

FRP PREFABRICATED BRIDGE SPECIFICATIONS

1.0 GENERAL

1.1 Scope

These specifications are for a fully engineered clear span bridge of fiber-reinforced polymer (FRP) composite construction and shall be regarded as minimum standards for design and construction as manufactured by Arété Structures or approved equal.

1.2 Qualified Suppliers

The bridge manufacturer shall have been in the business of design and fabrication of bridges for a minimum of 4 years and provide a list of 10 successful bridge projects of similar construction. List the location, bridge size, owner, and contact reference for each bridge.

2.0 GENERAL FEATURES OF DESIGN

2.1 Span

Bridge span will be xx' xx" (straight line dimension) and shall be measured from each end of the bridge structure.

2.2 Width

Bridge width shall be x' xx" and shall be measured from the inside face of structural elements at deck level.

2.3 Bridge System Type

Bridges must be designed as a FRP Truss Span for spans greater than 30ft. Spans less than 30ft may be FRP I-Beams. Truss Bridge shall have either a Straight-End or Sloped Ends, as requested.

2.4 Member Components

All members shall be fabricated from pultruded FRP composite profiles and structural shapes as required.

2.5 Camber

Bridge shall be mechanically precambered over full length of bridge. In order to achieve a mechanical chamber, hole spacing to the top chord at diagonals must measure slightly longer than that the bottom chords. This in turn makes top chords slightly longer than bottom chords & creates the chambered effect. Chamber shall not be held by friction connection.

3.0 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.

3.1 Uniform Live Load

Bridges shall be designed for an 85 PSF pedestrian live load rating.

3.2 Vehicle Load (as required)

A specified vehicle configuration determined by the operating agency may be used for the design vehicle. If an agency design vehicle is not specified, the loads conforming to the AASHTO Standard H-Truck used. The vehicle live load shall not be placed in combination with the pedestrian live load. A vehicle impact allowance is not required.

3.3 Wind Load

All bridges shall be designed for a minimum wind load of 35 psf. The wind is calculated on the entire vertical surface of the bridge as if fully enclosed.

3.4 Seismic Load

Seismic loads shall be determined according to the criteria specified in the standard building codes (IBC 2002, ASCE 7-02, BOCA, SBC or UBC) unless otherwise requested. Response Spectrum Analysis shall be performed in those designs that require complex seismic investigation. All necessary response spectra information will be provided by the client for evaluation.

3.5 Allowable Stress Design Approach

An Allowable Stress Design (ASD) approach is used for the design of all structural members. Factors of safety used by Arete Structures. in the design of FRP bridges are as follows unless otherwise specified (based on the Ultimate Strength of the FRP material):

Tension: 3.0
Bending: 3.0
Compression: 3.0
End bearing: 3.0
Shear: 3.0
Connections: 3.0

3.6 Serviceability Criteria

Service loads are used for the design of all structural members when addressing deflection and vibration issues. Criteria used in the design of FRP bridges are as follows:

Deflection:

Live load (LL) deflection = $L/240$

Vertical frequency (f_n): = 5.0 Hz

The fundamental frequency of the pedestrian bridge (in the vertical direction) without live load should be greater than 5.0 Hz to avoid any issues with the first and second harmonics.

Horizontal frequency (f_n): = 3.0 Hz

The fundamental frequency of the pedestrian bridge (in the horizontal direction) without live load should be greater than 3.0 hertz (Hz) to avoid any issues due to side to side motion involving the first and second harmonics.

3.7 Snow Load

Snow loads shall be determined according to the criteria specified in the standard building codes (IBC 2002, ASCE 7-02, BOCA, SBC or UBC) unless otherwise requested. Sustained snow load conditions shall be evaluated for time dependent effects (creep and relaxation) and expected recovery behavior.

4.0 MATERIALS

4.1 FRP Composites

FRP bridges shall be fabricated from high-strength E-glass and isophthalic polyester resin unless otherwise specified.

