FIBERMESH® 300 SYNTHETIC FIBER

Fibermesh 300, formerly InForce™ e3®, micro-reinforcement system for concrete—100 percent virgin homopolymer polypropylene fibrillated fibers with e3® patented technology containing no reprocessed olefin materials. Specifically engineered and manufactured in an ISO 9001:2000 certified facility to an optimum gradation for use as concrete secondary reinforcement at a minimum of 0.1% by volume (1.5 lbs/ yd³, 0.9 kg/m³). UL Classified. Complies with National Building Codes and ASTM C 1116 Type III 4.1.3., ASTM C 1116 Performance Level I and Residual Strength.

ADVANTAGES
Accepted by National Codes as an alternate method of secondary reinforcing to traditional systems • Non-magnetic • Rustproof • Alkali proof • Requires no minimum amount of concrete cover • Is always positioned in compliance with codes • Safe and easy to use • Saves time and hassle

FEATURES & BENEFITS
• Alternate construction system to traditional secondary reinforcing in concrete
• Inhibits and controls the formation of intrinsic cracking in concrete
• Reinforces against impact forces
• Reinforces against the effect of shattering forces
• Reinforces against material loss from abrading forces
• Reinforces against water migration
• Provides improved durability
• Imparts toughness to hardened concrete
• Reduces plastic shrinkage and settlement cracking
• Provides residual strength

PRIMARY APPLICATIONS
Applicable to all types of concrete which demonstrate a need for toughness, resistance to intrinsic cracking and improved water tightness.
• Slabs-on-ground • Stucco • Composite metal decks
• Sidewalks • Curbs • Slope paving
• Driveways • Shotcrete • Overlays & toppings

DO SPECIFY FIBERMESH 300 FIBERS:
• Reduced plastic shrinkage cracking
• Alternative to traditional reinforcement
• Improved impact, shatter and abrasion resistance
• Improved residual strength
• Reduced water migration and damage from freeze/thaw
• Improved durability
• Areas requiring non-metallic materials

DO NOT SPECIFY FIBERMESH 300 FIBERS:
• Crack control from external stresses
• Increasing joint spacing beyond ACI and PCA guidelines
• Decreasing thickness of slabs
• Replacing any moment or structural steel

CHEMICAL AND PHYSICAL PROPERTIES:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption</td>
<td>Nil</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.91</td>
</tr>
<tr>
<td>Fiber Length*</td>
<td>Graded</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>Low</td>
</tr>
<tr>
<td>Acid &amp; Salt Resistance</td>
<td>High</td>
</tr>
<tr>
<td>Melt Point</td>
<td>324°F (162°C)</td>
</tr>
<tr>
<td>Ignition Point</td>
<td>1100°F (593°C)</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>Low</td>
</tr>
<tr>
<td>Alkali Resistance</td>
<td>Alkali Proof</td>
</tr>
</tbody>
</table>

*Also available in single cut lengths.
FIBERMESH® 300

PRODUCT USE

MIXING DESIGNS AND PROCEDURES: Fibermesh® 300 micro-reinforcing is a mechanical, not chemical, process. The addition of Fibermesh 300 fibrillated fiber does not require any additional water or other mix design changes at normal rates. Fibermesh 300 fibrillated fiber is added to the mixer before, during or after batching the other concrete materials. Mixing time and speed are specified in ASTM C 94.

FINISHING: Fibermesh 300 micro-reinforced concrete can be finished by any finishing technique. Exposed aggregate, broomed and tined surfaces are no problem.

APPLICATION RATE: The standard application rate for Fibermesh 300 fibrillated fibers is 1.5 lbs/yd³ (0.9 kg/m³). For specialty performance see your local Fibermesh representative for recommendations regarding increased application rates.

GUIDELINES

Fibermesh 300 fibers should not be used to replace structural, load-bearing reinforcement. Fibermesh 300 fibers should not be used as a means of using thinner concrete sections than original design. Fibermesh 300 fibers should not be used to increase joint spacing past those dimensions suggested by PCA and ACI industry standard guidelines.

COMPATIBILITY

Fibermesh 300 fibers are compatible with all concrete admixtures and performance enhancing chemicals, but require no admixtures to work.

PACKAGING

Fibermesh 300 fibers are available in a variety of packaging options. The 1.5 lb bag (1 bag per cubic yard, 0.9 kg/m³) is standard. Special packaging is available for full truckload addition. Bags are packed into cartons, shrink-wrapped and palletized for protection during shipping.

TECHNICAL SERVICES

Trained Propex Concrete Systems specialists are available worldwide to assist and advise in specifications and field service. Propex Concrete Systems representatives do not engage in the practice of engineering or supervision of projects and are available solely for service and support of our customers.

REFERENCES

• ASTM C 1399 Average Residual Strength of Fiber Reinforced Concrete.
• ASTM C 1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
• ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete.
• ACI 506 Guide for Shotcrete.
• UL® Approvals for use as an alternate or in addition to welded wire fabric used in floor-ceiling D700, D800 and D900 series designs.
• International Code Council (ICC) ESR 1165 Report.

