

## 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 FRP bridge component manufacturer shall be an ISO9001:2015 accredited company. All FRP components shall be manufactured in the USA. The bridge manufacturer shall provide a list of three successful bridge projects of similar construction installed in the past five years. List the location bridge size owner and contact reference for each bridge project.

### 2.0 GENERAL GEOMETRY & DESIGN FEATURES

#### 2.1 Span Length & Width

Bridge span will be xx' xx" (straight line dimension) and shall be measured from each end of the bridge structure. (see fig.1 for reference)

Bridge width shall be xx' xx" and shall be measured from the inside face of structural elements at deck level. (see fig.2 for reference)

#### 2.2 Bridge System Type & Member Components

Bridge to be designed as an FRP Composite Truss Span. All truss members shall be fabricated from pultruded FRP composite profiles and structural shapes as required.

#### 2.3 Camber

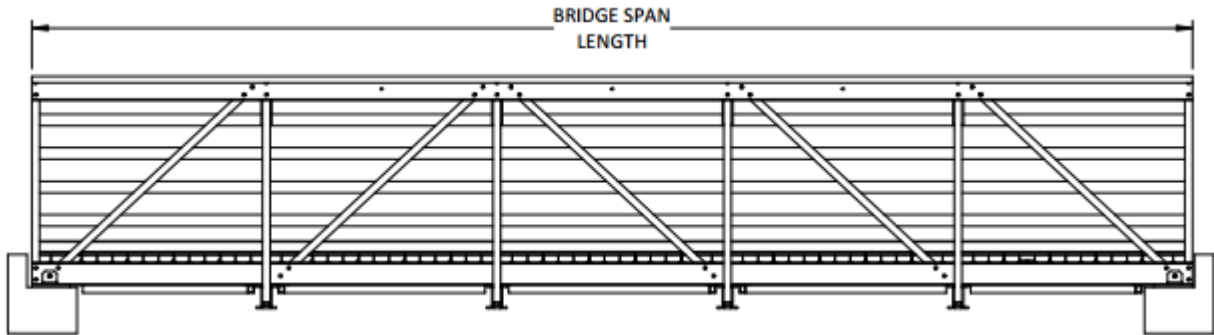
Bridges shall be precambered to eliminate dead load deflection. Mechanical Chamber required for bridges over 50ft in length.

#### 2.4 Railing & Toeplates

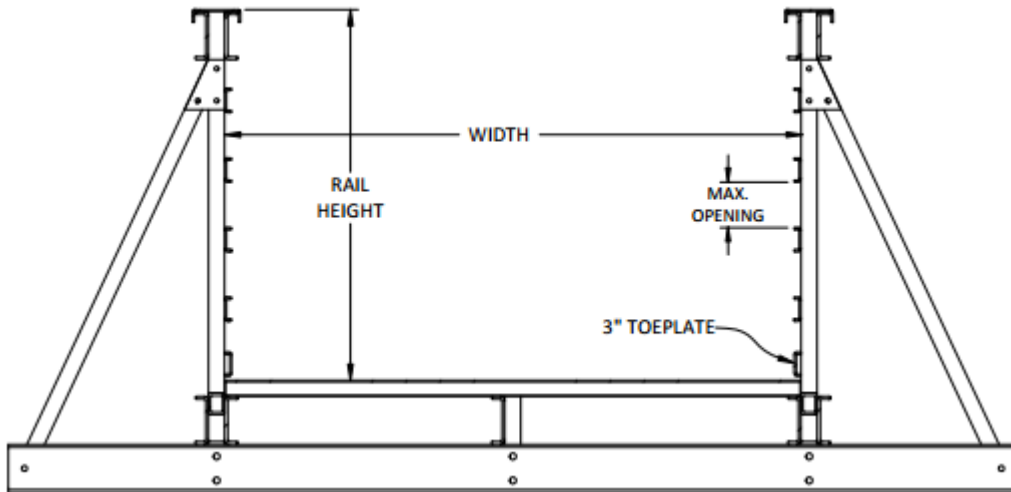
Railing height should be a *minimum* of 42" above the floor deck for pedestrian and equestrian use and a *minimum* of 54" for bicycle use. (see fig.2 for reference)

Safety Rails: Continuous horizontal rails shall be located on the inside of each truss. Maximum opening between the rails shall be no greater than 9". (see fig.2 for reference)

Toeplates shall be 3" channels. (see fig.2 for reference)



**FIGURE 1. TYP. ELEVATION**



**FIGURE 2. TYP. CROSS-SECTION**

### **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**

All bridges shall be designed for 85 psf live load.

#### **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 shall be used. The maintenance 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 ASCE 7-10 unless otherwise requested.

#### **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 the bridge manufacturer 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

Horizontal frequency ( $f_n$ ): = 3.0 Hz

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

The fundamental frequency of the pedestrian bridge (in the horizontal direction) without live load shall 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

All bridges shall be designed for a minimum snow load of XX psf. 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

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 is No. 2 southern yellow pine treated according to the American Wood Preservers Bureau. The standard 2- by 10-in planks are provided for pedestrian and bicycle type loading conditions.

*or*

Standard 3- by 12-in planks shall be provided for equestrian and light vehicle type loading conditions as required.

*or*

High-strength, E-glass/isophthalic polyester resin planks shall be provided.

#### **4.3 Hardware**

Bolted connections shall be A307 hot-dipped galvanized steel unless otherwise specified. Mounting devices at abutment shall be 6061-T6 Aluminum.

### **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 FINISHING**

Bridge color shall be determined by client with olive green, grey, beige, and safety yellow as standard. No painting is required as the color is added during the manufacturing process. Olive Green is recommended for park and trail bridge applications. Grey, beige, and safety yellow for industrial catwalk applications. Custom colors can be provided upon request.

## **8.0 DELIVERY AND ERECTION**

Delivery is made by truck to a location nearest the site accessible by roads. The bridge manufacturer will 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 totally assembled to the site. Unloading, splicing (if required) and placement of the bridge will be the responsibility of the client.

### **8.1 Erection Direction**

For bridges shipped in component parts or partially assembled, the bridge 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 bridge manufacturer shall advise the client of the actual lifting weights, attachment points and all necessary information to install the bridge.

### **8.2 Site Issues and Foundation Design**

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

## **9.0 WARRANTY**

The bridge 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.