

Adfil Ltd

Devonshire House
60 Goswell Road
London
England
EC1M 7AD

Tel: 01482 274777

e-mail: info@adfil.com

website: www.adfil.com



Agrément Certificate

21/5981

Product Sheet 1

ADFIL FIBRES FOR CONCRETE

SF86 STEEL FIBRE FOR BEAM AND BLOCK FLOORS

This Agrément Certificate Product Sheet ⁽¹⁾ relates to SF86 Steel Fibre for Beam and Block Floors, for use in fibre-reinforced concrete toppings in suspended beam and block ground floors in single-family dwellings.

(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 performance — concrete incorporating SF86 Steel Fibre for Beam and Block Floors can be designed to resist the loads associated with its intended use in single-family dwellings (see section 7).

Durability — concrete incorporating SF86 Steel Fibre for Beam and Block Floors at a dosage of 7.5 kg·m⁻³ will have a service life of 60 years when designed to BS 8500-2 : 2015 (see section 9).

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: 24 December 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

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.

British Board of Agrément

Bucknalls Lane
Watford
Herts WD25 9BA

tel: 01923 665300
clientservices@bbacerts.co.uk
www.bbacerts.co.uk

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Regulations

In the opinion of the BBA, SF86 Steel Fibre for Beam and Block Floors, 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)

Requirement: A1(1)

Comment:

Loading

The product can contribute to the strength of concrete members that resist dead and imposed loads. See section 7 of this Certificate.

Regulation: 7(1)

Comment:

Materials and workmanship

The product is acceptable. See section 9 and the *Installation* part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation: 8(1)

Comment:

Durability, workmanship and fitness of materials

The product can contribute to a construction satisfying this Regulation. See section 9 and the *Installation* part of this Certificate.

Regulation: 9

Standard:

Comment:

1.1(a)(b)

Building standards applicable to construction

Structure

The concrete members incorporating the product can satisfy this Standard. See section 7 of this Certificate.



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

Regulation: 23(a)(i)(iii)(b)

Comment:

Fitness of materials and workmanship

The product is acceptable. See section 9 and the *Installation* part of this Certificate.

Regulation: 30

Comment:

Stability

The product can contribute to the strength of concrete members that resist dead and imposed loads. See section 7 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* (3.1) and the *Installation* part of this Certificate.

Additional Information

NHBC Standards 2021

In the opinion of the BBA, SF86 Steel Fibre for Beam and Block Floors, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to NHBC Standards, Chapters 3.1 *Concrete and its reinforcement* and 5.2 *Suspended ground floors*.

CE marking

The Certificate holder has taken the responsibility of CE marking the product in accordance with harmonised European Standard BS EN 14889-1 : 2006.

1 Description

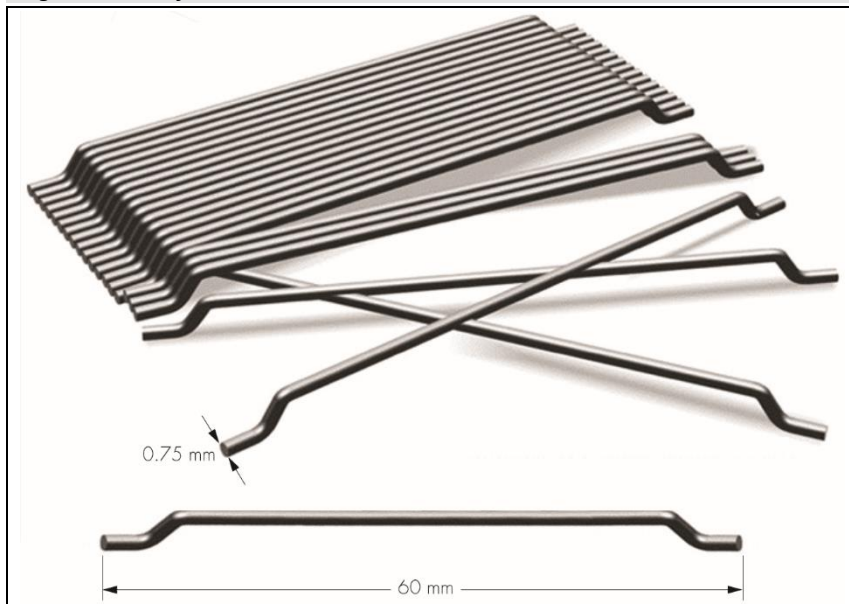
1.1 SF86 Steel Fibre for Beam and Block Floors is for addition to fresh concrete, to enhance the residual flexural strength of the concrete topping in a suspended beam and block ground floor. The fibres contribute to the flexural resistance of the hardened concrete and reduce the occurrence of plastic shrinkage cracking.