SPECIFICATION CLAUSE

Use only Fibermesh 300 - 100 percent virgin polypropylene fibrillated fibers with e3® patented technology containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Application per cubic yard shall equal a minimum of 0.1% by volume (1.5 lbs/yard³, 0.9 kg/m³). Fibermesh 300 fibers are for the control of cracking due to drying shrinkage and thermal expansion/contraction, lowered water migration, increased impact capacity, shatter resistance, abrasion resistance and residual strength. Fiber manufacturer must document evidence of 10 year satisfactory performance history, ISO 9001:2000 certification of manufacturing facility, compliance with applicable building codes and ASTM C 1116 Type III, 4.1.3, ASTM C 1116 (Ref: ASTM C 1018) Performance Level 1, I5 outlined in Section 21, Note 17 and an average minimum Residual Strength of 45 psi, of 4 beams from a single batch. Fibrous concrete reinforcement shall be manufactured by Propex Concrete Systems, 6025 Lee Highway, Suite 425, PO Box 22788, Chattanooga, TN, 37422, USA, tel: 423 892 8080, fax: 423 892 0157, web site: fibermesh.com.

NORTH AMERICA

Propex Concrete Systems Corp.
6025 Lee Highway, Suite 425
PO Box 22788
Chattanooga, TN 37422
Tel: 800 621 1273
Tel: 423 892 0157
Fax: 423 892 8080

INTERNATIONAL

Propex Concrete Systems Ltd.
Propex House, 9 Royal Court, Basil Close
Chesterfield, Derbyshire, S41 7SL, UK
Tel: +44 (0) 1246 364 200
Fax: +44 (0) 1246 465 200

www.fibermesh.com
Date: April 18, 2007

Certification of Compliance: FIBERMESH® 300

This letter is to certify that FIBERMESH® 300 fibers meet our published specification and the requirements of ASTM C-1116-03, Type III 4.1.3. FIBERMESH® 300 is a patented combination of three sizes of polypropylene fibrillated fibers are manufactured and tested at Propex Chattanooga facility that has maintained ISO-9001 certification for its systematic approach to quality.

The property values listed below are typical values which have been derived from quality control testing performed by our laboratory in Chattanooga, Tennessee, USA:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Fiber 1</th>
<th>Fiber 2</th>
<th>Fiber 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denier</td>
<td>ASTM D-1907</td>
<td>2600</td>
<td>1000</td>
<td>360</td>
</tr>
<tr>
<td>Length</td>
<td>Measured</td>
<td>½” &amp; ⅞” (12 &amp; 19 mm)</td>
<td>½” x ⅞” (12 &amp; 19 mm)</td>
<td>½” &amp; ⅞” (12 &amp; 19 mm)</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D-2256</td>
<td>23.0 lbs (10.4 kg)</td>
<td>8.8 lbs (5.26 kg)</td>
<td>4.6 lbs (2.1 kg)</td>
</tr>
<tr>
<td>Mpa</td>
<td>Calculated</td>
<td>386 Mpa</td>
<td>405 Mpa</td>
<td>436 Mpa</td>
</tr>
<tr>
<td>Elongation</td>
<td>ASTM D-2256</td>
<td>13.2%</td>
<td>14.6%</td>
<td>14.7%</td>
</tr>
</tbody>
</table>

Note: Values shown are typical values with (+/-) tolerances specified for individual properties.

FIBERMESH® 300 fibrillated fibers are made from 100% virgin polypropylene and are designed to separate out in a network of reinforcement that provides early age concrete benefits and toughness. FIBERMESH® 300 has excellent mixing properties and will not ball or clump during normal mixing procedures.

Thank you for choosing FIBERMESH® 300 fibers. Please do not hesitate to contact Propex Concrete Systems, if we can be of further assistance.

Sincerely,

Carl Labbe
Quality Manager

Phil Dyer, P.E.
Engineering Services Manager

Fibermesh®, Novomesh®, Novocon®, e3®, ENDURO® and Fibercast® are registered trademarks of Propex Concrete Systems Corp.

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Propex Concrete Systems Corp
6025 Lee Highway, Ste 425 PO Box 22788 Chattanooga, TN 37422
Telephone (800) 621-1273 – Fax (423) 899-5005; Internet: www.fibermesh.com
ENGINEERING REPORT No. 5

Static Load Test
Fibermesh® 300 versus Welded Wire Fabric

OVERVIEW – The following study compares W1.4 x W1.4 (6 x 6) welded wire fabric to Fibermesh® 300 fibers, formerly Fibermesh InForce™, on the basis of flexural strength and load deflection. The results of the study indicate that the use of Fibermesh 300 fibers at 1.5 pounds per cubic yard (0.9 kg per cubic meter) of concrete in place of welded wire fabric does supply at least the equivalent flexural strength capacity of a slab and load-deflection relationship.

NOTE: The study was conducted in the laboratories of Wiss, Janney, Elstner & Associates, Inc., Consulting & Research Engineers by registered professional engineers. Jens Holms was Project Engineer. Results apply only to Fibermesh® 300.

