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LRFD Guide Specifications for the Design of FRP Pedestrian Bridges



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TABLE OF CONTENTS

SECTION 1: INTRODUCTION 1-1
1.1—SCOPE 1-1
1.2—DEFINITIONS 1-5
1.3—NOTATION 1-8
1.4—AXES ORIENTATION CONVENTION 1-8
1.5—DESIGN PHILOSOPHY 1-9
1.6—FRP MANUFACTURER-DESIGNED PEDESTRIAN BRIDGES 1-10
1.7—ACCEPTABLE FRP TYPES 1-10
SECTION 2: GENERAL DESIGN FEATURES 2-1
2.1—SCOPE 2-1
2.2—SERVICE LIFE CONSIDERATIONS 2-1
2.2.1—Polymer Additives 2-1
2.2.2—Coatings 2-1
2.2.3—Connection Materials 2-2
2.3—DECK JOINTS 2-2
2.4—BEARINGS 2-3
2.5—FIRE RESISTANCE 2-3
2.6—NON-SLIP OVERLAY CONSIDERATIONS 2-4
2.6.1—General 2-4
2.6.2—Non-Slip Overlay Requirements 2-5
2.7—DRAINAGE CONSIDERATIONS 2-6
2.7.1—General 2-6
2.7.2—Scuppers 2-6
2.7.3—Drip Grooves 2-7
2.8—AESTHETICS 2-7
SECTION 3: LOADS 3-1
3.1—SCOPE 3-1
3.2—PERMANENT LOADS (*DC*, *DW*) 3-1
3.3—PEDESTRIAN LOADS (*PL*) 3-1
3.3.1—Application of Pedestrian Loads 3-1
3.4—VEHICLE LOADS (*LL*) 3-2
3.4.1—Tire Contact Area 3-3
3.5—EQUESTRIAN LOADS (*LL*) 3-3
3.6—OTHER LIVE LOADS (*LL*) 3-3
3.7—FATIGUE LOADS (*LL*) 3-3
3.8—WIND LOADS (*WS*) 3-4
3.9—WATER LOADS (*WA*) 3-4
3.10—SNOW OR ICE LOADS (*DW*) 3-4
3.11—EARTHQUAKE LOADS (*EQ*) 3-5
3.12—LOADS ON RAILINGS 3-5
3.13—FORCE EFFECTS DUE TO SUPERIMPOSED DEFORMATIONS (*TU*, *TG*, *CR*) 3-5
3.13.1—Uniform Temperature (*TU*) 3-5

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3.13.2—Thermal Gradient (*TG*) . . . 3-6
3.13.3—Creep and Relaxation (*CR*) . . . 3-7
3.14—COMBINATION OF LOADS . . . 3-8
3.14.1—Strength I . . . 3-8
3.14.2—Strength III . . . 3-8
3.14.3—Strength IV . . . 3-8
3.14.4—Extreme Event I . . . 3-9
3.14.5—Service I (Deflection) . . . 3-9
3.14.6—Service I (Fundamental Frequency of Bridge) . . . 3-9
3.14.7—Service I (Dynamic Behavior) . . . 3-9
3.14.8—Fatigue I . . . 3-9
SECTION 4: MATERIAL PROPERTIES . . . 4-1
4.1—SCOPE . . . 4-1
4.2—PHILOSOPHY . . . 4-1
4.3—GENERAL CONSIDERATIONS . . . 4-2
4.3.1—Anisotropy . . . 4-2
4.3.2—Elastic Behavior . . . 4-2
4.3.3—Fibers . . . 4-2
4.3.4—Polymer Resins . . . 4-2
4.3.5—Fiber Orientation . . . 4-3
4.3.6—Fiber Stacking Sequence . . . 4-3
4.4—DESIGN PROPERTIES . . . 4-3
4.4.1—Characteristic Properties . . . 4-4
4.4.2—Environmental Adjustment Factors . . . 4-4
4.4.3—Temperature Adjustment Factors . . . 4-5
4.5—MAXIMUM SERVICE TEMPERATURE . . . 4-6
SECTION 5: DESIGN AND ANALYSIS CONSIDERATIONS . . . 5-1
5.1—DEFLECTION . . . 5-1
5.2—VIBRATION . . . 5-2
5.2.1—FRP Decking . . . 5-2
5.2.2—FRP Truss Bridges . . . 5-2
5.3—MINIMUM THICKNESS OF FRP . . . 5-3
5.4—COMPOSITE ACTION . . . 5-4
5.5—DIAPHRAGM ACTION OF DECKS . . . 5-4
5.6—CAMBER . . . 5-5
5.6.1—Camber of FRP Truss Bridges . . . 5-5
5.6.2—Camber of FRP Decking . . . 5-5
SECTION 6: GENERAL DESIGN REQUIREMENTS . . . 6-1
6.1—SCOPE . . . 6-1
6.2—DESIGN APPROACH . . . 6-1
6.3—NOMINAL RESISTANCE . . . 6-1
6.4—RESISTANCE FACTORS . . . 6-2
6.5—TIME EFFECT FACTOR . . . 6-2