Weathering and ultraviolet light protection shall be provided by addition of a veil to the laminate construction. Minimum material strengths and properties are as follows:

Tension: 30 ksi

Compression: 30 ksi

Shear: 4 ksi

Bending: 30 ksi

Modulus: 2,800,000 psi

Young's Modulus: 2,800,000 psi

The minimum thickness of FRP Composite shapes shall be as follows unless otherwise specified: Square-tube members (closed-type shape) shall be 0.25 in. Wide-flange beams, channel sections, and angles (open-type shapes) shall be a minimum thickness of 0.25 in. Standard plate shall be a minimum thickness of 0.25 in.

4.2 Decking

Wood Decking shall be Standard 3x12, No. 2 southern yellow pine & treated according to the American Wood Preservers Bureau. Standard 3x12 planks are recommended for equestrian and light vehicle type loading conditions.

High-strength, E-glass/isophthalic polyester resin planks or recycled plastic deck planks can also be provided as required.

4.3 Hardware

Bolted connections shall be A307 hot-dipped galvanized steel unless otherwise specified. Mounting devices shall be galvanized or stainless steel.

5.0 SUBMITTALS

5.1 Submittal Drawings

Schematic drawings and diagrams shall be submitted to the client for their review after receipt of order. As required, all drawings shall be signed and sealed by a licensed professional engineer.

5.2 Submittal Calculations

As required, structural calculations shall be submitted to the client. All calculations will be signed and sealed by a licensed professional engineer.

6.0 FABRICATION

6.1 Tolerances

All cutting and drilling fabrication to be done by experienced fiberglass workers using carbide or diamond-tipped tooling to a tolerance of 1/16". No material deviations beyond industry standards are accepted. All cut edges to be cleaned and sealed.

7.0 RAILINGS

7.1 Rail Height

Railing height shall be 42" above the floor deck with an optional 54" high railing available upon request. For equestrian bridge, the railing height is recommended to be 54" above the floor deck.

7.2 Railing

Horizontal safety mid-rails shall be located on the inside of the trusses. Maximum opening between the mid-rails shall not be greater than 4" spacing.

7.3 Toe Kick

3" Channel "Toe Kick" are standard and must be installed no more than 1" above the decking.

8.0 FINISHING

Bridge color shall be determined by client with Olive Green as the standard color. No painting is required as the color is added during the manufacturing process. Custom colors can be provided upon request.

9.0 DELIVERY AND ERECTION

Delivery is made by truck to a location nearest the site accessible by roads. The manufacturer shall notify the client in advance of the expected time of arrival at the site. Bridges are usually shipped to the site in component parts or partially assembled depending on site requirements. The spans can then be completely assembled using standard hand tools. Upon request, bridges can also be shipped fully assembled to the site. Unloading, splicing (if required) and placement of the bridge will be the responsibility of the client.

9.1 Bridge Assembly

For bridges shipped in component parts or partially assembled, the manufacturer shall provide assembly drawings and a recommended assembly procedure for building the bridge. Temporary supports or rigging equipment, if needed, is the responsibility of the client. For bridges shipped assembled, the manufacturer shall advise the client of the actual lifting weights, attachment points and all necessary information to install the bridge.

9.2 Site Issues and Foundation Design

The engineering design and construction of the bridge abutments, piers and/or footing shall be by the client. The manufacturer will provide the necessary information pertaining to the bridge support reactions. The client shall install the anchor bolts in accordance with the manufacturer's anchor bolt spacing dimensions.

10.0 WARRANTY

The manufacturer shall warrant the structural integrity of all FRP materials, design and workmanship for 15 years. This warranty shall not cover defects in the bridge caused by foundation failures, abuse, misuse, overloading, accident, faulty construction or alteration, or other cause not the result of defective materials or workmanship. This warranty shall be limited to the repair or replacement of structural defects and shall not include liability for consequential or incidental damages.

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