

GLASS FIBER COMPOSITE REINFORCEMENT IN INFRASTRUCTURE

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MAINEDOT COMPOSITES



GFRP IMPLEMENTATION NECESSITIES

Audit Programs

Specifications

Minimum Qualifications



GFRP AUDIT PROGRAMS

AASHTO NTPEP Composite Concrete Reinforcement Audit Program

- Quality Control Plan requirements
 - Defined procedures and general requirements
 - Required minimum QC testing based on ASTM D7957 but with additional testing and frequency
- Annual audit administered by AASHTO
 - In person review of documents, facility and testing
 - Material samples taken for compliance testing
 - 5 samples from a random lot of each bar size will be taken
 - Properties tested:
 - Ultimate Tensile Force
 - Tensile Mod. of Elasticity
 - Ultimate Tensile Strain
 - Transverse Shear
 - Cross Sectional Area
 - Horizontal Shear

**NTPEP Committee Work Plan for
Evaluation of Glass Fiber
Reinforcing Bar Manufacturers**

NTPEP Designation: GFRP-22-01



National Transportation Product Evaluation Program
555 12th Street NW, Suite 1000
Washington, D.C. 20004

FRP INSTITUTE FACILITY AUDIT PROGRAM

FRP Institute Manufacturer Audit Program

- Designed to complement AASHTO
- Best practices and quality focused
- Standardized QC and production practices
- Annual- Offset with AASHTO
- Industry-wide accountability
- All GFRP Manufactures Participate

[Home](#) [US DOT Advisory Board](#) [FRP Plant Certification](#) [Approved Plants](#) [Professional Education](#) [FRP Testing](#)

About the FRP Institute

The FRP Institute is an unbiased source of sound technical information based on consensus standards, focused on practical implementation, design advice and training, third party qualification and oversight, plant certification and independent quality assurance testing.


It is formed as a non-profit 501c(6) corporation.


The FRP Institute is an independent network of volunteer experts in the field of FRP's that may be a resource for practical design and use information. We engage in training and evaluation of design software tools that foster more commercial implementation of fiber reinforced polymers in civil infrastructure. Collectively, we participate and are instrumental in authorship of consensus standards in appropriate bodies and via the FRP Institute we apply those standards to aid adoption and use of FRP's for the Civil Infrastructure.

The FRP Institute serves as an independent third-party auditor to certify FRP producers through:

- Management of independent plant certification program
- Performance of inspections on behalf of state DOTs and other owners
- Development of consensus standards for quality control and testing
- Publication of a Quality Control criteria based on ACI, AASHTO, FIB and other standards
- Facilitating technology transfer of industry standards, design methodology and appropriate use, to designers, state DOTs and other owners

The majority of State DOT materials labs are unfamiliar and unable to perform QA oversight of FRP's. The polymer materials are unfamiliar to them and they don't have the specialized equipment necessary to do QA testing. The FRP Institute will assist with QA testing for specific projects on behalf of the State DOTs / County's/ Cities / Owner's

[Learn about the Maine DOT FRP Educational Session - May 10, 2023](#) 



AUDIT PROGRAM POINTS OF CONTACT

AASHTO Composite Concrete
Reinforcement TC

Chair: Cabell Garbee-NCDOT

Vice Chair: Steve Nolan-FDOT

<https://transportation.org/product-evaluation-and-audit-solutions/technical-committees/composite-concrete-reinforcements-ccr/>

FRP Institute

Joe Stilwell- Auditing Chair/Technical
Service Chair

<https://www.frp-institute.org/>

FRP SPECIFICATIONS

AASHTO

- LFRD Bridge Design Guide Specifications for GFRP-Reinforced Concrete – 2018
- LFRD Guide Specifications for Design of Concrete-Filled FRP Tubes – 2012
- Guide Specifications for the Design of Concrete Bridge Beams Prestressed with Carbon Fiber-Reinforced Polymer (CFRP) Systems – 2018
- Guide Specifications for Design of FRP Pedestrian Bridges – 2008
- Guide Specifications for Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements – 2012
- M337 – Standard Specification for Fiber-Reinforced Polymer Composite Materials for Highway and Bridge Structures – 2021
- GFRP couplers in development

ACI

- 440 codes
 - 440.2: Externally Bonded FRP
 - 440.3: Test methods for FRP Reinforcement or Strengthening
 - 440.9: Durability
 - 440.11-22: Building Code requirements for structural concrete reinforced with GFRP (IBC req.)