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6.6—SERVICE LIMIT STATE 6-3
6.7—FATIGUE LIMIT STATE 6-3
6.8—STRENGTH LIMIT STATES 6-3
SECTION 7: DESIGN FOR PULTRUDED FRP MEMBERS 7-1
7.1—SCOPE 7-1
7.2—LIMIT STATES 7-1
7.3—BUILT-UP MEMBERS 7-2
7.4—CONNECTIONS 7-2
7.4.1—Bolted Connections 7-2
7.4.2—Adhesively Bonded Connections 7-3
SECTION 8: DESIGN OF VIP MOLDED FRP PANELS 8-1
8.1—SCOPE 8-1
8.2—LIMIT STATES 8-1
8.3—FRP SANDWICH PANEL REQUIREMENTS 8-2
8.4—DESIGN APPROACH 8-2
8.5—STRUCTURAL CONNECTIONS 8-3
8.5.1—Design Objective 8-4
SECTION 9: QUALITY CONTROL AND TOLERANCES 9-1
9.1—SCOPE 9-1
9.2—QUALITY CONTROL 9-1
9.3—TOLERANCES 9-1
9.3.1—Product Tolerances 9-1
9.3.2—Erection Tolerances 9-2
SECTION 10: REFERENCES 10-1
APPENDIX A: INSPECTION A-1
A.1—SCOPE A-1
A.2—INSPECTION REQUIREMENTS A-1
A.3—INSPECTION METHODS A-1
A.4—TYPES OF DEFICIENCIES A-2
APPENDIX B: MAINTENANCE B-1
B.1—SCOPE B-1
APPENDIX C: PROJECT SPECIAL PROVISIONS C-1
C.1—SCOPE C-1
C.2—PROJECT SCOPE C-1
C.3—SUBMITTALS C-1
C.4—FRP DESIGN CRITERIA C-2
C.5—DELIVERY, STORAGE, HANDLING C-2
C.6—WARRANTY C-2
C.7—PAY BASIS C-2
C.8—PRODUCTS C-2
C.9—TOLERANCES C-3
C.10—CONSTRUCTION C-3

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APPENDIX D: MATERIAL SPECIFICATION FOR FRP PEDESTRIAN BRIDGES D-1
D.1—SCOPE D-1

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LIST OF FIGURES

SECTION 1: INTRODUCTION

Figure C1.1-1—Flatt's Inlet FRP Pedestrian Truss Bridge (Bermuda) 1-2

Figure C1.1-2—VIP-Molded FRP Panels Used on Suspension Pedestrian Bridge (Trail, British Columbia, Canada) 1-3

Figure C1.1-3—VIP-Molded FRP Deck Panels Used on Rail Crossing Pedestrian Bridge (Boston, MA) 1-3

Figure C1.1-4—Pultruded FRP Planks Used in Construction of Cantilevered Sidewalk (Clinton Township, MI) 1-4

Figure C1.1-5—VIP-Molded FRP Panels Used in Construction of Cantilevered Sidewalk (Arlington, WA) 1-4

Figure C1.1-6—VIP-Molded FRP Tee Panels Used in Construction of Rail Platform (Pawtucket, RI) 1-5

Figure C1.7-1—Pultruded FRP Planks Placed Side-by-Side 1-11

Figure C1.7-2—Section of a VIP-Molded FRP Panel 1-11

SECTION 3: LOADS

Figure 3.4-1—AASHTO H-Truck Configuration 3-2

SECTION 7: DESIGN FOR PULTRUDED FRP MEMBERS

Figure C7.1-1— Pultruded FRP Truss Bridge Fully Assembled and Being Load Tested 7-1

SECTION 8: DESIGN OF VIP-MOLDED FRP PANELS

Figure C8.1-1—Cross Section of a VIP-Molded FRP Sandwich Panel. 8-1

Figure C8.5-1—Cross Section of a VIP-Molded FRP Sandwich Panel Showing Embedded Steel Plate Used for Making a Connection 8-3

Figure C8.5-2—Typical Detail for Connecting VIP-Molded FRP Panel to Steel I-Beam 8-4

