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**Agrément Certificate**

**21/5912**

Product Sheet 1

### BASALT COMPOSITE REBAR

### BASTECH BFRP REBAR

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to Bastech BFRP Rebar, composite fibre-reinforced polymer reinforcing bars comprising pultruded basalt fibres in a polymer matrix. The bars are for use in reinforced concrete structures.

(1) Hereinafter referred to as 'Certificate'.

#### CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



#### KEY FACTORS ASSESSED

**Structural aspects** — the bars can be used for the reinforcement of concrete structures in civil and structural engineering applications (see section 6).

**Durability** — under normal service conditions and protected with adequate concrete cover, Bastech BFRP rebar can achieve a service life in excess of 60 years (see section 10).

The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 18 June 2021

Hardy Giesler  
Chief Executive Officer

*The BBA is a UKAS accredited certification body – Number 113.*

*The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at [www.bbacerts.co.uk](http://www.bbacerts.co.uk)  
Readers MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.*

*Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.*

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## Regulations

In the opinion of the BBA, Bastech BFRP Rebar, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



### The Building Regulations 2010 (England and Wales) (as amended)

<b>Requirement:</b>	<b>A1</b>	<b>Loading</b>
Comment:		The product can sustain and transmit design loads. See section 6 of this Certificate.
<b>Regulation:</b>	<b>7(1)</b>	<b>Materials and workmanship</b>
Comment:		The product is acceptable. See section 10 and the <i>Installation</i> part of this Certificate.



### The Building (Scotland) Regulations 2004 (as amended)

<b>Regulation:</b>	<b>8(1)(2)</b>	<b>Durability, workmanship and fitness of materials</b>
Comment:		The product can contribute to a construction satisfying this Regulation. See section 10 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b>	<b>9</b>	<b>Building standards applicable to construction</b>
Standard:	1.1(a)(b)	Structure
Comment:		The product can sustain and transmit design loads, with reference to clause 1.1.1 <sup>(1)(2)</sup> . See section 6 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The product can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
		(1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



### The Building Regulations (Northern Ireland) 2012 (as amended)

<b>Regulation:</b>	<b>23(a)(i)</b>	<b>Fitness of materials and workmanship</b>
Comment:	<b>(iii)(b)(i)</b>	The product is acceptable. See section 10 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b>	<b>30</b>	<b>Stability</b>
Comment:		The product has adequate strength and stiffness to sustain and transmit design loads. See section 6 of this Certificate.

## Construction (Design and Management) Regulations 2015

## Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: **3** *Delivery and site handling* of this Certificate.

## Technical Specification

### 1 Description

1.1 Bastech BFRP Rebar is composed of continuous basalt fibre and a polymer matrix. The reinforcement bars are available in 8 and 10 mm diameters, with standard lengths of 6 and 12 m. The 8 mm diameter bars can be supplied rolled into a coil of up to 100 m (see Figure 2). Where required for the job, specific shapes, stirrups and bends must be produced at the factory (they cannot be made on site). The bars are available with two external finishes: epoxy coated with ribs, and sand coated with ribs (see Figure 1). Ribs are developed in relief on the surface of the bar by way of basalt fibre strands overwound and integrated into a helix form during the pultrusion process.

1.2 The product's characteristics and dimensions are shown in Table 1.

*Table 1 Bastech BFRP Rebar dimension and weight*

Nominal diameter (mm)	Standard lengths (m)	mass per unit length (kg.m <sup>-1</sup> )
8	Coils of 50 and 100 m	0.11
10	6 and 12 m	0.16

*Figure 1 BFRP Rebars bars*



Figure 2 BFRP Rebars coils



1.3 Ancillary components specified for use with the product, but outside the scope of this Certificate, include:

- Concrete
- Ties
- Prestressing equipment
- Anchors
- Couplers.

## 2 Manufacture

2.1 The product is formed by a pultrusion process which combines continuous basalt fibre and polymer matrix, and is finished with an epoxy or sand coating. The profile is then cut to length for the application requirements.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

## 3 Delivery and site handling

3.1 The manufacturer packages and delivers the product either as coil rolls (8 mm diameter) or as straight bars (10 mm diameter) up to 12 m long:

- Coils: the coil is tied up along its length and packed in bulk on pallets or individually, and wrapped in film. Warning labels are applied to indicate the product is spring-loaded. Coils are labelled with the batch number and the length.
- Straight bars: packs are tied with wires at every 1 to 1.5 metres, and comprise ten pieces of the same length. The packs are labelled with batch number and the length.

3.2 The product must not be stored or placed on sharp edges or surfaces.

3.3 Hoisting equipment and multiple lifting points must be used when handling bundled bars.

3.4 Bends and non-linear components must be placed on durable pallets using lifting and hoisting equipment.

3.5 The product should be stored above ground level on platforms, skids or other supports as close as possible to the point of placement.

3.6 Caution should be taken when handling coil rolls as the product is spring-loaded. Uncoiling rolls should be done from the inside, exercising great care to prevent instant uncoiling.