1.2 The steel fibres have the nominal properties and dimensions given in Table 1 and Figure 1 of this Certificate.

Table 1 Nominal properties of SF86 Steel Fibre

Property	Value
Shape	Hooked end
Steel type	Low carbon
Length (mm)	60 ± 3
Equivalent diameter (mm)	0.075 ± 0.04
Aspect ratio	80 ± 8
Tensile strength (N·mm ⁻²)	1225 ± 92 (for the mean value)
Elastic modulus (N·mm ⁻²)	200000
Density (kg·m ⁻³)	7850

Figure 1 Steel fibre dimensions



1.3 Ancillary items, which are outside the scope of this Certificate, include:

- normal or self-compacting concrete, to the minimum specification given in Table 2, below. The concrete must conform to the requirements of BS EN 206 : 2013, BS 8500-1 : 2015 and BS 8500-2 : 2015 and must be supplied by a ready-mix supplier with third-party quality scheme certification.
- a beam-and-block-type suspended ground floor system with current BBA certification (see Product Sheet 99 of this Certificate).

Table 2 Concrete specification

Concrete grade	C20/25
Maximum aggregate size	20 mm ⁽¹⁾
Consistency class (standard concrete)	S3 or S4
Slump flow class ⁽²⁾ (self-compacting concrete)	SF1 (550 to 650 mm) or SF2 (660 to 750 mm)
Dosage rate of SF86 Steel Fibre for Beam and Block Floors	7.5 kg per cubic metre of concrete

(1) Aggregate should be in accordance with BS EN 12620 : 2002.

(2) The sand content should be greater than 45%.

2 Manufacture

2.1 SF86 Steel Fibre is manufactured from low carbon steel using conventional steel fabrication techniques.

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 Fibres are packaged in measured quantities of 7.50 kg in bags, which are supplied on a pallet of 133 bags with a mass of approximately 997.5 kg.

3.2 Care must be taken when unloading, stacking and storing the fibres to prevent damage. They must be stored in a cool, dry environment and protected from exposure to direct sunlight.

3.3 The product is to be added directly to the concrete mix at a rate of 7.50 kg per 1 m³ of concrete, in accordance with the Certificate holder's instructions.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on SF86 Steel Fibre for Beam and Block Floors.

Design Considerations

4 Use

4.1 SF86 Steel Fibre for Beam and Block Floors is suitable for use as part of a reinforced concrete topping where the topping is designed to resist the imposed loading. The steel fibres, when added to the concrete mix in appropriate dosages, contribute to the flexural resistance of the concrete topping in single-family dwellings.

4.2 A suitably competent and experienced engineer must ensure that concrete mixes containing the product are properly designed, placed and cured, and comply with the relevant requirements of BS 8500-1 : 2015, BS 8500-2 : 2015 and BS EN 206 : 2013.

4.3 The addition of the product at the stated dosage does not normally require adjustment to the concrete mix design; however, this should be verified by trial mixes undertaken using the actual materials and mix design to be used by the ready-mix supplier.

4.4 The concrete topping for the suspended beam-and-block floor must be designed and installed strictly in accordance with this Certificate, and the BBA Certificate for the relevant floor system. The dosage rate for steel fibres must be in accordance with Table 2 of this Certificate.

4.5 Tests to confirm the dosage rate of steel fibre in a spot sample of the concrete mix, should be carried out in accordance with BS EN 14721 : 2005. The maximum allowed deviation of single test results from limit values, from tolerance on a target value or from the limits of the specified class, should be in accordance with Table 22 of BS EN 206 : 2013.

5 Practicability of installation

The product is designed to be used by competent contractors experienced with this type of product.

6 Fresh concrete properties

Plastic shrinkage cracking

6.1 The adequacy of the fibre-reinforced concrete and the detailing of the concrete topping for resistance to shrinkage cracking should be assessed by a suitably competent and experienced engineer in accordance with the requirements of BS EN 1992-1-1 : 2004, Annex B, and its National Annex. Particular care should be taken near corners, around service openings, at the detail of joints to adjoining members and at discontinuities in the concrete member.