ASCE:

- 74.23 Load and Resistance Factor Design for Pultruded Fiber Reinforced Polymer Structures
- Design Guide for FRP Composite Connections – 2011
- Design of Fiberglass-Reinforced Plastic Stacks – 2010

QUALIFIED PRODUCTS REQUIREMENTS

MaineDOT Composite Concrete Reinforcement

Product Evaluation Program

Product Acceptance Criteria & Information

This product acceptance criteria is for Composite Concrete Reinforcement (CCR) such as glass fiber reinforced polymer bars that have been manufactured for the purpose of concrete reinforcement. It does not apply to Hybrid FRP materials or bars, and bars that have not had their exteriors enhanced for concrete reinforcement. This product category requires participation in the AASHTO Product Evaluation & Audit Solutions program. As of August 1, 2024, all new submittals shall have a compliant AASHTO audit at the time of submission. All products currently on the QPL shall have a compliant audit completed through the AASHTO program by August 1, 2025 to remain on this qualified products list.

- CCRs must have a compliant audit through AASHTO Product Evaluation & Audit Solutions (formerly NTPEP) and shall comply with their audit schedule and the criteria herein. No submittals will be evaluated without test data and associated compliant audit. The information and data provided through the audit process shall be used for decisions regarding inclusion on MaineDOT's QPL for this product category.
- All glass fiber reinforced polymer bars must meet the standards in ASTM D7957, this includes geometric, material, mechanical, and physical properties.
- In addition to the above requirements, all GFRP bars will meet the following
 - Minimum Tensile Strength = 100,000 psi
 - Minimum Ultimate Tensile Strain = 1.10%
 - Minimum Elastic Modulus = 8,700,000 psi

