



***BASALT FIBER REINFORCED POLYMER
REBAR
(BFRP REBAR)***

PRODUCT GUIDE SPECIFICATION

Specifier Notes: This product specification is written according to the Construction Specifications Institute (CSI) Format, including Master Format (2016 Edition), Section Format and Page Format, contained in the CSI Manual of Practice.

This section must be carefully reviewed by the Engineer to meet the requirements of the project and local building code. Coordinate with other specification sections and the drawings.

SECTION 03 21 11

Basalt Fiber Reinforced Polymer (**BFRP**) rebar for Concrete Reinforcement according to ASTM D7957.

Specifier Notes: This section covers Basalt Engineering, LLC. – BASTECH® – Basalt Fiber Reinforced Polymer Rebar (BFRP Rebar)

BFRP Rebar is an alternative to galvanized or epoxy coated rebar, stainless steel rebar or GFRP rebar. BFRP rebar should be considered for any concrete member susceptible to corrosion of steel reinforcement by water, salt water, deicing salts or other corrosive agents as BFRP Rebar **DOES NOT CORRODE**. Other advantages of specifying BFRP Rebar: 75% lighter than steel rebar, tensile strength is 2.5 times stronger than steel rebar, up to 30% less concrete coverage required versus steel rebar (subject to design), transparent to radio frequencies, non-conductive, non-magnetic, same thermal coefficient as concrete, dielectric, UV resistant, BFRP Rebar can withstand temperatures from -50 C to 300 C, less shipping costs, easier to handle, easier to cut, less cost than stainless steel rebar. Life span is 100 plus years in comparison to 50 years for steel rebar.

BFRP Rebar applications as an alternative to steel rebar: bridges, tunnels, seawalls, highways, mining, median barriers, approach slabs, parking structures, salt storage facilities, railroad grade crossings, precast, ports, airports, transformer sub stations, underground utilities, foundations, concrete tanks, submerged concrete structures, floating marine docks, aquaculture projects, MRI rooms, swimming pools, ice skating arenas.

Specifier Notes: The references below should be referred to by the Engineer regarding the application of BFRP Rebar for concrete reinforcement. Basalt Engineering LLC. Technical Division will assist the engineer in the appropriate applications of BFRP Rebar.

1. ACI 318-95, "Building Code Requirements for Concrete" (1995), American Concrete Institute, Detroit, MI, 347 pp.
2. ACI 440R-96, "State-of-the-Art Report on Fiber Reinforced Plastic Reinforcement for Concrete Structures" (1996), American Concrete Institute, Detroit, MI, 68 pp.
3. "Placing Reinforcing Bars" (1992), Concrete Reinforcing Steel Institute, Schaumburg, IL.
4. "ACI 440. 1R-15 "Guide for the Design and Construction of Concrete Reinforced with FRP Bars". Reported by ACI Committee 440, May 2006.
5. "ACI 440.3R-04 "Guide Test Methods for FRP's Reinforcing or Strengthening Concrete Structures". Report by ACI Committee 440, October 2004.
6. ASTM D7205-06 "Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars"
7. ACI 440.5-18 "Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars". Reported by ACI Committee 440, July 2008.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Deformed fiber reinforced polymer (FRP) bars for concrete reinforcement.

1.2 RELATED SECTIONS

Specifier Notes: Edit the following list as required for the project. List other sections with work directly related to the BFRP rebar.

- A. Section 03300 – Cast-In-Place Concrete
- B. Section 03400 – Precast Concrete

1.3 REFERENCES

Specifier Notes: List standards referenced in this section, complete with designations and titles. This article does not require compliance with standards but is merely a listing of those used.

- A. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
- B. CRSI Placing Reinforcing Bars.

1.4 DESIGN REQUIREMENTS

Specifier Notes: Design with BASTECH® – Basalt Fiber Reinforced Polymer Rebar (BFRP Rebar) shall be in accordance with ACI publication ACI 440.1R “Guide for the Design and Construction of Concrete Reinforced with FRP Bars” for building structures. For transportation structures, use AASHTO LRFD Bridge Design Guide Specifications for FRP – Reinforced Concrete, 2nd Edition December 2018. Alternatively, by the provisions of the Canadian Highway Bridge Design Code Section 16. Canadian Standards Association, CSA S806-02 Design and Construction of Building Components with Fiber Reinforced Polymers, Interim design guidelines have been published by the British Institution of Structural Engineers covering modifications to BS8110 and BS5400, the Norwegian Concrete Standard NS3473, and the Japanese Society of Civil Engineers.

In general, the designer shall consider the following:

- A. Do not substitute BFRP reinforcing bars for steel reinforcing bars on an equal area basis, due to differences in material properties.
- B. Specifically design reinforced concrete members for BFRP rebar, taking into account properties of the material and effects, on strength, deflection and crack width.
- C. In most cases, deflection will control design of concrete structures reinforced with BFRP rebar based on value of modulus of elasticity of BFRP rebar.

1.5 SUBMITTALS

- A. Comply with Section 01330 – Submittal Procedure
- B. Product Data: Submit manufacturer's product data, including material and mechanical properties.
- C. Test Reports: Submit manufacturer's certified test reports for source quality control testing for material and mechanical properties performed either in house or by an independent testing agency. If independent testing is required, this shall be noted at the time of bidding.
 - 1. Each bar size.
 - 2. Basalt Fiber Reinforced Polymer Rebar. (BFRP Rebar)
 - 3. Each type of resin matrix specified.

1.6 QUALITY ASSURANCE

Specifier Notes: Describe requirements for the placement and tolerances of BFRP rebar in the formwork.

- A. Placing of the BFRP rebar, handling and tolerance in formwork shall be in accordance with ACI 440.5-18 "Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars". Reported by ACI Committee 440, July 2018.