Workability

6.2 When used with either normal or self-compacting concrete, trial mixes should be undertaken by the concrete supplier to establish the effect of the addition of fibres on workability and compaction. Advice, if required, may be obtained from the Certificate holder.

6.3 Care is required when using slump test data as a general indicator of uniformity of concrete mixes containing fibres. The value obtained may suggest a misleadingly low workability, and their compaction under vibration is likely to be better than indicated.

6.4 Additional water must not be added to increase the slump of fibre concrete mixes.

Distribution of fibres

6.5 The fibres will be uniformly dispersed throughout the concrete mix without balling or agglomeration providing the Certificate holder's instructions for batching and mixing are followed (also see section 12 of this Certificate). When required, the fibre content of a sample of fresh concrete can be measured in accordance with BS EN 14721 : 2005.

7 Structural performance

Hardened concrete properties

Structural effects



7.1 A typical ready-mix concrete with the specification detailed in Table 2 of this Certificate, incorporating $7.5 \text{ kg}\cdot\text{m}^{-3}$ of SF86 Steel Fibre for Beam and Block Floors, has been shown to adequately resist the loading on a typical suspended beam and block floor in a single-family dwelling with the characteristic loading shown in Table 3. This has been verified by full-scale tests using the 'design assisted by testing' approach in accordance with BS EN 1990 : 2002.

Table 3 Maximum characteristic loads for single-family dwellings

Description	Maximum characteristic loads for single-family dwellings
Imposed uniformly distributed load (UDL) (kN·m ⁻²)	1.5 ⁽¹⁾
Imposed concentrated load (kN)	2.0 ⁽¹⁾⁽²⁾
Line load partition, parallel and perpendicular to the beam (kN·m ⁻¹)	1.0 ⁽³⁾⁽⁴⁾
Allowance for moveable partition (kN·m ⁻²)	1.0 ⁽³⁾
Finishes (kN·m ⁻²)	0.5

- (1) Imposed concentrated load must not be combined with the imposed UDL or other variable actions.
- (2) Imposed concentrated load is assumed to be applied over a square plate not less than 50 by 50 mm.
- (3) Either the imposed load for lightweight partitions (moveable) or line load partition must be considered.
- (4) Non-load-bearing partition walls heavier than 1.0 kN·m⁻¹, in any orientation with respect to the concrete beams, must either be supported by the foundation or bear directly on the concrete beams, except where the fibre-reinforced screed is supported directly by the beams.

7.2 SF86 Steel Fibre has been assessed as being suitable for use (at a dosage of 7.5 kg·m⁻³) with beam and block floor systems with current BBA certification as detailed in Product Sheet 99 of this Certificate, and with the parameters defined in Table 4 of this Certificate. The product must be used in a floor system that is designed, installed and used strictly in accordance with the relevant floor system Certificate. The minimum required depth of concrete topping incorporating the product is specified in Product Sheet 99.

Table 4 Scope of application for beam and EPS block floors

Description	Parameter
Floor type	Beam and block with EPS infill blocks, with EPS top sheet/structural rails or under-beam insulation
Minimum EPS top sheet grade (compressive strength at 10% deformation)	120 kPa
Beam – minimum width of top flange	42 mm
Concrete topping – maximum edge cantilever length	335 mm

8 Maintenance

The product is contained within the concrete and does not require maintenance.

9 Durability



The product contains carbon steel, which may rust. Therefore, the product's use should be limited to applications where the concrete member is in an environment classified as XC1 in accordance with BS EN 206 : 2013, which will result in a service life of 60 years. The product will not adversely affect the durability of the concrete under such conditions.

10 Reuse and recyclability

The product is made of steel, which can be recycled.

Installation

11 General

11.1 SF86 Steel Fibre for Beam and Block Floors must be added to the concrete strictly in accordance with the Certificate holder's instructions and this Certificate.

11.2 Good practice should be followed throughout the installation process, to include:

- cube compressive strength and slump tests for concrete pouring
- limitation of slump for standard concrete and slump flow for self-compacting concrete
- concrete topping not to be poured at a temperature below 5°C
- the maximum temperature at which concrete is placed is 30°C and decreasing
- all the constituents, including the fibres, to be added at the plant mixer
- concrete not to be poured during rainfall.