MaineDOT Standard Specifications: Current Version ASTM D7957

V•ROD 60

GLASS FIBER REINFORCED POLYMER (GFRP) REBAR

REVISION: May 2019

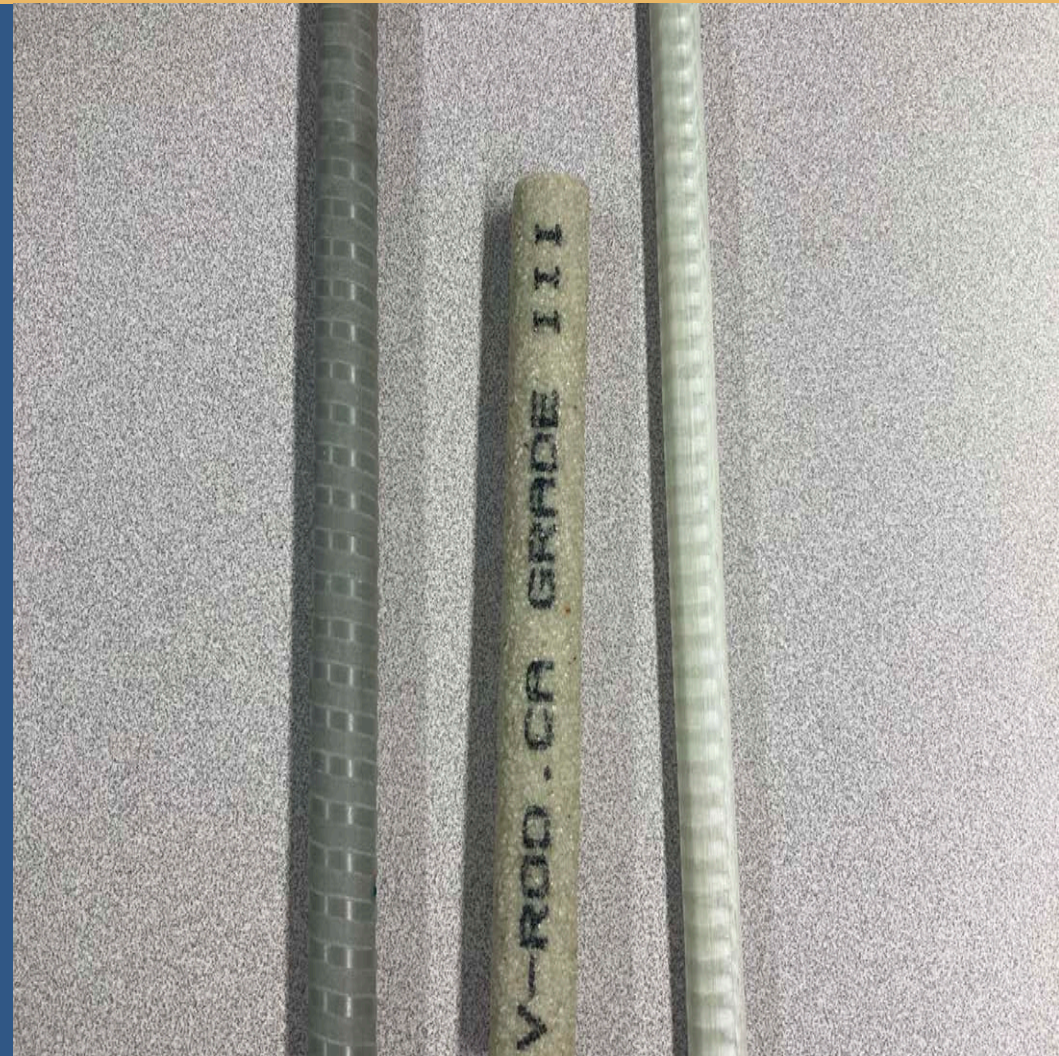
Product Data Sheet – V•ROD 60

		#2 (6 M)	#3 (10 M)	#4 (12 M)	#5 (15 M)	#6 (20 M)	#7 (22 M)	#8 (25 M)	#9 (30 M)	#10 (32 M)
Guaranteed tensile strength* [ASTM D7205]	MPa	1100	1100	1100	1100	1100	1100	1100	1000	1000
	ksi	159.5	159.5	159.5	159.5	159.5	159.5	159.5	145	145
Minimum tensile modulus [ASTM D7205]	GPa	60								
	ksi	8702.3								
Guaranteed transverse shear capacity [ASTM D7617]	MPa	180								
	ksi	26.1								
Resin		vinylester								
Weight	g/m	78	175	310	442	633	863	1127	1426	1761
	lb/ft	0.052	0.118	0.208	0.297	0.425	0.58	0.757	0.958	1.183
Effective cross-sectional area** (including sand coating) [CSA S806 Annex A]	mm ²	37.2	83.8	145	232.9	326.8	438.2	572.3	724.3	894.2
	in ²	0.058	0.130	0.225	0.361	0.507	0.679	0.887	1.123	1.386
	mm ²	6.9	10.33	13.59	17.22	20.39	23.6	26.99	30.4	33.7
Effective diameter	in ²	0.272	0.407	0.535	0.678	0.803	0.929	1.063	1.197	1.327
	mm ²	32	71	129	199	284	387	510	645	819
Nominal cross-sectional area [CSA S807 Table 1]	mm ²	32	71	129	199	284	387	510	645	819
	in ²	0.05	0.110	0.199	0.308	0.440	0.6	0.790	1	1.269

GFRP CONCRETE REINFORCEMENT

Qualified Manufactures

- Mateen: Concord, NC
- Pultrall: Thetford Mines, Quebec
 - Rockford II facility opening Late 2024
- MST Bar: Toronto, Ontario
 - Buffalo NY facility opening Early 2025
- Tokyo Rope- Canton, MI
 - Carbon Fiber Cable: Prestressing and Post-tensioning



