BFRP COMPOSITE REBAR

PRODUCT GUIDE SPECIFICATION

Specifier Notes: This product specification is written to correspond 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 closely reviewed by the Engineer to meet the specific requirements of the project and building codes. Coordinate with other specification sections and the drawings.

SECTION 03 21 21

BASALT FIBER REINFORCED POLYMER (BFRP) COMPOSITE BARS FOR CONCRETE REINFORCEMENT ACCORDING TO ASTM D7205

Specifier Notes: This section covers ZeBAR™ BFRP (Basalt Fiber Reinforced Product) rebar also referred to as basalt fiber reinforced rebar; as manufactured by GrayStone Industries.

Basalt FRP Rebar is used as per ACI 440.1R-06. The construction use is dictated by code 440.6-08. It is specified by 440.5-08 and tested according to ASTM D7205 and several other test methods. ASTM testing of Basalt FRP rebar shows that Basalt FRP rebar easily meets and exceeds the performance requirements of ACI 440.6-08.

Basalt rebar is an approved alternative to traditional black steel, epoxy coated, hot dipped galvanized (HDG), or stainless-steel rebar. It can and should be considered in any concrete application (poured or precast) where traditional steel rebar would be subject to oxidation by natural or chemical corrosion. It should also be considered when non-conductive applications are a benefit or necessity.

ZeBAR™ (Basalt) Fiber Reinforced Rebar is:

- 2.5 – 3 times stronger in tensile strength than steel rebar
- Only 25% of the weight of steel rebar
- Is impervious to high saline and moisture environments
- Has superior flexural strength and capacity
- May be used in high alkaline environments
- Does not oxidize, rust or otherwise corrode
- Has a 100+ year life span due to its inherent properties

ZeBAR™ (Basalt) Fiber Reinforced Rebar may be an appropriate option to steel reinforcement in areas of high saline content and/or applied salt environments:

- Bridge decks and Elevated Slabs like Parking Garages
- Sea Walls, Sound Barrier Walls, Retaining Walls
- Walkways, Roads and Residential, Commercial and Industrial Slabs on Grade (SOG)
- Swimming Pools (commercial and residential)
- All types of Precast Concrete

ZeBAR™ (Basalt) Fiber Rebar may also be appropriate in precast applications, including:

- Wastewater and Chemical Storage Vessels
- Underground Use: Manholes and Storm drainage
- Architectural Panels and Cladding
- High Heat or other Harsh Environment
- Any typical Precast Application to reduce the weight of the element

ZeBAR™ (Basalt) may also be appropriate for consideration in electrical and electromagnetic environments:

- Hospitals (MRI)
- Areas of high voltage (transformers, substations)
- Airports
- High Tech facilities

Additional applications may include use in UHPC (Ultra High-Performance Concrete); ECC (Engineering Cementicious Composites); Geopolymer Concrete and applications with limited concrete cover.

The following references are for the Engineer regarding the application of BFRP bars for concrete reinforcement. GrayStone Industries will provide support to the engineer of record for the implementation of BFRP Rebar.

1. ASTM D7205 -06 “Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars”.
2. ACI 440.5-18 “Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars”.
3. ACI 440.6-08 “Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement” (Reapproved 2017).
4. ACI 440.1R-15 “Guide for the Design and Construction of Concrete Reinforced with FRP Bars”.
5. ACI 440.3R-04 “Guide Test Methods for FRP’s for Reinforcing or Strengthening Concrete Structures”.
6. ACI 318-19 “Building Code Requirements For Structural Concrete And Commentary.”
7. ACI PRC-440.2-17 “Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.”

PART I – GENERAL

1.1 SECTION INCLUDES

A. This section includes BFRP bars for concrete reinforcement in agreement ACI 440.6-08.

1.2 RELATED SECTIONS

Specifier Notes: The sections noted below can be edited as required for specific projects.

