

UltraFiber 500®

CELLULOSE FIBER REINFORCEMENT
FOR THE CONCRETE INDUSTRY

SGS SOLOMON
COLORS, INC.



UltraFiber 500



Cellulose Fiber Reinforcement for industrial, commercial, residential, architectural & decorative applications

SOLOMON ULTRAFIBER 500 is the only alkaline resistant cellulose fiber reinforcement. It is perfect for commercial and residential slabs, composite metal decks, paving, pervious paving, curb and gutter, slip form, architectural and decorative, shotcrete, wall, and white topping applications. UltraFiber 500 cellulose fiber accepts color better than any other commercially available fiber.

ULTRAFIBER 500 provides excellent secondary reinforcement, is safe and easy to use, and provides superior finishability. It can replace traditional secondary reinforcement while improving durability, impact resistance, shatter resistance, and freeze/thaw resistance. Bonding between rebar and cement paste is improved while concrete permeability and absorption are reduced. Unlike polypropylene fiber, UltraFiber 500 is invisible in concrete, does not ball, fuzz, or blemish. It yields an aesthetically perfect finish with no special finishing practices. Also, unlike polypropylene fiber, UltraFiber 500 is derived from renewable resources.

ULTRAFIBER 500 has superb finishing quality, unsurpassed crack control, better hydration and bonding, is great for decorative and colored concrete, and utilizes an automated dispensing system.





SOLOMON **UltraFiber** **500®**

UltraFiber 500® has multiple advantages:

- Best finishing fiber; invisible, with no fuzz or balling
- Negligible impact on slump vs synthetic fibers
- Only cellulose fiber that accepts integral color, stains, & dyes
- Reduces plastic shrinkage & temperature cracking by 80% at 1.5 lbs
- Improves impact & abrasion resistance
- Improves freeze-thaw resistance
- Higher fiber count and better tensile strength than polypropylene. Fiber count 770 million fibers per lb. Tensile strength UF500 (90-130 KSI) vs polypropylene (30-70 KSI)
- Improves hydration
- Sustainably sourced
- Meets building codes for durability, crack control & fire resistance
- ICC certified



UltraFiber 500®: Benefits vs. Welded Wire Fabric (WWF)

ULTRAFIBER 500 provides a reduction in plastic shrinkage cracking and is distributed throughout the concrete matrix to provide 3-dimensional reinforcement. UltraFiber 500 will not corrode, provides internal curing, and improves concrete strength, durability, permeability and freeze-thaw properties. UltraFiber 500 is also more cost effective to use than welded wire fabric (WWF). WWF is typically not positioned in the proper location in the concrete and only reinforces the concrete after cracking has occurred.

ICC Evaluation Report ESR-1032 Fire-resistance-rated Construction

ULTRAFIBER 500 virgin cellulose fibers may be used as an alternative to welded wire fabric in concrete and steel floor units of listed fire-resistant-rated floor/ceiling and floor-design assemblies, using a minimum dosage rate of 1.0 pound per cubic yard (0.59 kg/m³) and dosage rate of 2.0 pounds per cubic yard (1.19 kg/m³) of concrete for up to two-hour fire-resistance ratings. Concrete-steel

form unit floor assemblies must be a minimum of No. 22 gage steel for fluted decks and No. 20/20 gage for cellular units, and must have minimum 2 1/2-inch-thick concrete over the top of the flutes. Except for substitution of the fibers for the welded-wire fabric, all other aspects of the fire-resistance-rated assembly must comply.



UltraFiber 500®: Decorative Concrete

UltraFiber 500 and decorative concrete are a natural pairing. Due to its aesthetic nature, decorative concrete demands more effort be made to preventing shrinkage cracking. However, synthetic fibers are not an option because they remain visible and ruin the appearance of the concrete. UltraFiber 500 brings equal or greater performance enhancement while remaining invisible in the concrete. UltraFiber 500 does not fuzz, ball, or negatively impact the appearance of concrete.