TYPICAL GRFP DECK DETAILS

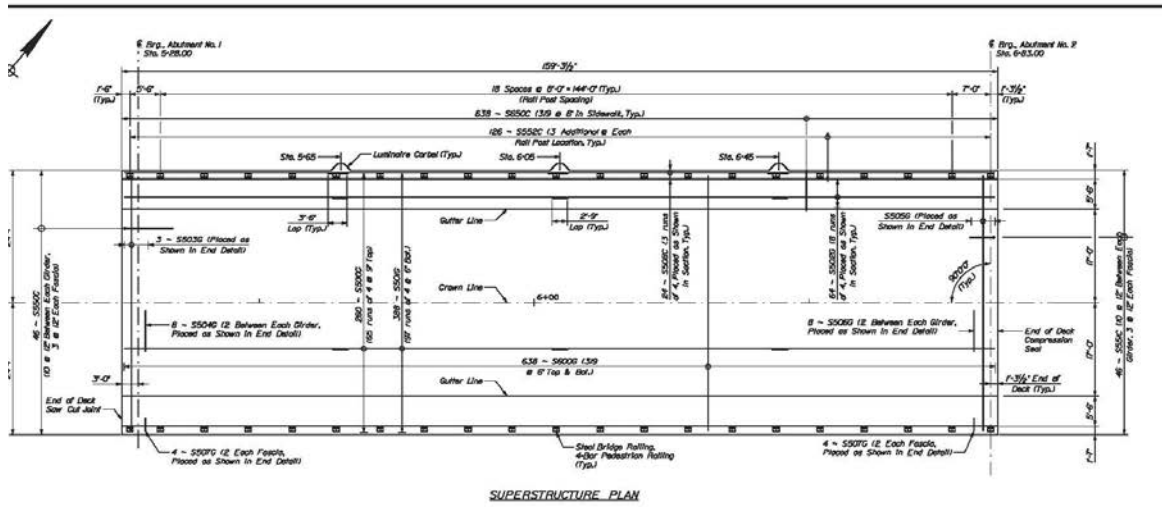
Single Span

\$1.50/LF

60,700 LF

2023 Adv with 2024 construction

Over 3 million LF of GFRP used in the last 5 years

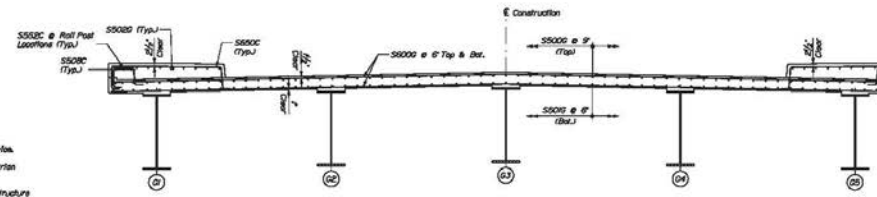


SUPERSTRUCTURE PLAN

STRUCTURE NOTES:

- Formwork blocking used for design of the structure is # of the size of bearing of the abutments, Refer to Standards Detail U1 for blocking details.
- Welding steel shall have a minimum concrete cover of 2" unless otherwise noted.
- A one inch V groove in the fascias of the horizontal joint between the end walls.
- Concrete Deck Panels are not allowed on this project.
- Wall to be furnished shall have minimum Movement Rating as in.
- Abutment No. 2 - 1.83 inches
- superstructure slab concrete shall be placed continuously and shall be cast to full entire placement has been made.
- contractor shall approve the seals prior to fabrication of the Expansion Device.
- separation joint shall be provided in the Steel Bridge Rolling, 4-Bar Pedestrian Rolling centered on the compression seal joint opening of Abutment No. 2.
- see details and Saw Cut Joint Details and Notes, see sheet, "Superstructure E."
- roll posts for the steel bridge roll posts shall be shortened by 1 inch to provide full clearance between the top of the deck and bottom of the anchor rod.