A. Section 03300 - Cast-in-Place Concrete
B. Section 03400 - Precast Concrete

1.3 REFERENCES

Specifier Notes: List standards referenced in this section, with full designation and title. This does not require amenability with standards; it is a list 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 BasaFlex BFRP bars shall be in accordance with ACI 440.1R-15 "Guide for the Design and Construction of Concrete Reinforced with FRP Bars". For highway and other transportation assemblies, use AASHTO LRFD Bridge Design Guide Specifications for GFRP- Reinforced Concrete, 2nd Edition December 2018.

In general, the designer shall consider the following:

A. It may or may not be acceptable to substitute BFRP bars for same size steel reinforcing bars on a one-to-one basis. An engineering review is recommended due to distinctions in the materials characteristics.

B. Concrete members should be designed with BFRP properties in mind, with consideration for material characteristics and the impact on deflection, crack width, and strength.

1.5 SUBMITALS

A. Comply with Section 01330 – Submittal Procedures.

B. Product Data: Submit manufacturer's product information, in agreement with ASTM D7205 "Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars."

C. Test Reports: The manufacturer's test reports (certified) must be submitted as the source for quality control testing of material and mechanical properties (done in-house or by a third-party facility). If independent testing is noted as a requirement, it must be specified at the time of bidding.

1.6 QUALITY ASSURANCE

Specifier Notes: Describe requirements for reporting traceable material properties for a production lot and tolerances on field placement of composite rebar in formwork.

A. ATSM D7205 material standard for Fiber Reinforced Bars describes the tensile strength of the BFRP; quality control and material limitations (inclusive of test methods for quality control and certification) are summarized below in Table 1.

B. Placing of the BFRP, handing and tolerance in formwork shall be in accordance with ACI 440.5-18 "Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars".

ZeBAR™ is an approved reinforcement product according to ACI 440R-07, which summarily addresses the present knowledge base of this material and its use in masonry and concrete structures. (ACI 440R-07 addresses basalt, glass, carbon, and aramid fiber reinforced products.) Further ACI requirements met by **ZeBAR** are noted below.

PRODUCT BY ACI REQUIRMENTS

ACI 440R-07	Addresses multiple FRP's for utilization
ACI 440.1R-06	Design and structural use of FRP bars
ACI 440.6-08	Directs assessment and acceptance of fiber reinforced (FRP) bars sourced as reinforcement for concrete.
ACI 440.11-22	Specifically calls out GFRP however, BFRP is a suitable and acceptable direct replacement for GFRP according to FL DOT 932, with appropriate supporting data. 440.11-22 establishes the comparison between FRP and steel as used in ACI 318, its dependence on this Code, and the differences from the traditional steel-reinforced concrete design procedures adopted in ACI 318, and approach design from the perspective of deformability (the ability of a member to undergo large displacements prior to failure) rather than from the steel-reinforced concrete design focus on ductility. Consequently, this Code permits GFRP-reinforced concrete flexural members to have either tension-controlled or compression-controlled failure modes.

ASTM TESTING STANDARDS

ASTM D570	Water absorption of plastics
ASTM D619	Conditioning plastics for testing
ASTM D695	Compressive properties of rigid plastics
ASTM D7205	Tensile/Tensile Modulus
ASTM D790	Flex properties of unreinforced/reinforced plastics
ASTM D7914	Strength of Fiber Reinforced Polymer (FRP) Bent Bars in Bend Locations
ASTM D792	Density and specific gravity
ASTM D2734	Void content of reinforced plastics
ASTM D3410	Compressive properties of polymer matrix composite materials

ADDITIONAL STANDANDS

ISIS DESIGN MANUAL #3 Reinforcing concrete structures with fiber reinforced polymers (FRP's).

1.7 PROPER STORAGE AND HANDLING OF BFRP REINFORCEMENT

Specifier Notes: BasaFlex bar should be treated in the same manner as fiberglass and carbon fiber bar and be handled and placed in a similar manner. Exercise of caution to avoid surface damage should be taken.

A. ZeBARs bars should be handled in accordance with ACI 440.5-18 "Specification for Construction with Fiber- Reinforced Polymer Reinforcing Bars".