3.7 The packaging must be opened completely when removing the product.

3.8 The product must not be dragged on the ground or across sharp edges as this can score the bars.

3.9 Equipment or tooling that could cause damage the product should not be used with the bars.

3.10 On-site cutting is permitted by means of grinders with carbide, diamond-coated blades or by hand with a hacksaw. The product must not be cut with shears.

3.11 Gloves must be worn when handling the product, as the surface is treated and designed to facilitate bonding to concrete. In addition, when cutting the product, both eye and face protection must be worn.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Bastech BFRP Rebar.

### Design Considerations

## 4 Use

4.1 Bastech BFRP Rebars are used for the reinforcement of concrete structures in civil and structural engineering applications. They can be used in the following applications:

- Sea wall defences
- Transport infrastructure roads and bridges
- Groundwork
- Concrete exposed to aggressive chemicals, temperature extremes, and also increased mechanical stress
- Hydraulic structures and water treatment facilities
- Tunnels and mines
- Municipal underground engineering infrastructure facilities
- Concrete tanks and structural systems of chemical plants
- Landfill facilities
- Concrete structures near current leakage sources (high voltage cables and transformer substations).

4.2 The design of any civil and structural engineering structures incorporating the product must be carried out by a suitably qualified engineer in accordance with the requirements of the specifier.

## 5 Practicability of installation

The product is designed to be installed by a competent general builder, or a contractor, experienced with this type of product.

## 6 Structural aspects



6.1 The characteristic values for tensile strength, modulus of elasticity, shear strength, bond strength, flexural tensile and the modulus of toughness of the bars are listed in Table 2.

**Table 2 Short term structural characteristics**

Nominal diameter (mm)	Characteristic tensile strength $f_{tk}^{(1)}$ (MPa)	Characteristic modulus of elasticity <sup>(1)</sup> (GPa)	Characteristic shear strength <sup>(1)</sup> (MPa)	Characteristic bond strength <sup>(1)</sup> (MPa)	Characteristic flexural tensile strength <sup>(1)</sup> (MPa)	Characteristic modulus of toughness <sup>(1)</sup> (MPa)
8 mm	1431	53.2	189	18	1395	18
10 mm	1393	56.2	201	19	1445	16

(1) Characteristic values have been calculated in accordance with BS EN 1990 : 2002.

6.2 Tests carried out in accordance with ISO 10406-1 : 2008 indicate that anchorages and couplers can be used with the product. The average tensile failure capacities for anchorages used with the 8 mm and 10 mm diameter rebar are 1362 MPa and 1121 MPa respectively, and the average tensile failure capacities for couplers used with the 8 mm and 10 mm diameter rebar are 1190 MPa and 1010 MPa respectively.

6.3 Tests carried out in accordance with ISO 10406-1 : 2008 indicate that the bars failed after more than 50000 cycles, with an average minimum load of 10 kN and average maximum load of 68 kN for the 8 mm diameter rebar, and an average minimum load of 16 kN and average maximum load of 112 kN for the 10 mm diameter rebar.

6.4 Based on the creep rupture test in accordance with ISO 10406-1 : 2008, long term tensile strengths of 472 MPa and 390 MPa are declared for the 8 mm and 10 mm rebars, respectively.

6.5 A suitably qualified and experienced design engineer should ensure that:

- the differences of the tensile characteristics and modulus of elasticity of the FRP bars in comparison with traditional steel bars are considered in the design and particular attention is paid to balancing the reinforcement ratio, considering the deflection and creep behaviours.
- anchorages and overlap lengths are in accordance with the relevant codes and Standards.

## 7 Behaviour in relation to fire

7.1 Where the product is incorporated into a construction that requires fire resistance or combustibility limitations, the performance should be assessed by a suitably qualified and experienced individual.

7.2 The Certificate holder has not declared a reaction to fire classification for the product to BS EN 13501-1 : 2018.

7.3 Tests carried out in accordance with GOST 31938 : 2012 indicate that the average maximum operating temperature for the product is 144°C.

## 8 Thermal behaviour

Tests carried out in accordance with ISO 10406-1 : 2008 indicate that the average values of the coefficient of thermal expansion for the 8 mm and 10 mm diameter basalt bars are  $9.82 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$  and  $9.69 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$ , respectively.

## 9 Maintenance

The product is installed within concrete and therefore does not require maintenance.

## 10 Durability



The product will not adversely affect the durability of the reinforced concrete member provided that good quality concrete is used in conjunction with adequate cover and the criteria of BS EN 1992-1-1 : 2004, BS EN 1992-2 : 2005 and BS EN 1992-3 : 2006 are satisfied. Design in accordance with of BS EN 1992-1-1 : 2004 and its UK National Annex will provide a service life in excess of 60 years.

## 11 Reuse and recyclability

The product can be recycled.

## Installation

### 12 General

Installation of Bastech rebar is similar to that of other reinforcement bars and it must be carried out by adequately supervised and trained operatives, strictly in accordance with the Certificate holder's instructions and the reinforcement detailing drawings for the structure. Typical installation details are shown in Figures 3 and 4.