1.7 DELIVERY, STORAGE AND HANDLING

Specifier Notes: Care should be taken to avoid damaging the surface of the rebar by abrasion, nicks, or cuts

- A. General: Deliver, store and handle BFRP rebar in accordance with manufacturer's instructions to prevent damage and in accordance with ACI 440.5-18 "Specification for Construction with Fiber Reinforced Polymer reinforcing rebar. Reported by ACI Committee 440, July 2018.
- B. Storage:
 - 1. Do not store BFRP rebar directly on the ground. Place rebar on timbers or pallets to keep free from dirt and mud and to provide easy handling.

2 PART 2 PRODUCTS

2.1 MANUFACTURER

A. **BASTECH®** – Basalt Fiber Reinforced Polymer Rebar (BFRP Rebar)

By Basalt Engineering, LLC.
188 Brooke Road, #150
Winchester, VA. 22603
1-888-244-7865
www.basalt-usa.com

BASTECH® is the trademark name for BFRP Rebar manufactured by Basalt Engineering, LLC.

B. Binding Material: Wound Ribbing – also basalt fiber reinforced polymer.

C. Manufacturing Process:

1. Pultrusion process.
2. Basalt fiber ROVINGS are drawn through a resin bath, forming mechanism with die, curing tunnels, pulling device and final cutting mechanism. An addition step prior cutting will factory form **shapes**.

Specifier Notes: Basalt Engineering, LLC. produces rebar sizes #2, #3, #4, #5, #6, #7, #8- bar size ¼" through to 1" diameter.

Material	BFRP Rebar
Tensile Strength MPa	1100-1500
Density g/cm3	1.9
Corrosion Resistance	Non-Corrosive
Thermal Conductivity	Non-Conductive
Alkali Resistance	High
Electrical Conductivity	Dielectric
Magnetic Feature	Non-Magnetic
Lengths	Cut to specification size #2 & #3 can be coiled up to 300 feet
Embodied Carbon	60% less than steel
Maintenance	Life span close to 100 years

Comparison of BASTECH® BFRP rebar size #3 performance to existing acceptance criteria

			Per diameter	FDOT 9322-3/2017	AC454	ASTM D 7957				
Test Method	Test Description	Unit	Norm	Exp.	Criteria	✓/✗	Criteria	✓/✗	Criteria	✓/✗
ASTM D 792	Measured Cross-Sectional Area	mm²	78.54	83.97	67 – 103.87	✓	67-103.87	✓	67-103.87	✓
ASTM D 2584	Fiber Content	% wt.	80.03	80.03	≥ 70	✓	≥ 70	✓	≥ 70	✓
ASTM D 570	Moist Absorption Short Term @ 50 C	%	0.24	0.24	≤ 0.25	✓	≤ 0.25	✓	≤ 0.25	✓
ASTM D 570	Moist Absorption Long Term @ 50 C	%	0.75	0.75	≤ 1.0	✓	n/a	n/a	≤ 1.0	✓
ASTM D 7617	Min. Guaranteed Transverse Shear	MPa	210.01	209.26	≥ 151.69	✓	≥ 151.69	✓	≥ 131	✓
ASTM D 4475	Horizontal Shear Stress	MPa	53.88	46.16	≥ 37.93	✓	≥ 37.93	✓	n/a	n/a
ASTM D 7205	Min. Guaranteed Tensile Load	kN	85.03	85.03	≥ 58.71	✓	≥ 58.71	✓	≥ 58.71	✓
ASTM D 7205	Min. Guaranteed Tensile Strength	MPa	1119	948.98	n/a	n/a	n/a	n/a	n/a	n/a
ASTM D 7205	Tensile Modulus	GPa	58	49	≥ 44.82	✓	≥ 44.82	✓	≥ 44.82	✓
ASTM D 7205	Max Strain	%	2.1	2.1	n/a	n/a	n/a	n/a	n/a	n/a

Basalt Engineering, LLC. reserves the right to make improvements to the product or process which may result in benefits or changes to some of the physical-mechanical characteristics. The data contained herein is considered representative of current production and is believed to be reliable and to represent the best available characterization to the product as of September 1, 2020.

There are some dimensional limitations to shape details. Please contact Basalt Engineering LLC. to confirm availability of a particular shape. 1-888-244-7865.

2.1 SOURCE QUALITY CONTROL

Individual bars are sampled on a regular basis during production for tensile, modulus and ultimate strain testing. Testing is performed per ASTM D7205-06.

3 PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive BFRP rebar. Notify Engineer if areas are not acceptable. Do not begin placing BFRP rebar until unacceptable conditions have been corrected.

3.2 PLACING

Specifier Notes: Placing of BFRP rebar performed similarly as for steel reinforcing rebar, and common practices should apply with some key exceptions, as specified below.

- A. Place BFRP rebar in accordance with CRSI Placing Reinforcing Bars, unless otherwise specified.
- B. Place BFRP rebar accurately in accordance with approved placing drawings, schedules, typical details and notes.
- C. Field Cutting; use high speed grinding cutter, Sawzall with metal cutting blade, diamond blade or masonry blade. Do not shear rebar.
- D. Do not field bend.
- E. Securing: Secure BFRP rebar in formwork to prevent displacement by concrete.
- F. Supports: Place and support BFRP rebar accurately using plastic or non-corrosive chairs before concrete placement.
- G. Fastening: Fasten BFRP rebar with coated tie wire, nylon ties, stainless steel tie wire.
- H. Splicing: Use lap splices whenever continuity is required in the reinforcement. Do not use mechanical connections.
- I. Tolerances: Do not exceed placing tolerances specified in ACI 117.
- J. Cleaning: Remove form oil from BFRP rebar by wiping bars with cleaning solvents before placing concrete.