Temperature (Dep. F)	-30	-20	-10	0	10	20	30	40	45	50	60	70	80	90	100
Opening (Inches)	3.43	3.31	3.18	3.06	2.93	2.81	2.69	2.56	2.50	2.44	2.31	2.19	2.07	1.94	1.82



TRANSVERSE REINFORCING SECTION

TYPICAL LAYOUT



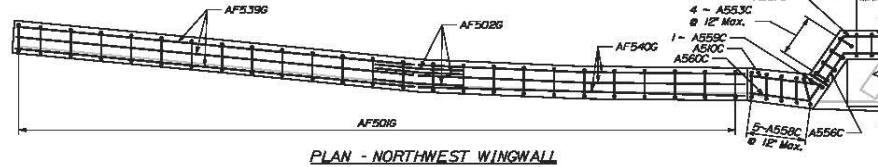


2011 Construction - 2024 photos

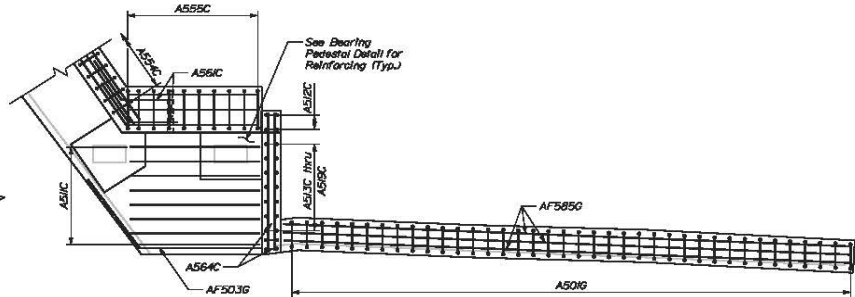
AUBURN HOTEL RD- OLDEST GFRP DECK

CONCRETE SUBSTRUCTURE STRUCTURAL REPAIR

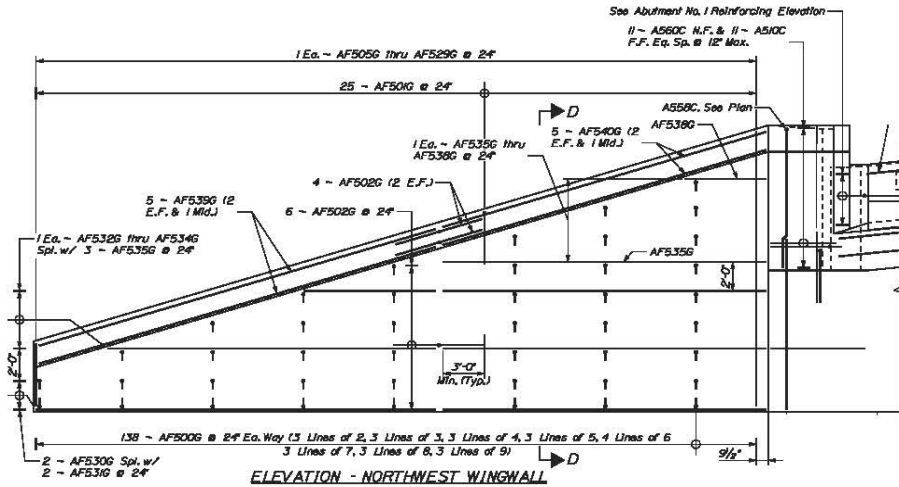




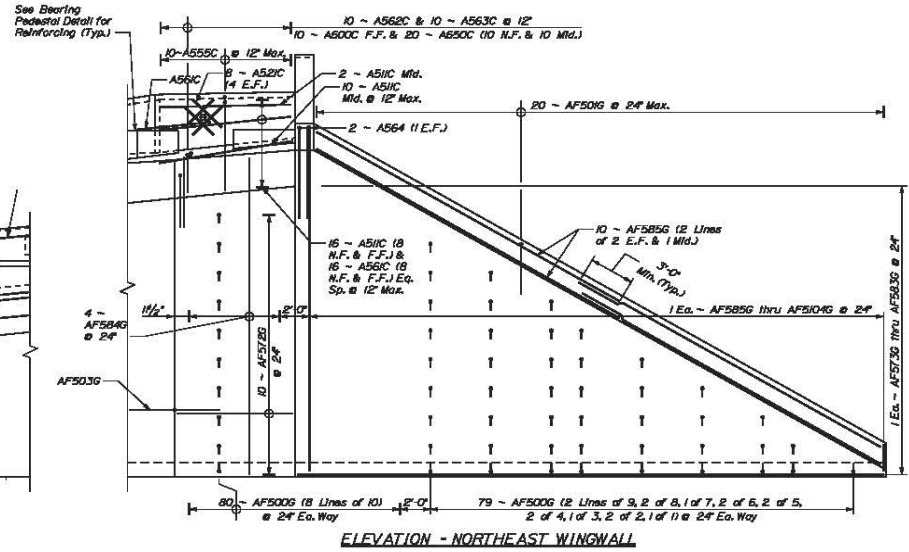
PLAN - NORTHWEST WINGWALL



PLAN - NORTHEAST WINGWALL



ELEVATION - NORTHWEST WINGWALL



ELEVATION - NORTHEAST WINGWALL

STATE	
DEPARTMENT	
PROJECT NO.	3028
SHEET NO.	21

DATE	
BY	
CHECKED	
DESIGNED	
DRAWN	
SCALE	
PROJECT NO.	
P.R. NUMBER	
DATE	

RINES HILL BRIDGE
 OLD MAINE CENTRAL RAILROAD
 AUGUSTA KENNEBEC COUNTY
ABUTMENT NO. 1
REINFORCING (2 OF 2)