### 13 Procedure

13.1 The bars must be held firmly during the pouring and setting of concrete, with the use of ties. Bars should be tied at every intersection when the spacing is more than 30 cm in any direction. Where the spacing is less than this, the bars should be tied at every intersection or at alternate intersections.

13.2 It is essential that bars do not float upwards and out of position during concrete placement and consolidation. If movement is detected, the pour should be halted whilst additional support or fixtures are added.

13.3 If the bars become contaminated, they should be cleaned prior to installation.

13.4 The product can be used and tied in with steel bars. The same tying method as steel should be used in order to achieve the best performance.

13.5 Shape codes cannot be bent on-site – all shape codes are factory made and delivered to exact specifications.

13.6 Nicks, scrapes and cuts that do not exceed 5% of the depth of the bar are acceptable. Beyond 5%, the bar should be replaced, or a lap splice with the appropriate lap length either side of the damage may be applied.

13.7 The product may be jointed with lap joints or couplings as shown on the engineer/site plans. Unless shown otherwise on the plans, the product should be lap spliced using a bar of the same diameter. Lap lengths and bar cover should also be as indicated on the plans.

*Figure 3 BFRP Rebar installation*

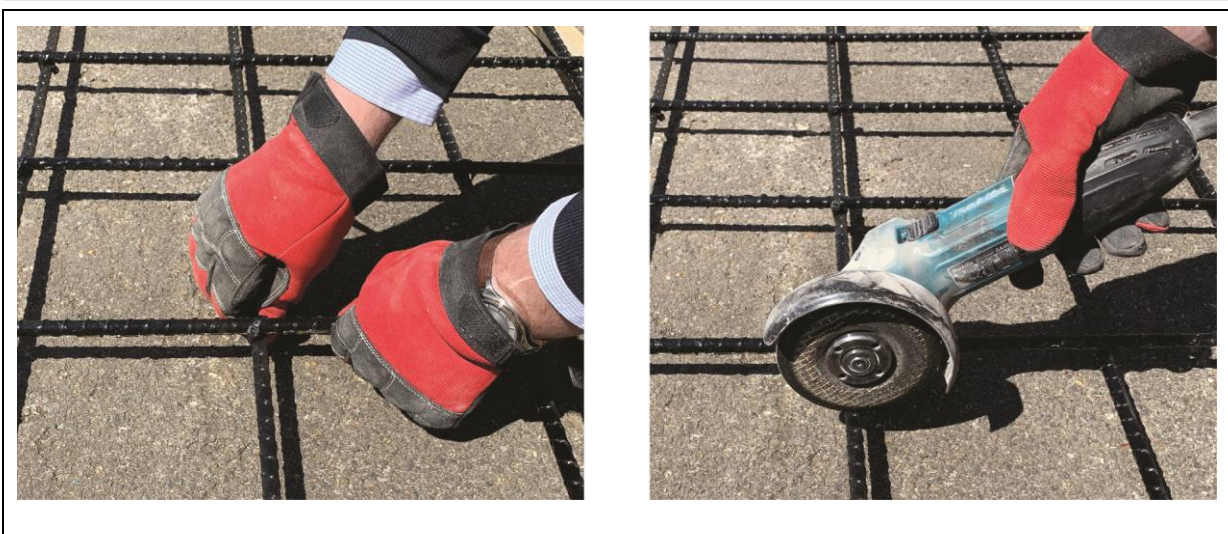


Figure 4 BFRP Rebar installation on site



## Technical Investigations

### 14 Tests

Tests were carried out and the results assessed to determine:

- Cross-sectional properties and mass
- Tensile strength and modulus
- Short- and long-term bond strength
- Tensile fatigue
- Durability: corrosion and alkaline environment
- Creep failure
- Transverse shear strength
- Flexural tensile properties
- The coefficient of longitudinal thermal expansion
- Dimensions of ribs
- Effect of fire / elevated temperature.

### 15 Investigations

The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.



## Bibliography

BS EN 1990 : 2002 + A1 : 2005 *Eurocode — Basis of structural design*

BS EN 1992-1-1 : 2004 + A1 : 2014 *Eurocode 2 — Design of concrete structures — General rules and rules for buildings*  
NA + A2 : 2014 to BS EN 1992-1-1 : 2004 + A1 : 2014 UK National Annex to *Eurocode 2 — Design of concrete structures — General rules and rules for buildings*

BS EN 1992-2 : 2005 *Eurocode 2 — Design of concrete structures — Concrete bridges — Design and detailing rules*

BS EN 1992-3 : 2006 *Eurocode 2 — Design of concrete structures — Liquid retaining and containment structures*

BS EN 13501-1 : 2018 *Fire classification of construction products and building elements — Classification using test data from reaction to fire tests*

GOST 31938 : 2012 *Interstate standard — Fiber-reinforced polymer (FRP) for concrete reinforcement — General specifications*

ISO 10406-1 : 2008 *Fibre-reinforced polymer (FRP) reinforcement of concrete – Test methods – Part 1: FRP bars and grids*

### 16 Conditions

16.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

16.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

16.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

16.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

16.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/systems
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

16.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.