CONCLUSIONS

The results of the study reported herein indicate that substituting welded wire fabric with Fibermesh 300 at a rate of 1.5 lbs. per cubic yard (0.9 kilograms/cubic meter) of concrete yield:

- Equivalent flexural strength capacity of the slab
- Equivalent load-deflection relationship

The flexural capacity of the slab containing Fibermesh 300 was 2 percent higher than the slab containing welded wire fabric and 8 percent higher than the plain concrete slab.

The load-deflection data indicate that with respect to flexural response characteristics, Fibermesh 300 fibers can be used as a practical alternative to welded wire fabric.
Fabrication of Test Slabs
Three 10 ft. x 10 ft. x 6 in. (3 meters x 3 meters x 15 cm) concrete slabs were cast on April 24, 1985, in the Wiss, Janney, Elstner & Associates laboratories. The concrete mix was as follows:

Mix Design — Ready mixed concrete was a standard 4,000 psi (28 N/mm²) mix, without air entrainment, having the following mix design (1 yd.³, SSD quantities) (1 m³):

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1 Portland Cement</td>
<td>564 lbs. (256 kg)</td>
</tr>
<tr>
<td>Coarse Aggregate #6 Gravel</td>
<td>283 lbs. (128 kg)</td>
</tr>
<tr>
<td>Fine Aggregate #2 Torpedo</td>
<td>135 lbs. (62 kg)</td>
</tr>
<tr>
<td>Water</td>
<td>283 lbs. (128 kg)</td>
</tr>
<tr>
<td>Water Reducing Retarder</td>
<td>23 fl.oz. (680 ml)</td>
</tr>
</tbody>
</table>

Total: 4,077 lbs. (1849 kg)

Measured Properties of Fresh Concrete
Air (pressure meter) 2.4 percent
Slump 5 in. (127 mm)
Unit Weight 150 pcf (2403 kg/m³)
Concrete Temperature 65°F (18.3°C)

Casting of Concrete Slabs
Forms — The slabs were cast on polyethylene on top of the existing laboratory concrete slab on grade. The sides of the forms were made of plywood and were anchored to the slab surface. Lifting anchors, made of bent pieces of No. 4 rebar, were embedded in each corner of all three slabs.

Casting Sequence and Procedure — The three slabs were cast according to the following sequence:
1. The slab containing WWF
2. The plain concrete slab
3. The slab containing Fibermesh® 300 fibers.

After the WWF and the plain slabs were cast, Fibermesh 300 was added to the remaining concrete in the ready mix truck at a quantity of 1.5 lbs. per cubic yard (0.9 kg/cubic meter) of concrete. The concrete with the polypropylene fibers was mixed for 5 minutes in the ready mix truck and the fiber slab was cast. All concrete was consolidated using internal vibration. The concrete was subsequently struck with a wooden board and given a magnesium float finish. After initial set, the three slabs were covered with wet burlap and polyethylene sheeting.

Fabrication of Test Specimens — Two sets of test specimens, each consisting of six 6 x 12 in. (15 x 30 cm) cylinders and three 6 x 6 x 30 in. (15 x 15 x 76 cm) prisms, were fabricated during casting of the slabs. The first set of cylinders and prisms was made of concrete from the ready mix truck before fibers were added and represents the concrete in the WWF and plain slabs. The second set of cylinders and prisms was made after the fibers had been added to the remaining concrete and represents the concrete in the Fibermesh 300 slab. After initial set, the specimens were covered with wet burlap and polyethylene sheeting.

Static Load Testing of the Three Slabs
Test Setup — The slabs were elevated using the embedded anchors and supported on 4 x 4 ft. (10 x 10 cm) wood beams along all four edges. Drilled-in expansion anchors were set on opposite sides of the slab to support a reaction beam. An I-beam supported by concrete blocks independent of the slab was placed perpendicular to the reaction beam. Twelve dial gauges on magnetic stands were mounted along the I-beam to monitor deflections. The two gauges closest to the center of the slab had a 3 in. (76 mm) stroke. The other dial gauges had a 1 in. (25 mm) stroke. The gauge points rested on 1 in. (25 mm) squares of glass plate epoxied to the top surface of the concrete slab. The outermost two dial gauges were mounted over the centerline of the 4 x 4 ft. (10 x 10 cm) to monitor deflections at the support.

Twelve 12 x 12 x 1 in. (30 x 30 x 2.5 cm) steel plates, placed on a piece of pegboard over a piece of carpet the same size as the plates, served as a force-transmitting system. Force was applied using a hydraulic ram and a calibrated load cell placed between the reaction beam and the steel plate. Applied forces were monitored using the load cell and a strain indicator. Ram pressure could be read on a hydraulic pressure gauge (manometer).

Testing of Test Specimens — Three 6 x 12 in. (15 cm by 30 cm) cylinders and two 6 x 6 x 30 in. (15 x 15 x 76 cm) prisms, for each set of specimens, were stripped the day after casting and cured in a curing tank. The cylinders were tested for compressive strength (ASTM C39) and the beams were tested for flexural strength (ASTM C78) at ages of 28 days. The remaining six cylinders and two prisms were cured under wet burlap and polyethylene for three days. At the time the the slabs were uncovered, the burlap and polyethylene sheeting were removed, the bottom of the plastic cylinder molds were cut off and the cylinders were laid on their side. The prisms remained uncovered in the molds until they were 30 days old (i.e., until the day of testing of the slabs).