UltraFiber 500®: Comparison to Polypropylene (PP)

Polypropylene fibers are completely hydrophobic, meaning that they will absorb no moisture. As a result, PP fibers do not assimilate well in the concrete paste, and petrography proves that they do not bond well within the cement paste, therefore creating additional voids. (Fig. A)

Unlike polypropylene fibers, cellulose fibers are highly hydrophilic and will absorb moisture. UltraFiber 500 can absorb up to about 85% of its weight in moisture. This hydrophilic characteristic promotes outstanding bonding between cellulose fiber and the cement paste. (Fig. B and C)

Compared to typical synthetic polypropylene fibers, UltraFiber 500 cellulose fiber has greater fiber tensile strength and higher elastic modulus than polypropylene fibers (ACI SP182-8). The fine diameter and short fiber length provide exponentially higher fiber counts, closer fiber spacing, and higher specific

surface area versus polypropylene fibers (ACI 544.1R-96).

Cellulose is slightly heavier than water (1.1 g/cm^3) while synthetic PP fibers are lighter than water (0.9 g/cm^3). Hydrophilic cellulose fibers acclimate much better within the paste than light, hydrophobic synthetic PP fibers. Because of their hydrophilic nature, cellulose fibers more easily disperse within the concrete in typical industry concrete mixing processes.

Good fiber dispersion within the concrete is important for uniform performance throughout the concrete. The hydrophobic nature of PP presents a challenge to good mixing and good fiber distribution. UF500 reduces the occurrence of fiber clumping and balling that affects the in-place concrete performance and finishability.

Table 1 below summarizes some of the key fiber property differences:

Table 1: Fiber Property Comparison

Fiber Attributes, Units	UltraFiber 500®	Typical PP
Avg. length, mm	2.1	16
Denier, g/9,000 m	2.5	6
Projected diameter	18	30
Max. moisture uptake, wt. %	85	0
Fiber count, fibers/lb.	720×10^6	44×10^6
Apparent density, g/cm^3	1.10	0.91
Surface area, cm^2/g	25,000	1,500
Avg. fiber tensile, KSI	90-130	30-70
*Fiber spacing μm	640	950

*Dosage @ 1.5 lbs./yd³

Synthetic Polypropylene in Concrete

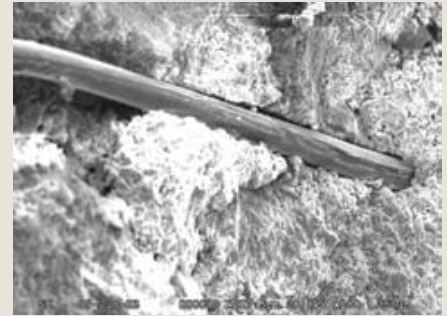


Fig. A: Note micro-voids around fiber and lack of paste/fiber bonding.

Cellulose Fibers in Concrete

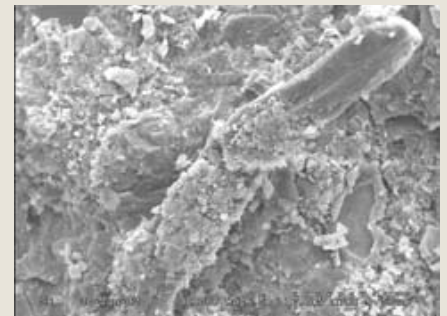


Fig. B: Cellulose fiber bonded into concrete.