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LIST OF TABLES

SECTION 2: GENERAL DESIGN FEATURES

Table 2.6.2-1—Non-Slip Overlay Requirements 2-6

SECTION 3: LOADS

Table 3.4-1—Design Vehicle 3-2

SECTION 4: MATERIAL PROPERTIES

Table C4.3.5-1—Recommended Fiber Content of Laminates in Pultruded Members 4-3

Table C4.3.5-2—Recommended Fiber Content of Laminates in VIP Panels 4-3

Table 4.4.2-1—Minimum Environmental Adjustment Factors (C_E) for FRPs 4-5

Table 4.4.3-1 Minimum Temperature Adjustment Factors (C_T) for FRPs 4-6

SECTION 5: DESIGN AND ANALYSIS CONSIDERATIONS

Table 5.1-1—Deflection Limits for FRP Decking 5-1

Table 5.1-2—Deflection Limits for FRP Truss Bridges 5-1

Table C5.3-1—Recommended Minimum Thickness of FRP Laminates for Structural Members 5-4

SECTION 9: QUALITY CONTROL AND TOLERANCE

Table 9.3.1-1—Product Tolerances for VIP-Molded FRP Panels 9-2

Table C9.3.2-1—Suggested Erection Tolerances 9-3

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SECTION 1

INTRODUCTION

1.1—SCOPE

These Guide Specifications apply to bridges and other structures constructed with fiber-reinforced polymer (FRP) composite members or FRP decking. These structures are designed to carry primarily pedestrians, bicyclists, equestrian riders, and light maintenance vehicles, but not highway traffic. FRP pedestrian bridges covered by these Guide Specifications include truss bridges constructed with pultruded FRP members, pultruded FRP decking, and FRP members manufactured using a vacuum infusion process (VIP).

These Guide Specifications provide additional guidance as a supplement to the *AASHTO LRFD Bridge Design Specifications* (AASHTO BDS) and the AASHTO *LRFD Guide Specifications for the Design of Pedestrian Bridges,* 2nd Edition (AASHTO PEDESTRIAN) (AASHTO, 2024) (AASHTO, 2015). Only those issues unique to the design of FRP pedestrian bridges are addressed in these Guide Specifications.

These Guide Specifications refer to ASCE/SEI 7-22 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE 7) for loadings important to FRP pedestrian bridges that are not adequately addressed in AASHTO BDS or in AASHTO PEDESTRIAN.

C1.1

The first edition of these Guide Specifications (2008) was intended for truss-style pedestrian bridges constructed with pultruded FRP structural shapes. Since 2008, pultruded FRP planks and VIP-molded FRP panels have been used as bridge decking in numerous bridge projects. FRP beams have been used to support decks of pedestrian bridges. Long span VIP-molded FRP double-tees and triple-tees have been used in commuter rail platforms. The provisions contained in these Guide Specifications may also be applicable to other structures, such as sidewalks cantilevered off existing bridges, commuter rail platforms, and boardwalks.

These Guide Specifications include provisions for the design and detailing of pultruded FRP structural shapes used in the construction of truss bridges and FRP decking supported on steel, reinforced concrete, or FRP beams. FRP decking includes pultruded FRP planks and VIP-molded FRP sandwich panels.

Timber planks are often used as decking on FRP truss bridges. Design guidelines for timber decking are covered by other references, including *National Design Specification (NDS) for Wood Construction*.

Representative examples of FRP pedestrian bridge projects are shown in Figures C1.1-1 through C1.1-6.

This first edition of these Guide Specifications was based on Allowable Stress Design (ASD) and Load Factor Design (LFD). This edition is based on AASHTO BDS and integrates current state of practice for the design and detailing of FRP composite pedestrian bridges.

Loadings important to FRP pedestrian bridges, such as snow loading, are better addressed in ASCE 7.

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These Guide Specifications refer to the interim material specification in Appendix D until requirements are added to AASHTO M 337 or another AASHTO material specification for FRP pedestrian bridges is published.

These Guide Specifications incorporate information and guidelines from other FRP standards and technical specifications, including ASCE/SEI 74 *Load and Resistance Factor Design (LRFD) for Pultruded Fiber Reinforced Polymer (FRP) Structures* (ASCE 74) and the JRC Report EUR 27666 EN, *Prospect for New Guidance in the Design of FRP* (EURO GUIDE), which is the basis for the technical specifications for FRP structures published by many European countries (Ascione et al., 2016).

For ease of use, some information found in the reference documents is replicated in these Guide Specifications.