By cutting off the bottom of the cylinders and uncovering the prisms, the curing condition of the slabs was simulated, i.e., maximum distance from any point to a free (dry) surface is 6 in. (15 cm).

The compressive strength of the cylinders and the flexural strength of the prisms — cured wet for 3 days and dried for 27 days — was determined at the time the slabs were load tested.

<table>
<thead>
<tr>
<th>Specimen Type</th>
<th>28 days wet cure</th>
<th>3 days wet cure &amp; 25 days dry cure</th>
<th>With fibers 28 days wet cure &amp; 25 days dry cure</th>
<th>3 days wet cure &amp; 25 days dry cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>6,920 (41.51)</td>
<td>5,840 (40.88)</td>
<td>6,280 (43.82)</td>
<td>6,480 (45.36)</td>
</tr>
<tr>
<td>Flexural</td>
<td>750 (5.25)</td>
<td>730 (5.11)</td>
<td>795 (5.28)</td>
<td>780 (5.32)</td>
</tr>
</tbody>
</table>

* Each value is the average of three tests. ** Each value is the average of two tests.
Fabrication of Test Slabs

Three 10 ft. x 10 ft. x 6 in. (3 meters x 3 meters x 15 cm) concrete slabs were cast on April 24, 1985, in the Wiss, Janney, Elstner & Associates laboratories. The concrete mix was as follows:

**Mix Design**

- Ready mixed concrete was a standard 4,000 psi (28 N/mm²) mix, without air entrainment, having the following mix design (1 yd.³, SSD quantities) (1 m³):
  - Type I Portland Cement: 564 lbs (256 kg)
  - Coarse Aggregate #6 Gravel: 283 lbs (128 kg)
  - Water Reducing Retarder: 23 fl. oz. (680 ml)
- Total: 4,077 lbs (1849 kg)

**Measured Properties of Fresh Concrete**

- Air (pressure meter): 2.4 percent
- Slump: 5 in. (127 mm)
- Unit Weight: 150 pcf (2403 kg/m³)
- Concrete Temperature: 65°F (18.3°C)

**Casting of Concrete Slabs**

**Forms**

- The slabs were cast on polyethylene on top of the existing laboratory concrete slab on grade. The sides of the forms were made of plywood and were anchored to the slab surface. Lifting anchors, made of bent pieces of No. 4 rebar, were embedded in each corner of all three slabs.

**Casting Sequence and Procedure**

1. The slab containing WWF
2. The plain concrete slab
3. The slab containing Fibermesh®300 fibers.

After the WWF and the plain slabs were cast, Fibermesh 300 was added to the remaining concrete in the ready mix truck at a quantity of 1.5 lbs per cubic yard (0.9 kg/cubic meter) of concrete. The concrete with the polypropylene fibers was mixed for 5 minutes in the ready mix truck and the fiber slab was cast.

All concrete was consolidated using internal vibration. The concrete was subsequently struck with a wooden board and given a magnesium float finish. After initial set, the three slabs were covered with wet burlap and polyethylene sheeting.

**Fabrication of Test Specimens**

Two sets of test specimens, each consisting of six 6 x 12 in. (15 x 30 cm) cylinders and three 6 x 6 x 30 in. (15 x 15 x 76 cm) prisms, were fabricated during casting of the slabs. The first set of cylinders and prisms was made of concrete from the ready mix truck before fibers were added and represents the concrete in the WWF and plain slabs. The second set of cylinders and prisms was made after the fibers had been added to the remaining concrete and represents the concrete in the Fibermesh 300 slab. After initial set, the specimens were covered with wet burlap and polyethylene sheeting.

Static Load Testing of the Three Slabs

**Test Setup**

- The slabs were elevated using the embedded anchors and supported on 4 x 4 in. (10 x 10 cm) wood beams along all four edges.
- Drilled-in expansion anchors were set on opposite sides of the slab to support a reaction beam.

An I-beam supported by concrete blocks independent of the slab was placed perpendicular to the reaction beam. Twelve dial gauges on magnetic stands were mounted along the I-beam to monitor deflections. The two gauges closest to the center of the slab had a 3 in. (76 mm) stroke. The other dial gauges had a 1 in. (25 mm) stroke. The gauge points rested on 1 in. (25 mm) squares of glass plate epoxied to the top surface of the concrete slab. The outermost two dial gauges were mounted over the centerline of the 4 x 4 in. (10 x 10 cm) to monitor deflections at the support.

Two 12 x 12 x 1 in. (30 x 30 x 2.5 cm) steel plates, placed on a piece of pegboard over a piece of carpet the same size as the plates, served as a force-transmitting system. Force was applied using a hydraulic ram and a calibrated load cell placed between the reaction beam and the steel plate.

**Load Testing of the Three Slabs**

The load testing of the three concrete slabs was conducted on May 24, 1985, when the slabs were 30 days old and had been drying from the top surface for 27 days.