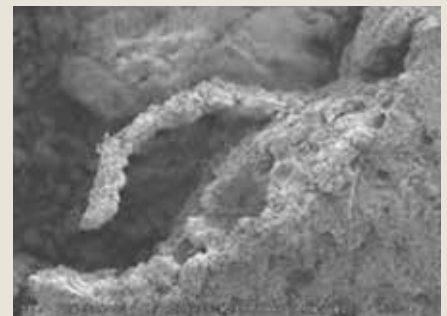
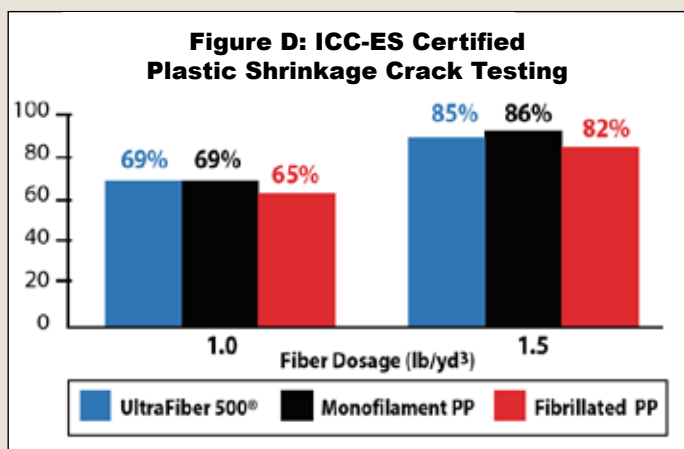


Fig. C: Cellulose fiber bonded with cement paste.



UltraFiber 500®: Crack Control

On a practical level, UltraFiber 500 has differentiated itself for crack control in the field. It is well known in the industry that the addition of PP fibers (monofilament or fibrillated) can substantially reduce the concrete slump. This creates the desire for additional water to be mixed in at the jobsite, which lowers strength properties and increases the potential for cracking. The use of UltraFiber 500 has a zero to negligible change on concrete slump and, therefore, the desire to add water at the jobsite is substantially reduced. This represents a significant advantage for UltraFiber 500 to control cracking in the field.

Figure D shows plastic shrinkage crack data from an ICC-ES certified test lab using the ICC standard plastic shrinkage crack method. In this finely controlled lab test, the concrete containing UltraFiber 500 performed essentially identical compared to the polypropylene fiber concrete samples. Also note that the fibers in each batch were dosed based on fiber weight per unit volume of concrete. This dosing methodology is standard in the concrete industry.

UltraFiber 500®: Alkali Resistance

UltraFiber 500 has been successfully tested for ASTM D6942 and it exceeded ICC's performance criteria. In saturated calcium hydroxide, UltraFiber 500 retained 100% fiber tensile strength, and in 1.0 normal sodium hydroxide it retained 96% fiber tensile strength. The following micrographs (Fig. E and F) were taken from a driveway slab containing UF500 that was poured in the summer of 2002. Notice the presence of healthy, non-deteriorated UltraFiber 500 cellulose fibers.

UltraFiber 500 in Aging Concrete

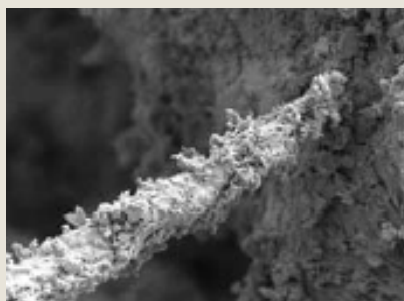


Fig. E: UltraFiber 500 in concrete after 4.5 years



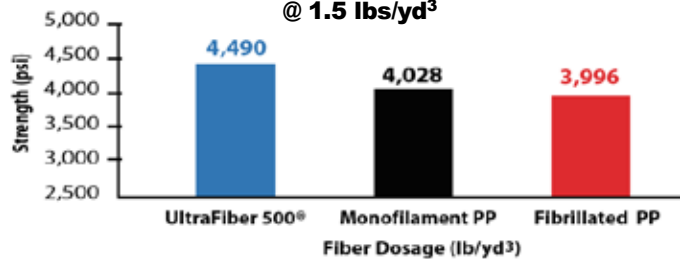
Fig. F: UltraFiber 500 in concrete after 4.5 years



