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Agrément Certificate No 92/2857
*Fourth issue**

Designated by Government to issue European Technical Approvals

FIBERMESH FIBRES FOR CONCRETE

Fibres pour béton
Faserbeton

Product

Fibrillated fibres *Multifilament fibres*

• THIS CERTIFICATE RELATES TO FIBERMESH FIBRES FOR CONCRETE, POLYPROPYLENE FIBRES, AS DESCRIBED IN THE ACCOMPANYING DETAIL SHEETS.

• The products are for use in concrete mixes of nominal maximum aggregate sizes of 10 mm and 20 mm to reduce the occurrence of plastic shrinkage cracking and plastic settlement, and enhance the surface properties of the hardened concrete.

• The products may be used as an alternative to steel wire mesh for crack control purposes when sufficient movement joints are detailed in a slab but are not a substitute for conventional structural steel reinforcement or normal good curing procedures for concrete.

These Front Sheets must be read in conjunction with the accompanying Detail Sheets which provide information on specific fibres.

Regulations — Detail Sheet 1

1 The Building Regulations 2000 (as amended) (England and Wales)

In the opinion of the British Board of Agrément, the use of Fibermesh Fibres for Concrete is not subject to these Regulations.

2 The Building Standards (Scotland) Regulations 1990 (as amended)

In the opinion of the BBA, the use of Fibermesh Fibres for Concrete is not subject to these Regulations.

3 The Building Regulations (Northern Ireland) 2000

In the opinion of the BBA, the use of Fibermesh Fibres for Concrete is not subject to these Regulations.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

In the opinion of the BBA there is no information in this Certificate which relates to the obligations of the client, planning supervisor, designer and contractors under these Regulations.

Technical Specification

5 Description

5.1 Fibermesh Fibres for Concrete are polypropylene fibres manufactured in fibrillated(1) form or as short lengths of multifilament(1) yarn for use in concrete mixes of nominal aggregate sizes of 10 mm and 20 mm to reduce the occurrence of plastic shrinkage cracking and plastic settlement, and, at the higher dosage, enhance the surface properties of the hardened concrete.

(1) Definition of word given in section 8.6.

5.2 The short lengths of multifilament yarn become separated into individual monofilaments(1) when mixed in concrete.

(1) Definition of word given in section 8.6.

5.3 Fibres are coated to improve wetting and dispersibility within the cement paste, to increase the extent of contact and to bond to the hardened concrete.

6 Manufacture and quality control

6.1 The fibres are manufactured in a continuous process by extrusion of polypropylene homopolymer resin, into either monoaxially co-ordinated film, or multifilament yarn.

6.2 Fibrillated fibres are manufactured from the extruded sheet/film material which is molecularly aligned, fibrillated, coated and cut to the appropriate length.

6.3 Multifilament fibres are manufactured as extruded yarn which is molecularly aligned, coated and cut to the appropriate length.

6.4 The manufacturing process includes control checks on:

denier(1)
surface finish
shrinkage
tensile strength
elongation
fibre length
packaged weight.

(1) Definition of word given in section 8.6.

6.5 Quality assurance checks are conducted for weight and length, and visual appearance for fibrillated fibres.

7 Delivery and storage

7.1 The fibres are packed in measured quantities of 0.6 kg or 0.9 kg, in degradable 'Fas-Pak' bags. The bagged fibres are delivered in cardboard boxes. (Other packaging configurations to suit customer requirements are available on request).

7.2 Boxes of fibres must be stored on a clean surface, in dry conditions under cover and away from the possibility of damage.

7.3 The cardboard boxes bear the manufacturer's product name and batch number.

Design Data

8 General

8.1 Fibermesh Fibres for Concrete are satisfactory for use with concrete mixes of nominal aggregate sizes of 10 mm and 20 mm (typified by that shown in section 2 of the appropriate Detail Sheets) to reduce the occurrence of plastic shrinkage cracking and plastic settlement, and, at the higher dosage enhance the properties of the concrete.

8.2 The fibres are not a substitute for conventional structural steel reinforcement or normal good curing procedures for concrete.

8.3 The addition of fibres at the recommended rates of 0.6 kgm^{-3} or 0.9 kgm^{-3} does not normally require adjustment to the concrete mix design.

8.4 Mixes containing the product should be properly designed and placed, and comply with the relevant requirements of BS 8204-1 : 1999 and BS 8204-2 : 1999 and guidelines of BS 5328-1: 1997, BS 5328-2 : 1997 and BS 5328-3 : 1990.

8.5 Workmanship should comply with the relevant requirements of BS 8000-2.1 : 1990 and BS 8000-2.2 : 1990.

Definitions

8.6 Some words in this Certificate have a precise definition taken from ACI publication ACI 544.IR *Fiber Reinforced Concrete. American Concrete Institute, Michigan, USA:*

Collated — Fibres bundled together by cross-linking by chemical or mechanical means

Denier — Weight in grammes of 9000 metres of a single fibre

Fibrillated — A slit-film fibre where sections of the fibre peel away forming branching fibrils

Monofilament — Any single filament of a manufactured fibre

Multifilament — A yarn consisting of many continuous filaments or strands.