All dial gauges were zeroed and force was applied in increments of 1,000 lbs. (453.6 kg). After each increment, the applied force was held constant and the dial gauges were read. Output from the strain indicator was checked periodically with a standard and actual pressure gauge readings. Force application continued until each slab failed.

**Testing of Test Specimens**

Three 6 x 12 in. (15 cm by 30 cm) cylinders and two 6 x 6 x 30 in. (15 x 15 x 76 cm) prisms, for each set of specimens, were stripped the day after casting. The cylinders were tested for compressive strength (ASTM C39) and the beams were tested for flexural strength (ASTM C78) at ages of 28 days. The remaining six cylinders and two prisms were cured under wet burlap and polyethylene for three days. At the time the slabs were uncovered, the burlap and polyethylene sheeting were removed, the bottom of the plastic cylinder molds were cut off and the cylinders were laid on their side. The prisms remained uncured in the molds until they were 30 days old (i.e., until the day of testing of the slabs).

By cutting off the bottom of the cylinders and uncovering the prisms, the curing condition of the slabs was simulated, i.e., until they were 30 days old (i.e., until the day of testing of the slabs).

**Concrete**

- **Compressive Strength (PSI/N/mm²):**
  - Plain: 6,920 (41.91)
  - 3 days wet cure & 25 days dry cure: 5,840 (40.88)
  - With fibers: 6,260 (43.82)
  - 3 days wet cure & 25 days dry cure: 6,480 (45.36)

**Flexural Strength (N/mm²):**

- Plain: 790 (5.25)
- 3 days wet cure & 25 days dry cure: 730 (5.11)
- With fibers: 795 (5.28)
- 3 days wet cure & 25 days dry cure: 800 (5.32)

*Each value is the average of three tests. **Each value is the average of two tests.
ENGINEERING REPORT No. 5

Static Load Test
Fibermesh® 300 versus Welded Wire Fabric

OVERVIEW – The following study compares 1.4 x 1.4 (6 x 6) welded wire fabric to Fibermesh® 300 fibers, formerly Fibermesh InForce™, on the basis of flexural strength and load deflection. The results of the study indicate that the use of Fibermesh 300 fibers at 1.5 pounds per cubic yard (0.9 kg per cubic meter) of concrete in place of welded wire fabric does supply at least the equivalent flexural strength capacity of a slab and load-deflection relationship.

Purpose of the Test
This test program compared on a large scale the flexural capacity and deflections of concrete slabs containing the recommended use of Fibermesh 300 polypropylene fibers to a plain concrete slab and a concrete slab containing a typical amount of welded wire fabric for drying shrinkage crack control purposes. All three slabs were cast from one batch of concrete.

NOTE: The study was conducted in the laboratories of Wiss, Janney, Elstner & Associates Inc., Consulting & Research Engineers by registered professional engineers. Jens Holms was Project Engineer. Results apply only to Fibermesh® 300.

CONCLUSIONS

The results of the study reported herein indicate that substituting welded wire fabric with Fibermesh 300 at a rate of 1.5 lbs. per cubic yard (0.9 kilograms/cubic meter) of concrete yield:

- Equivalent flexural strength capacity of the slab
- Equivalent load-deflection relationship

The flexural capacity of the slab containing Fibermesh 300 was 2 percent higher than the slab containing welded wire fabric and 8 percent higher than the plain concrete slab.

The load-deflection data indicate that with respect to flexural response characteristics, Fibermesh 300 fibers can be used as a practical alternative to welded wire fabric.

- Findings from the Wiss, Janney, Elstner & Associates report

Load Testing of Three Slabs

1. The respective failure loads for the plain, WWF and Fibermesh 300 slabs were 16,000 lbs. (7258 kg), 17,000 lbs. (7711 kg), and 17,350 lbs. (7870 kg).
2. The WWF slab failed at a static load of 17,000 lbs. (7711 kg) without allowing the dial gauges. In contrast, the dial gauges could be read at the same load for the Fibermesh 300 slab.
3. The relationship between applied load (force) and measured deflections was approximately linear for the slabs up to about 14,000 lbs. (6350 kg) force.

CONCLUSIONS

- The results of the study reported herein indicate that substituting welded wire fabric with Fibermesh 300 at a rate of 1.5 lbs. per cubic yard (0.9 kilograms/cubic meter) of concrete yield:
  - Equivalent flexural strength capacity of the slab
  - Equivalent load-deflection relationship

- The flexural capacity of the slab containing Fibermesh 300 was 2 percent higher than the slab containing welded wire fabric and 8 percent higher than the plain concrete slab.

- The load-deflection data indicate that with respect to flexural response characteristics, Fibermesh 300 fibers can be used as a practical alternative to welded wire fabric.

MEASUREMENTS

Average Net Deflection at Gauges 6 & 7 (x0.001 in.)