11.3 To prevent shrinkage cracks:

- joints should be incorporated into the slab, and appropriate joints between the opening of two adjacent rooms should be provided. Inclusion of joints must not compromise the structural performance of the concrete topping
- where the internal walls are built through the slab, a joint should be formed across the door threshold where the wall separates the two rooms
- an aspect ratio greater than 2:1 should be avoided
- a compressible insulating material around the perimeter of the slab should be provided
- the use of high-shrinkage-potential aggregate must be avoided
- the water/cement ratio should not be increased beyond the limits specified in BS 8500-1 : 2015, BS 8500-2 : 2015 and BS EN 206 : 2013
- steel mesh or loose bars should be placed across re-entrant corners and any openings in the slab greater than 500 x 500 mm
- consideration should be given to the provision of an appropriate slab detail (eg crack inducer) over external walls at the position of porches.

12 Procedure

Mixing

12.1 The fibres are added at the batching plant, and care must be taken to ensure that adequate mix control and supervision is available.

12.2 The fibres may be added to the mixer during or after the batching of the other concrete constituents.

12.3 The tolerances for the batching process and criteria for acceptability of steel fibre content must be in accordance with Tables 27 and B.2 of BS EN 206 : 2013.

Placing

12.4 Concrete mixes containing the product can be transported by conventional methods.

12.5 Special precautions are not necessary when pouring into moulds or shutters.

12.6 Fibre concrete mixes will flow around reinforcement, into restricted areas and against mould faces, as for plain concrete of similar mix proportions.

12.7 Fibre concrete mixes can be hand tamped or vibrated by conventional means to provide the necessary compaction.

Finishing

12.8 Placed concrete mixes containing the fibres may be floated and trowelled using any normal hand or power tools, to provide a smooth, fibre-free surface appearance.

Curing

12.9 It is essential that normal 'best practice' for concrete curing is followed. Concrete containing SF86 Steel Fibre for Beam and Block Floors should be cured using the same methodology as for a plain or steel-reinforced concrete. Concrete should be protected from direct sunlight, wind and frost for the duration of the curing period. In addition, the concrete surface should be kept moist for the duration of the curing period to prevent excessive drying rates; a curing compound may be used for this purpose.

13 Tests

13.1 A series of tests was carried out to establish the resistance of the fibre-reinforced concrete topping to service loads and to ultimate loads, for single-family dwellings. The tests were designed to create the maximum curvature of the floor beams and fibre-reinforced concrete toppings.

13.2 Prism and cube tests for concrete toppings reinforced with steel fibre were carried out in accordance with BS EN 14651 : 2005 and BS EN 12390-3 : 2019 respectively.

14 Investigations

14.1 An evaluation was made of data to determine:

- the durability and practicability of installation of the product
- dimensional accuracy
- adequacy of a standard concrete topping reinforced with SF86 Steel Fibre for Beam and Block Floors in accordance with BS EN 1990 : 2002, BS EN 1991-1-1 : 2002 and BS EN 1992-1-1 : 2004 and their UK National Annexes, for use in suspended ground floors in single-family dwellings.

14.2 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 8500-1 : 2015 + A2 : 2019 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*

BS 8500-2 : 2015 + A2 : 2019 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*

BS EN 206 : 2013 + A2 : 2021 *Concrete — Specification, performance, production and conformity*

BS EN 12390-3 : 2019 *Testing hardened concrete - Compressive strength of test specimens*

BS EN 12620 : 2002 + A1 : 2008 *Concrete — Aggregates for concrete*

BS EN 14651 : 2005 + A1 2007 *Test method for metallic fibre concrete — Measuring the flexural tensile strength (limit of proportionality (LOP), residual)*

BS EN 14721 : 2005 *Test method for metallic fibre concrete — Measuring the fibre content in fresh and hardened concrete*

BS EN 14889-1 : 2006 *Fibres for concrete — Steel fibres — Definitions, specifications and conformity*

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

NA to BS EN 1990 : 2002 + A1 : 2005 *UK National Annex to Eurocode — Basis of structural design*

BS EN 1991-1-1 : 2002 *Eurocode 1 — Actions on structures — General actions — Densities, self-weight, imposed loads for buildings*

NA to BS EN 1991-1-1 : 2002 *UK National Annex to Eurocode 1 — Actions on structures — General actions — Densities, self-weight, imposed loads for buildings*

BS EN 1992-1-1 : 2004 + A1 : 2014 *Eurocode 2 — Design of concrete structures — General rules and rules for buildings*

NA 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*

15 Conditions

15.1 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.

15.2 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.

15.3 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.

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

15.5 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/system
- 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.

15.6 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.