).

C. Blast Cleaning: Bare applications of enhanced corrosion resistant steels.

To aid in providing a uniformly “weathered” appearance, all exposed surfaces of steel shall be blast cleaned in accordance with Steel Structures Painting Council Surface Preparation Specifications No. 7 Brush-Off Blast Cleaning, SSPC-SP7 latest edition.

Exposed surfaces of steel shall be defined as those surfaces seen from the deck and from outside of the structure. Stringers, floor beams, lower brace diagonals, and the inside face of the truss below deck and bottom face of the bottom chord shall not be blasted.

D. Wood Decking Attachment.

- At time of installation, planks are to be placed tight together with no gaps.
- Every plank must be attached to at least one support with at least one fastener.
- Fasteners shall be bolts with a material that is compatible with the wood decking material. Hex-head bolts, with a steel plank hold down, are to be used at the ends of planks. Carriage bolts are to be used as interior connection fasteners. Power actuated

fasteners shall not be used.

- Planks are to be drilled prior to installation of bolts.
- In addition to the minimum of one fastener at either end of every plank (typical for all installations), planks for bridges with widths of seventy-two inches (72") to one hundred forty-three inches (143") are to receive a minimum of one (1) interior connection bolt at a stringer location approximately near the center of the bridge width. Bridges one hundred forty-four inches (144") or wider are to have interior connection bolts located at a minimum of two interior stringer locations, approximately located at the third points of the bridge width.

E. Foundation

1. Bearings.

Bridge bearing devices shall consist of a steel setting or slide plate placed on the abutment or grout pad. The bridge bearing plate which is welded to the bridge structure shall bear on this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end will have finger tight only nuts to allow movement under thermal expansion or contraction.

The bridge bearings shall sit in a recessed pocket on the concrete abutment. Minimum twenty-eight (28) day strength for the abutment concrete shall be three thousand five hundred pounds per square inch (3,500 PSI) SHA Mix #3. The bearing seat shall be a minimum of sixteen inches (16") wide. The step height (from bottom of bearing to top-of-deck) shall be determined by the bridge manufacturer. Testing of concrete is required per MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS section 902.10.08. Acceptance of concrete decking bridge slab will only be allowed after proper testing results of compression break results are provided to MNCPPC CM and meet the criteria of section 902.10.09 of the MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS. Price adjustments will be made in accordance with section 902.10.10 of the MDOT MDSHA 2021 STANDARD SPECIFICATIONS AND MATERIALS.

Bridges in excess of one hundred feet (100') in length or bridges with dead load reactions of fifteen thousand pounds (15,000 lbs) or more (at each bearing location) shall have Teflon on Teflon or stainless steel on Teflon slide bearings placed between the bridge bearing plate and the setting plate. The top slide plate shall be large enough to cover the lower Teflon slide surface at both temperature extremes.

2. Anchor Bolts.

Unless specified otherwise, the bridge manufacturer shall determine the number, diameter,

minimum grade and finish of all anchor bolts. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting foundations. Engineering design of the bridge supporting foundations. The Contractor shall install the anchor bolts in accordance with the manufacturer's anchor bolt spacing dimensions.

Information as to bridge support reactions and anchor bolt locations shall be furnished by the bridge manufacturer.

3. Helical Piers.

The foundation support of the bridge shall be a helical pier system below a concrete grade beam. Refer to M-NCPPC Specification 413 for helical pier requirements.

F. Shipping, Storage, and Erection.

The contractors must notify the M-NCPPC Construction Manager forty-eight (48) hours in advance of the bridge installation, and either the M-NCPPC Construction Manager or the Inspector shall be presented during the bridge installation. Delivery is to be made to a location nearest the site which is easily accessible to normal over-the-road tractor/trailer equipment. All trucks delivering bridge materials will need to be unloaded at the time of arrival.

The bridge manufacturer shall provide detailed, written instructions for proper lifting and splicing procedures (if splicing procedures are required). The contractor shall install bridges in strict accordance with the manufacture's recommendations. A shop drawing which includes a list of written instructions for the aforementioned procedures signed by a Maryland Professional Engineer shall be submitted for approval.

The bridge manufacturer shall provide written inspection and maintenance procedures for use by the Commission.

G. Warranty.

The bridge manufacturer shall warrant their steel truss structure(s) to be free of design, material, and workmanship defects for a period of fifteen (15) years from the date of delivery. Naturally durable hardwood decking and wood attachments shall carry a fifteen (15) year warranty against rot, termite damage, or fungal decay.

This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper maintenance, alteration or any cause not the result of defective materials or workmanship.

Repair or replacement shall be the exclusive remedy for defects under this warranty. The bridge manufacturer shall not be liable for any consequential or incidental damages for

breach of any express or implied warranty on their structures.

401.08 MEASUREMENT AND PAYMENT

Prefabricated Pedestrian Bridge will be measured and paid at the lump sum price in the Contract. The payment will be full compensation for the bridge structure including anchor bolts and bearing devices, transporting, storage, erection, and for all material, labor, equipment, tools, extended warranty, and incidentals necessary to complete the work. Note that Price adjustments are in effect for concrete. Refer to section 401.04.E4, and 401.07.E1.