= Findings from the Wiss, Janney, Elstner & Associates report

PROPEX CONCRETE SYSTEMS

NORTH AMERICA
Propex Concrete Systems Corp. 6025 Lee Highway, Suite 425 PO Box 2278 Chattanooga, TN 37422 Tel: 801.621.1273 Tel: 801.621.1230 Fax: 801.621.2157

INTERNATIONAL
Propex Concrete Systems Ltd. Propex House, 9 Royal Court, Basildon, Essex CO4 9LA UK Tel: +44 (0) 1246 644200 Fax: +44 (0) 1246 644201 www.fibermesh.com

www.fibermesh.com
NORTH AMERICA
Propex Concrete Systems Corp. 6025 Lee Highway, Suite 425 PO Box 2278 Chattanooga, TN 37422 Tel: 801.621.1273 Tel: 801.621.1230 Fax: 801.621.2157

INTERNATIONAL
Propex Concrete Systems Ltd. Propex House, 9 Royal Court, Basildon, Essex CO4 9LA UK Tel: +44 (0) 1246 644200 Fax: +44 (0) 1246 644201 www.fibermesh.com
Performance Characteristics of Fibermesh® 300

Distribution of Fibermesh® 300 in Concrete

This photo represents a polished section taken from a 6” x 12” (15 mm x 30 mm) cylinder of concrete that was batched in a ready-mix truck with 470 pounds of cement, 1.5 pounds of fiber per cubic yard (279 kilos of cement, 900 grams of fiber per cubic meter). The photo represents approximately a 1/8 in2 (3 mm) area that has been enlarged 50 times indicating the ability of the fibers to distribute uniformly throughout the mix.

CONCLUSIONS

- Splitting tensile strength was increased by the addition of Fibermesh 300 (at 1.5 lbs/yd3) (900 g/m3) and compressive and flexural strengths were not affected by the addition of fibers.
- The photos clearly show the beneficial effect of Fibermesh 300 in controlling the magnitude of concrete cracking under adverse drying conditions. The above drying shrinkage data, supported by increased strength results in conjunction with favorable water retention rates, suggests that the use of Fibermesh 300 synthetic fibers at 1.5 lbs per cubic yard (900 g/m3) will reduce plastic shrinkage to a large degree. Thus controlling the amount of cracking or possibly eliminating it.
- Migration of water rates indicate reduction in permeability 33%-44% at 1.5 lbs/yd3 (900 g/m3) and as high as 79% at 2 lbs/cy3 (1187 g/m3).
- Increase in splitting tensile strength would indicate increase in toughness, thereby producing a less brittle and more ductile concrete with high impact resistance.

OVERVIEW

- The following study compares test results of plain concrete with fiber reinforced concrete. The results of the study indicate that the use of Fibermesh® 300 fibers, formerly Fibermesh InForce™, at 1.5 pounds per cubic yard (900 grams per cubic meter) will reduce plastic shrinkage cracking. Splitting tensile strength was increased by the addition of Fibermesh 300 fibers and compressive and flexural strengths were not affected by the addition of fibers.

PURPOSE OF THE TEST

- A test program, designed to produce useful engineering data, should be based on a comparative parameter. When the data are expressed as a percentage of a control test, this parameter can then be used in estimating the potential performance of most any Portland Cement concrete containing the same addition rate of Fibermesh 300.

NOTE: The data contained in this report represent one of the most comprehensive studies to date on the properties, performance characteristics and value of polypropylene fiber when added to concrete. Results apply only to Fibermesh 300. This study was conducted by a registered professional engineer noted for his concrete expertise.
Performance Characteristics of Fibermesh® 300

Relative Engineering Data

The following comparisons are based on ready mix concrete, which contained 5 sacks of 94 pounds each (42.7 kg) of cement per cubic yard (6.5 sacks per cubic meter), 3/4" (19 mm) maximum aggregate, and a W/C ratio of 0.64. The control set of specimens were cast first, then 1.5 lbs/yd³ (900 g/m³) of polypropylene fiber was added and mixed for five minutes before the second set of specimens were made. Specific variations from this mix are noted below.

<table>
<thead>
<tr>
<th>Compressive Strength (ASTM C-39, psf (N/mm²))</th>
<th>12 Hours</th>
<th>24 Hours</th>
<th>3 Days</th>
<th>7 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>4300</td>
<td>5300</td>
<td>3550</td>
<td>4050</td>
</tr>
<tr>
<td>Fibermesh® 300</td>
<td>4750</td>
<td>5600</td>
<td>5100</td>
<td>5400</td>
</tr>
<tr>
<td>Data (Average)</td>
<td>4750</td>
<td>5600</td>
<td>5100</td>
<td>5400</td>
</tr>
</tbody>
</table>

The following test data were also produced by Signet Laboratory and issued in a report entitled “Evaluation of Fibermesh® Synthetic Fibers in Concrete”, by P. Kraai (June 15, 1983).

Performance Characteristics of Fibermesh® 300

Fibermesh® 300

The modulus of elasticity most commonly used in engineering is the secant modulus. The secant of strain modulus for Fibermesh 300 concrete was determined on the basis of 40% of the 28-day compressive strength. According to Graph Pa. 1, the “E” value was 2.96 x 10⁶ psi (20.72 KN/mm²).