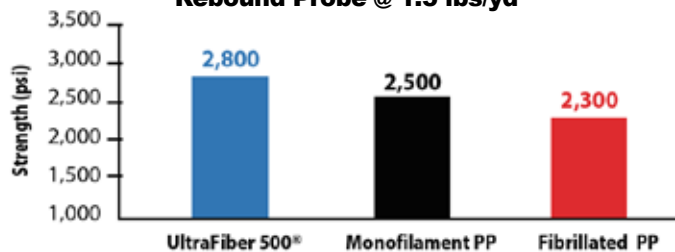
Studies & Comparisons



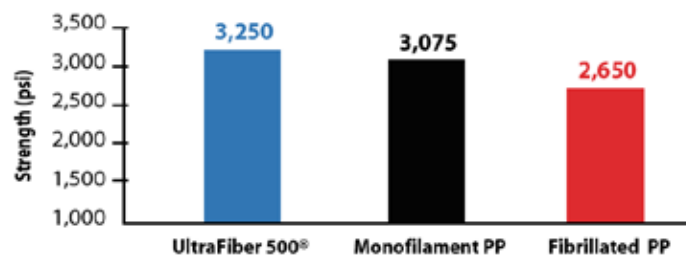
**Figure G: Compressive Strength Testing
@ 1.5 lbs/yd³**



**Figure H: In-Field Slab Testing with
Rebound Probe @ 1.5 lbs/yd³**



**Figure I: In-Field Slab Testing with
Windsor Probe @ 1.5 lbs/yd³**



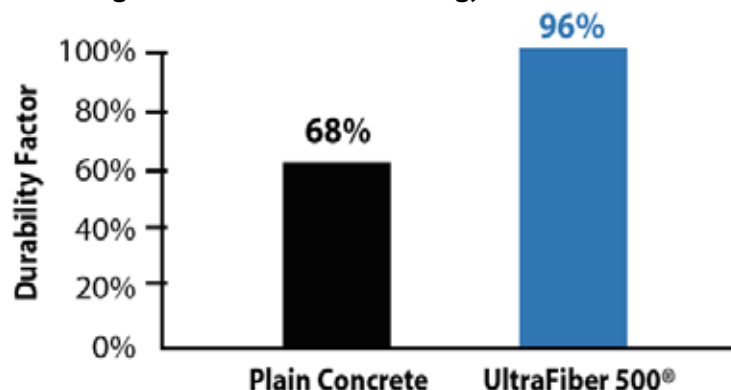
UltraFiber 500®: Compressive Strength

The hydrophilic nature of cellulose fibers provides an added benefit that hydrophobic synthetic fibers cannot provide. The moisture initially held by the fibers during mixing and initial placement is given up to enhance the hydration level in regions in and around the fiber. This phenomenon is commonly referred to as internal curing. This enhanced hydration can have a positive impact on strength properties. Identical mixes were tested for compressive strength; each mix contained 1.5 lbs/yd³ of fiber (see Fig.G).

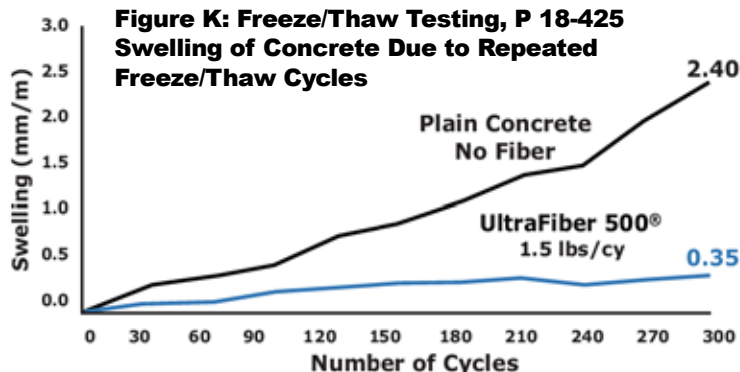
The compressive strength of the concrete containing UltraFiber 500 exceeded the concrete containing synthetic polypropylene fibers. Three residential grade slabs (6 yards each) were poured and placed side-by-side with identical mix designs on the same day, supplied by the same ready mix producer, and finished by the same contractor. Each slab contained 1.5 lbs/yd³ of one fiber type (UltraFiber 500, monofilament PP, and fibrillated PP). After approximately 8 months of curing in the field, the slabs were tested for strength using a rebound probe and a Windsor probe. The data are summarized in Figures H and I.