In these Guide Specifications, the term "FRP Pedestrian Bridge" shall mean any pedestrian bridge whose superstructure or deck is constructed with FRP members. FRP truss bridges with timber decks are also classified as FRP pedestrian bridges.

AASHTO M 337 defines the requirements for FRP strengthening systems and is not entirely suitable for the FRP materials used in FRP pedestrian bridges.

ASCE 74 represents the current state of practice for the LRFD design of pultruded FRP structures. EURO GUIDE is wider in scope than ASCE 74, including provisions for VIP-molded panels.

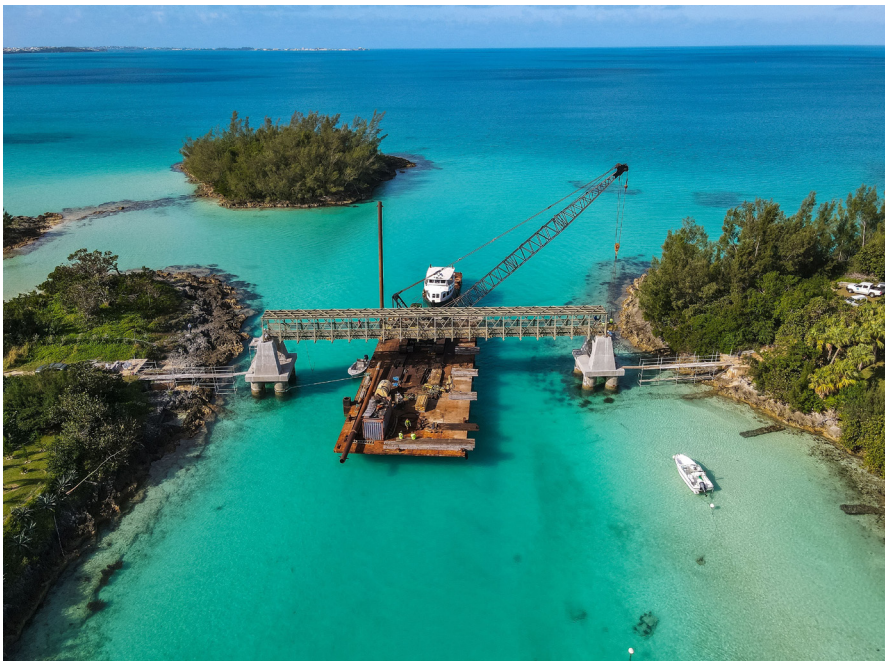


Figure C1.1-1—Flatt's Inlet FRP Pedestrian Truss Bridge (Bermuda)
(Source: Creative Composites Group)

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Figure C1.1-2—VIP-Molded FRP Panels Used on Suspension Pedestrian Bridge (Trail, British Columbia, Canada) (Source: Graham Group)



Figure C1.1-3—VIP-Molded FRP Deck Panels Used on Rail Crossing Pedestrian Bridge (Boston, MA) (Source: Creative Composites Group)

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Figure C1.1-4—Pultruded FRP Planks Used in Construction of Cantilevered Sidewalk (Clinton Township, MI) (Source: C.A. Hull Company)



Figure C1.1-5—VIP-Molded FRP Panels Used in Construction of Cantilevered Sidewalk (Arlington, WA) (Source: Francis Zera Photography)

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Figure C1.1-6—VIP-Molded FRP Tee Panels Used in Construction of Rail Platform (Pawtucket, RI) (Source: Coastline Composites)

1.2—DEFINITIONS

Additives—Substances added to the polymer resin to improve properties or aid in the processing of the FRP composite material.

Adhesive—Substance capable of holding materials together by surface bond, through chemical or mechanical bond.

Anisotropic—Exhibiting properties with different values when measured along axes in different directions.

Balanced Laminate—A composite in which all laminae at angles other than 0 and 90 degrees occur in +/- pairs with the pairs having the same thickness and material (not necessarily adjacent).

Carbon Fiber—A reinforcing fiber known for its light weight, high strength, and high stiffness produced by pyrolysis of an organic precursor fiber in an inert atmosphere at temperatures above 1800°F. Can also be graphitized by heat treating above 3,000°F.

CFRP—Carbon fiber-reinforced polymer.

Characteristic Design Value—Statistically-based property value representing the 80 percent lower confidence bound on the fifth-percentile value of a specified population, determined in accordance with ASTM D7290.

Chopped Strand Mats—Continuous strand yarn or roving cut up into uniform lengths, usually from 1 to 2 in. long, and pressed flat to form fabric held together with a binder.

Classical Lamination Theory (CLT)—A theoretical framework used in the field of mechanics of composite materials. It provides a methodology to analyze the complex mechanical behavior of composite structures

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