9 Air content and compacting factor

Tests conducted in accordance with BS 1881-103 : 1983 and BS 1881-106 : 1983 indicate that the presence of the fibres only marginally affects the compacting factor and air content of concrete.

10 Workability

10.1 The fibres increase the apparent cohesiveness and have little effect on the slump of a concrete mix.

10.2 The placeability of the Fibermesh concrete and its compactability under vibration is much better than indicated by the value in the slump test.

10.3 Additional water must not be added to increase the slump of Fibermesh concrete mixes.

11 Distribution of fibres

The fibres are uniformly and rapidly dispersed throughout the concrete mix without balling or agglomeration (see section 27).

12 Bleeding and plastic settlement

12.1 Tests results indicate that the presence of fibres in a concrete mix reduces the amount of bleeding. Concrete with fibre generally has better surface integrity than plain concrete with the same mix design.

12.2 Tests conducted in accordance with ASTM C 827-87 indicate that the fibres will significantly reduce plastic settlement (volume change) of a concrete.

13 Plastic shrinkage cracking

13.1 The reduction in plastic shrinkage, bleed water migration and segregation together with increased early strain capacity contribute to reduce both the occurrence and degree of plastic cracking.

13.2 Tests conducted on both concrete ring and slab specimens indicate that the presence of the product significantly reduces the amount of plastic shrinkage cracking when compared to concrete made from the equivalent plain mix.

14 Stiffening times

The fibres do not affect the hydration rate or stiffening times of the concrete.

15 Water absorption

Initial Surface Absorption Tests (ISAT), conducted in accordance with BS 1881-5 : 1970, water absorption to BS 1881-122 : 1983, and results of other tests on concrete cores, indicate that the fibres have a small but generally positive effect in reducing water absorption.

16 Resistance to freeze/thaw

16.1 Tests conducted in accordance with BS 5075-2 : 1982 indicate that Fibermesh concrete has a significantly greater resistance to frost attack than concrete made from the equivalent plain mix.

16.2 Test results indicate that Fibermesh concrete:

(a) may be considered as an alternative to air-entrained concrete where freeze/thaw resistance is required

(b) has a greater erosion resistance than the corresponding plain concrete.

17 Resistance to abrasion

Tests conducted generally in accordance with BS 784 : 1953, using an A'Court apparatus, indicate that Fibermesh concrete has a better surface abrasion resistance than plain concrete (see Table 3 of the appropriate Detail Sheets).

18 Resistance to impact

Tests conducted in accordance with ASTM D 1557-87 show that concrete uniformly distributed with the fibres has a significantly greater impact resistance than the corresponding plain concrete. These results also indicate that the degree of spalling and damage to arrises of joints may be lessened.

19 Length changes on wetting and drying

Test data on concrete containing polypropylene fibres indicate that the changes in length on wetting and drying depend on the concrete mix proportions and density, and are unaffected by the presence of the fibres.

20 Strength characteristics

20.1 Compressive strength cube tests conducted in accordance with BS 1881-116 : 1983 and BS 1881-119 : 1983 indicate that the fibres, when used at the recommended dosage rate have no significant effect on the compressive strength of concrete.

20.2 The fibres have no significant effect on the flexural strength of concrete and structural reinforcement will still be required if it was required for the equivalent plain concrete.

21 Chemical resistance

The fibres are inert and alkali-resistant, and the presence of the fibres does not alter the chemical resistance of the concrete.

22 Performance in relation to fire

22.1 General conclusions drawn from the results of tests are:

(a) when concrete containing the product is subjected to fire, the structural integrity will be the same as for the plain concrete.

(b) Fire will destroy fibres located close to the surface, resulting in a localised increase in porosity of the concrete.

22.2 The results of single tests on particular mixes are given in section 32.1.

23 Surface appearance and hardness

23.1 The fibres generally improve the surface quality of conventional concrete by reducing the number of bleed holes. Consequently the improved surface absorption of the fibre concrete causes both water and dirt to be absorbed more slowly and evenly into the surface, and results in a more uniform appearance.

23.2 The fibres are not readily visible on the concrete surface.

23.3 Tests indicate that the presence of fibres does not affect the surface hardness of concrete.

24 Toughness after cracking

Tests carried out in accordance with ASTM C 1399 : 1998 indicate that certain Fibermesh fibres (see appropriate Detail Sheet) increase the residual strength of the concrete. The effectiveness of the fibres in holding the cracked concrete matrix together is demonstrated.

25 Durability

Test data examined by the BBA indicate that the presence of Fibermesh fibres in conventional concrete mixes reduces the amount of plastic shrinkage cracking and bleeding in its plastic state, and improves the resistance to impact, surface abrasion, and freeze/thaw resistance of the hardened concrete. Fibermesh concrete is generally more durable than plain concrete to the same mix design.

Installation

26 General

Fibermesh Fibres should be added to the concrete mix strictly in accordance with this Certificate and the manufacturer's instructions.

27 Mixing

27.1 The fibres may be added either at a conventional batching/mixing plant, or by hand to the ready-mix truck on site at the rate given in the appropriate Detail Sheet.