B. Storage:
All ZeBAR products should be stored either indoors, palletized if possible, or if stored outside, recommend it be protected from potential damage and covered. If covering is not available, please avoid extended exposure (EX: >6 months) to direct UV sunlight.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Company_____
Address_____
Phone:_____
Email: _____
http://www._____

2.2 BASALT FIBER REINFORCED POLYMER (BFRP) BARS FOR CONCRETE REINFORCEMENT

A. Basalt Fiber Reinforced Polymer (BFRP) Bars: Deformed, resin coated, and circumferentially wrapped for concrete reinforcement. Surface of BFRP bar is similar to that of steel and other fiber reinforced bars in that the surfaced is formed to increase the chemical and mechanical bond to concrete in accordance with and tested according to ASTM D7205 and several other testing methods. It may or may not contain a silica-based sand coating.

B. Binding Material: Binding material is composed of a proprietary resin matrix; uniform all through the bar.

C. Manufacturing Process:
   1. Pultrusion process.
   2. Basalt strands are moved through a resin bath, and a fiber strand encapsulates the bar and is applied prior to the heated curing process.
   3. Bends are produced in a similar manner at the factory and per specification; structural bends and hard angles should not be completed onsite.

Specifier Notes: There are currently seven (7) standard bar sizes in the ZeBAR™ product lineup, from #2 (6mm) diameter to #8 (25mm). Other sizes are available from smaller up to a #10 (32). Bent shapes are available in any bar diameters, but most common stirrup and connectors are #2 through #5 (19 mm).

Straight bars are labeled and shall be designated as follows:
Production logs and records are maintained, and raw materials and their corresponding lots identified. Bars manufactured are identified by the raw materials used, the formation of materials (inclusive of the proprietary resin matrix, which is identified by batch number and corresponds to the production of materials). Materials are often bundled, and lot numbers for each bar are easily identified.

D. Factory Formed Bends:
   1. Bent shapes are limited only by code with specific inside bend diameter requirements for various bar diameters is as follows:

Bar	***Inside Bend Dia.***
#2	***1.5”***
#3	***2.25”***
#4	***3.0”***
#5	***3.75”***
#6	***4.5”***
#7	***5.25”***
#8	***6.0”***

Specifier Notes: All bends must be fabricated per specification at the factory. No onsite bending or modification should be attempted.

2.3 SOURCE QUALITY CONTROL

A. Each production run is sampled and tested at specific intervals and noted with the corresponding bar diameter, the order number / stock run identification, and the day, month, year, and time of the production run. The bar marking corresponds to the sampled and tested materials and is thus traceable to the certifications associated to the product on a Mill Report.

B. Individual bars are sampled on a regular basis during production for tensile, modulus and ultimate strain testing. Testing is performed and reported per ASTM D7205-06. Tests performed and limits thereof are described in accordance with ASTM D7957. “Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement”.

C. Certifications of conformance are available for any given production run upon request.

D. Test certs validating material properties of full-scale bars, traceable to the job site must be furnished upon request.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine specific location that is to receive BFRP bars. Notify the site Engineer if the specific locations are not adequate. No placement may begin prior to the rectification of inadequate conditions.

3.2 PLACING

Specifier Notes: Placing of BFRP bars is accomplished in a comparable manner for uncoated or coated steel reinforcing bars, and the common practices should be employed with some noted exceptions, which are detailed below.

A. Place BFRP bars in accordance with CRSI Placing Reinforcing Bars, unless otherwise specified.
B. Place BFRP bars specifically as noted in all approved placing drawings, schedules, typical details, and notes.
C. Field Cutting:
    i. BFRP bars may be cut with a high-speed grinder (cutter). Shearing is not permitted.
D. Field Bending: Do not field bend FRP bars.
E. Securing: BFRP bars must be secured in the formwork to avoid disarticulation.
F. Supports should be plastic, or of a non-corrosive material and placed prior to pouring.
G. Fastening: Standard steel or nylon ties may be utilized.
H. Splicing: Lap splices are permitted per engineer's recommendation; no welding is required or permitted.