SHEET NUMBER	37
OF	84

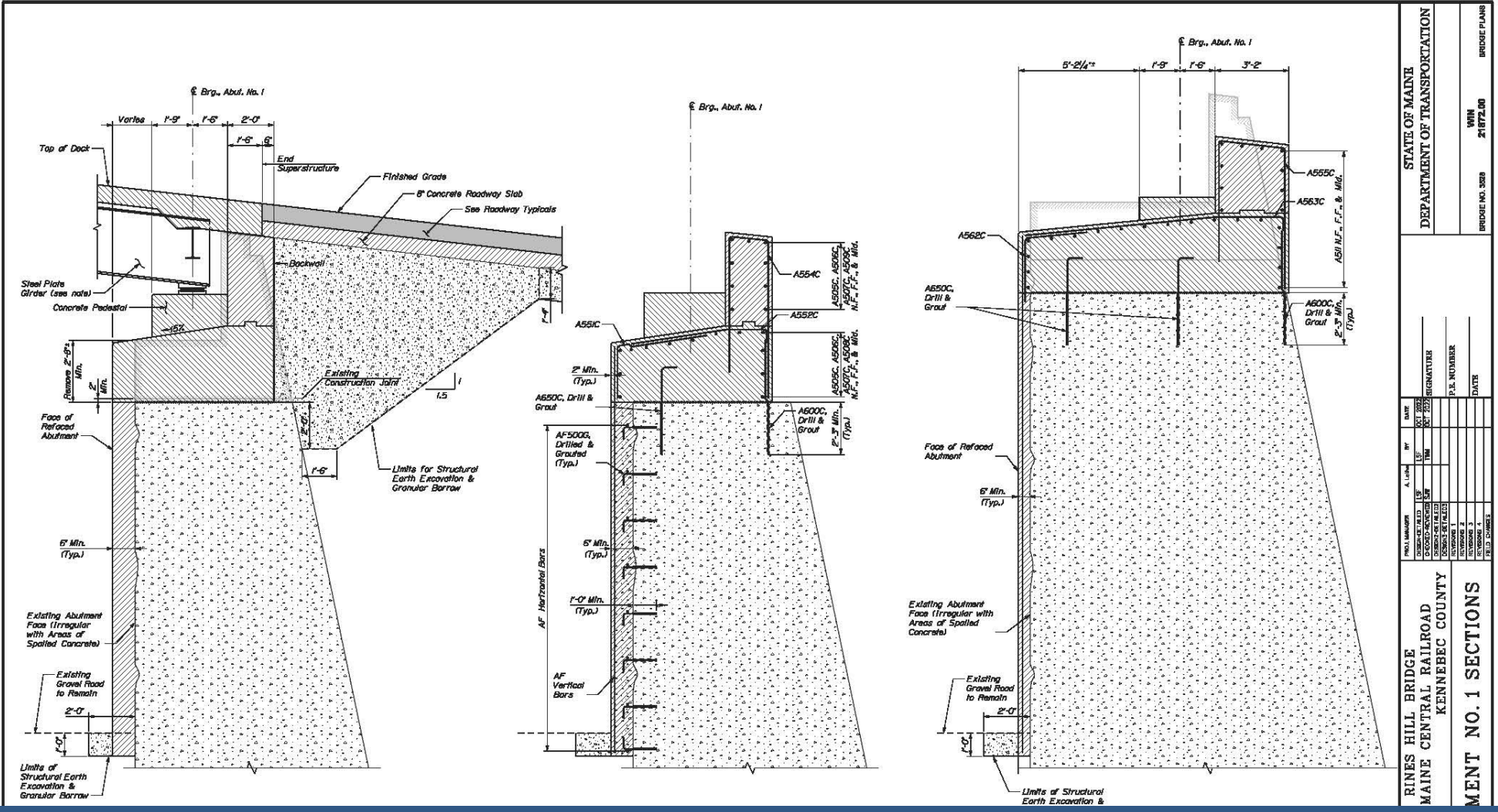


DATE: 11/24/2022

USER: systems

ISSUED: 11/24/2022

ISSUED BY: MS.AVJUL...@maine.gov



STATE OF MAINE DEPARTMENT OF TRANSPORTATION		BRIDGE NO. 3389		WVIN		21872.00		BRIDGE PLANS	
RINES HILL BRIDGE MAINE CENTRAL RAILROAD KENNEBEC COUNTY		MENT NO. 1 SECTIONS		DATE	DESIGNER	DATE	DESIGNER	DATE	DESIGNER





NCDOT COMPOSITES