No. “E” value was run on the average compressive strength of the control concrete. However, if one assumes an average unit weight of 145 pcf and an average strength of 2280 psi, we can calculate the potential “E” value with the following formula:

\[ E = \sigma / \varepsilon \]

According to the ACI Building Code, the following values are acceptable:

<table>
<thead>
<tr>
<th>Compressive Strength</th>
<th>Modulus of Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 psi</td>
<td>10,000,000 psi (70 KN/mm²)</td>
</tr>
<tr>
<td>1500 psi</td>
<td>14,000,000 psi (98 KN/mm²)</td>
</tr>
<tr>
<td>2000 psi</td>
<td>20,000,000 psi (137 KN/mm²)</td>
</tr>
</tbody>
</table>

Concrete Setting Times

The chart below shows the effect of Fibermesh 300 on the setting characteristics of concrete. The critical area is below the initial setline. This area represents the mixing, placing and finishing time available to most concrete. The test data indicates most cracking occurred during the initial hours after concrete was placed. This being the time when moisture retention is extremely important.

Water Migration Rates

The potential for minimizing water loss from concrete, due to evaporation, is of considerable importance as a prime control in the possible elimination of cracking. Any concrete with the lowest water migration rate would have the highest water retention rate.

As part of the subject evaluation, additional water migration rates for concrete were determined and compared. The Von Test Method was used to make this comparison. Essentially, the method measures the amount of water that would migrate through a 2-inch (51 mm) thickness of concrete under a 11-inch (28 cm) head of water. The following mix was used: 5.5 sacks/yd³ (7 sacks/m³); each sack of cement weighs 94 pounds (42.7 kg); 1" (25 mm) max. aggregate. Control specimens were taken, then synthetic fibers were added at 1.0 lb/yd³ (593 g/m³) in three stages using the same mix. No water was added to the truck during this period.

Water Migration Rates

<table>
<thead>
<tr>
<th>Water Loss Test</th>
<th>Material</th>
<th>Water Loss (lbs)</th>
<th>Water Loss (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.75</td>
<td>1.53 (0.013)</td>
<td></td>
</tr>
<tr>
<td>Fibermesh® 300</td>
<td>2.59</td>
<td>1.43 (0.012)</td>
<td></td>
</tr>
</tbody>
</table>

The most critical period in the life of a slab, exposed to adverse curing conditions, is the first 4 to 6 hours after placing. The above data shows that 50% of the total water lost in 28 days occurred during the first 4 hours.
Performance Characteristics of Fibermesh® 300

Relative Engineering Data

The following comparisons are based on ready mix concrete, which contained 5 sacks of 94 pounds each (42.7 kg) of cement per cubic yard (6.5 sacks per cubic meter), 3/4” (19 mm) maximum aggregate, and a W/C ratio of 0.64. The control set of specimens were cast first, then 1.5 lbs/yd.³ (900 g/m³) of polypropylene fiber was added and mixed for five minutes before the second set of specimens were made. Specific variations from this mix are noted below.

<table>
<thead>
<tr>
<th>Compressive Strength (ASTM C-109, psi) (N/mm²)</th>
<th>7 Days</th>
<th>28 Days</th>
<th>7 Days</th>
<th>28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>530</td>
<td>805</td>
<td>540</td>
<td>840</td>
</tr>
<tr>
<td>Fibermesh® 300</td>
<td>540</td>
<td>850</td>
<td>580</td>
<td>905</td>
</tr>
<tr>
<td>Fibermesh® 300 (Percent Increase)</td>
<td>3.8%</td>
<td>7.5%</td>
<td>7.5%</td>
<td>10.5%</td>
</tr>
</tbody>
</table>

The following test data were also produced by Signet Laboratory and issued in a report entitled “Evaluation of Fibermesh® Synthetic Fibers in Concrete”, by P. Kraai (June 15, 1983).

Compressive Strength Modulus of Elasticity

The modulus of elasticity most commonly used in engineering is the secant modulus. The secant of static modulus for Fibermesh 300 concrete was determined on the basis of 40% of the 28 day compressive strength. According to Graph No. 1, the “E” value was 2.96 x 10⁶ psi (20.72 KN/mm²).

Relative Effect on Concrete Cracking

Evaporation Rates

This comparison was based on concrete slabs that had 4 square feet (0.37 m²) of surface area and were 3 inches (76 mm) thick. The form had a slick base to eliminate the finishing variable. No curing compound was added at 1.0 lb/yd.³ (593 g/m³) in three stages four hours after the mixing, placing, and finishing time available to the slab.

Water Migration Rates

The potential for minimizing water loss from concrete, due to evaporation, is of considerable importance as a prime control in the possible elimination of cracking. Any concrete with the lowest water migration rate would have the highest water retention rate.

The most critical period in the life of a slab, exposed to adverse curing conditions, is the first 4 to 6 hours after placing. The above data shows that 50% of the total water lost in 28 days occurred during the first 4 hours.

The chart below shows the effect of Fibermesh 300 on the setting characteristics of concrete. The critical area is below the initial setline. This area represents the mixing, placing and finishing time available to most concrete. This test data indicates most cracking occurred during the initial hours after concrete was placed. This being the time when moisture retention is extremely important.