27.2 For either wet or dry mixing, the fibres may be added before or during the addition of the other concrete mix constituents.

27.3 When adding fibres to ready-mix trucks on site. The concrete should be mixed for a minimum of five minutes, at full mixing speed (approximately 70 revolutions per minute), to ensure uniform fibre dispersion.

28 Placing

28.1 Concrete mixes containing fibres can be transported by conventional methods. The presence of the fibres lessens the danger of segregation. Fibre concrete mixes flow easily from the hopper outlet.

28.2 No special precautions are necessary when pouring into moulds or shutters.

28.3 Fibre concrete mixes will flow around reinforcement, into restricted areas and against mould faces in the same manner as plain concrete of similar mix proportions.

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

29 Curing

29.1 It is essential that all normal good curing procedures are strictly followed.

29.2 The fibres are made from polypropylene and should not be used when curing is to be carried out at temperatures in excess of 140°C.

30 Finishing

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.

Technical Investigations

31 Site visits

31.1 A visit was made to a site in progress to assess the ease of use and practicability of placing Fibermesh concrete.

31.2 Visits were made to existing sites to assess Fibermesh concrete's performance in service.

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

32 Performance

32.1 An examination of independent fire test data was made to assess polypropylene fibre concrete's behaviour in relation to fire. This data included a fire resistance test to:

(a) BS 476-20 : 1987 where it was observed that no explosive spalling took place

(b) BS 476-21 : 1987, Section 7, on 120 mm Fibermesh concrete on 0.9 mm metal decking when a fire resistance of one hour was achieved.

32.2 An assessment was made of the product's range of use and durability.

Additional Information

The management systems of SI Corporation have been assessed and registered as meeting the requirements of ISO 9002 : 1994 by NSF International Strategic Registrations Ltd (Registration No 84583-3).

Bibliography

BS 476-20 : 1987 *Fire tests on building materials and structures — Method for determination of the fire resistance of elements of construction (general principles)*
BS 476-21 : 1987 *Fire tests on building materials and structures — Methods for determination of the fire resistance of loadbearing elements of construction*

BS 784 : 1953 *Methods of test for chemical stoneware*

BS 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*
BS 1881-103 : 1993 *Testing concrete — Method for determination of compacting factor*
BS 1881-106 : 1983 *Testing concrete — Methods for determination of air content of fresh concrete*
BS 1881-116 : 1983 *Testing concrete — Method for determination of compressive strength of concrete cubes*
BS 1881-119 : 1983 *Testing concrete — Method for determination of compressive strength using portions of beams broken in flexure (equivalent cube method)*
BS 1881-122 : 1983 *Testing concrete — Method for determination of water absorption*

BS 5075-2 : 1982 *Concrete admixtures — Specification for air-entraining admixtures*

BS 5328-1 : 1997 *Concrete — Guide to specifying concrete*
BS 5328-2 : 1997 *Concrete — Methods for specifying concrete mixes*
BS 5328-3 : 1990 *Concrete — Specification for the procedures to be used in producing and transporting concrete*

BS 8000-2.1 : 1990 *Workmanship on building sites — Code of practice for concrete work — Mixing and transporting concrete*
BS 8000-2.2 : 1990 *Workmanship on building sites — Code of practice for concrete work — Sitework with in-situ and precast concrete*

BS 8204-1 : 1999 *Screeds, bases and in-situ floorings — Concrete bases and cement sand levelling screeds to receive floorings — Code of practice*
BS 8204-2 : 1999 *Screeds, bases and in-situ floorings — Concrete wearing surfaces — Code of practice*

ASTM C 827-87 *Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures*

ASTM C 1399 : 1998 *Test method for obtaining Average Residual — Strength for Fiber-Reinforced Concrete*

ASTM D 1557-87 (Reapproved 1990) *Standard Test Methods for Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 in (457 mm) Drop*

ISO 9002 : 1994 *Quality Systems — Model for quality assurance in production, installation and servicing*

Conditions of Certification

33 Conditions

33.1 This Certificate:

(a) relates only to the product that is described, installed, used and maintained as set out in this Certificate;

(b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;

(c) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;

(d) is copyright of the BBA.

33.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, shall be construed as references to such publication in the form in which it was current at the date of this Certificate.

33.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabricating process(es) thereof:

(a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked by the BBA or its agents; and

(c) are reviewed by the BBA as and when it considers appropriate.

33.4 In granting this Certificate, the BBA makes no representation as to:

(a) the presence or absence of any patent or similar rights subsisting in the product or any other product;

(b) the right of the Certificate holder to market, supply, install or maintain the product; and

(c) the nature of individual installations of the product, including methods and workmanship.

33.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

In the opinion of the British Board of Agrément, Fibermesh Fibres for Concrete are fit for their intended use provided they are installed, used and maintained as set out in this Certificate. Certificate No 92/2857 is accordingly awarded to SI Concrete Systems.

On behalf of the British Board of Agrément

Date of Fourth issue: 14th November 2002

Chief Executive

**Original Certificate issued 9th February 1993. This revised version includes change of Certificate holder and reference to the revised national Building Regulations.*

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