Harkers Island (complete)

- 3,200' Long
- 28 Span
- \$68 Million

Alligator River (Final design)

- 3 miles
- \$110 Million
- All reinforcement is composite sub and super structure



STATES THAT USE GFRP AND CFCC

Michigan

Virginia

Florida

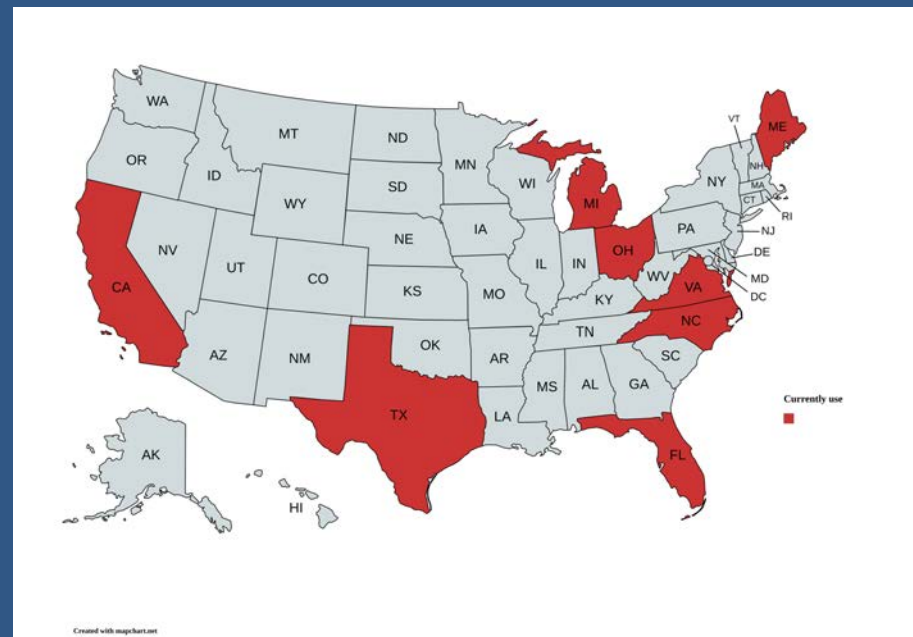
Maine

North Carolina

Ohio

Texas

California



QUESTIONS?

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