The photos (below left) show a comparison between the two slabs at 24 hours. The cracking in the control slab started at 2.5 hours, with most of the cracking patterns developed by the 4th hour. At 24 hours, the Fibermesh 300 slab did not show any noticeable cracks.

After 28 days, the control slab had not changed significantly with the exception of slightly more noticeable crack widths. The Fibermesh 300 slab did exhibit minor cracking. An estimate of relative cracking tendencies based on crack length would indicate that the Fibermesh 300 cracking pattern was 90 to 95 percent less than the control slab at 28 days.

Fibermesh® 300 Concrete

Concrete Setting Times

Flexural Strength (ASTM C-78, psi (N/mm²))

<table>
<thead>
<tr>
<th>Flexural Strength (ASTM C-78) (psi) (N/mm²)</th>
<th>7 Days</th>
<th>28 Days</th>
<th>7 Days</th>
<th>28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>320</td>
<td>570</td>
<td>320</td>
<td>570</td>
</tr>
<tr>
<td>Fibermesh® 300</td>
<td>320</td>
<td>570</td>
<td>320</td>
<td>570</td>
</tr>
<tr>
<td>Fibermesh® 300 (Percent Increase)</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Concrete Water Loss

The most critical period in the life of a slab, exposed to adverse curing conditions, is the first 4 to 6 hours after placing. The above data shows that 50% of the total water lost in 28 days occurred during the first 4 hours.

Performance Characteristics of Fibermesh® 300

Water Migration Rates

Water Migration Rates

Migrate through a 2-inch (51 mm) thickness of water under a 11-inch (28 cm) head of water.

The following mix was used: 5.5 sacks/yd³ (6.5 sacks/m³); each sack of cement weighs 94 pounds (42.7 kgs); 1” (25 mm) max. aggregate.

Control specimens were taken, then synthetic fibers were added at 1.0 lb/yd.³ (593 g/m³) in three stages using the same mix. No water was added to the truck during this period.

Water Migration Rates

The potential for minimizing water loss from concrete, due to evaporation, is of considerable importance as a prime control in the possible elimination of cracking. Any concrete with the lowest water migration rate would have the highest water retention rate.

<table>
<thead>
<tr>
<th>Water Migration Rates</th>
<th>7 Days</th>
<th>28 Days</th>
<th>7 Days</th>
<th>28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fibermesh® 300</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Fibermesh® 300 Concrete

Concrete Water Loss

The most critical period in the life of a slab, exposed to adverse curing conditions, is the first 4 to 6 hours after placing. The above data shows that 50% of the total water lost in 28 days occurred during the first 4 hours.

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Fibermesh® 300 Concrete

Concrete Water Loss

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Performance Characteristics of Fibermesh® 300

Distribution of Fibermesh® 300 in Concrete

This photo represents a polished section taken from a 6" x 12" (15 mm x 30 mm) cylinder of concrete that was batched in a ready-mix truck with 470 pounds of cement, 1.5 pounds of fiber per cubic yard (279 kilos of cement, 900 grams of fiber per cubic meter). The photo represents approximately 1/8 in2 (3 mm) area that has been enlarged 50 times indicating the ability of the fibers to distribute uniformly throughout the mix.

CONCLUSIONS

- Splitting tensile strength was increased by the addition of Fibermesh 300 (at 1.5 lbs/yd3) (900 g/m3) and compressive and flexural strengths were not affected by the addition of fibers.
- The photos clearly show the beneficial effect of Fibermesh 300 in controlling the magnitude of concrete cracking under adverse drying conditions. The above drying shrinkage data, supported by increased strength results in conjunction with favorable water retention rates, suggests that the use of Fibermesh 300 synthetic fibers at 1.5 lbs. per cubic yard (900 g/m3) will reduce plastic shrinkage to a large degree. Thus controlling the amount of cracking or possibly eliminating it.
- Migration of water rates indicate reduction in permeability 33%-44% at 1.5 lbs/yd3, (900 g/m3) and as high as 79% at 2 lbs/yd3 (1187 g/m3).
- Increase in splitting tensile strength would indicate increase in toughness, thereby producing a less brittle and more ductile concrete with high impact resistance.

Fibermesh 300 is produced in fibrillated bundles as shown (left). When added to the concrete during mixing cycle, the mixing action opens the bundles and separates into multifilament fibers (right photo).

ENGINEERING REPORT No. 1
Performance Characteristics of Fibermesh® 300

OVERVIEW — The following study compares test results of plain concrete with fiber reinforced concrete. The results of the study indicate that the use of Fibermesh® 300 fibers, formerly Fibermesh InForce™, at 1.5 pounds per cubic yard (900 grams per cubic meter) will reduce plastic shrinkage cracking. Splitting tensile strength was increased by the addition of Fibermesh 300 fibers and compressive and flexural strengths were not affected by the addition of fibers.

PURPOSE OF THE TEST — A test program, designed to produce useful engineering data, should be based on a comparative parameter. When the data are expressed as a percentage of a control test, this parameter can then be used in estimating the potential performance of most any Portland Cement concrete containing the same addition rate of Fibermesh 300.

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