In both test methodologies, the slabs containing UF500 achieved higher in-place strength values.

Figure J: Freeze/Thaw Testing, ASTM C666



**Figure K: Freeze/Thaw Testing, P 18-425
Swelling of Concrete Due to Repeated Freeze/Thaw Cycles**

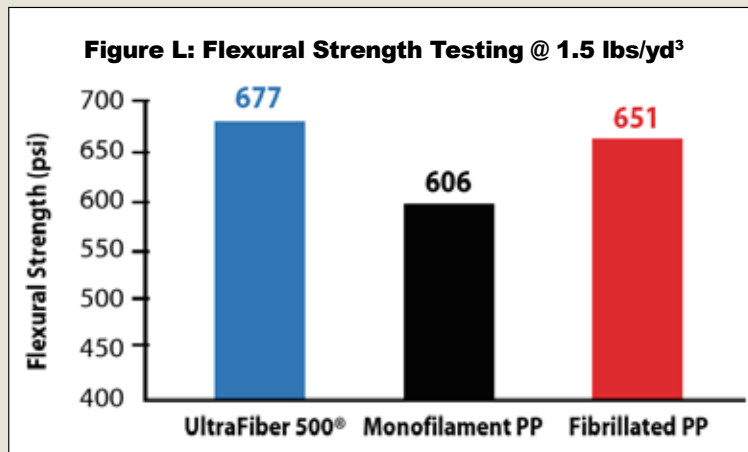


UltraFiber 500®: Freeze/Thaw Performance

The reduced concrete absorption and reduced concrete permeability benefits documented from the use of UltraFiber 500 have a favorable impact on freeze/thaw durability performance. The presence of UltraFiber 500 can improve the F/T resistance of concrete that would otherwise have poor performance. The data in Figures J and K show two different freeze/thaw test results using ASTM 666 and French Standard P 18-425 respectively. UltraFiber 500 was dosed at 1.5 lbs/yd³ for both tests. More testing is underway.

Compared to the poor results for the control in each of these tests, the presence of UltraFiber 500 had a substantial improvement on the freeze/thaw durability of the concrete.





UltraFiber 500®: Residual Strength/Toughness Testing

The mechanism of cracking in the field is different from what these tests measure. Cracks in concrete slabs are subject to movement due to shrinkage in the horizontal plane.

The crack holding capacity of fibers during concrete shrinkage is directly proportional to the tensile capacity of the fibers. UltraFiber 500 obtains similar results in these test compared to monofilament synthetic fibers. But, more importantly, UltraFiber 500 performs at the micro level to combat crack formation and increase the stress carrying capacity of the concrete prior to reaching the first crack level (i.e. flexural strength). Flexural strength testing is required by ICC in their evaluation criteria for fibers in concrete (synthetic and cellulose). Flexural strength testing has shown that UltraFiber 500 fibers are equal to or better than synthetic fibers used for secondary reinforcement (see Figure L).

UltraFiber 500® advantages over synthetic fibers for fiber reinforced concrete (FRC):

- Higher surface area, higher fiber tensile strength, higher fiber count, and closer fiber spacing
- Cellulose fiber properties promote better fiber dispersion throughout the FRC
- Cellulose fibers assimilate and bond within the paste, creating a tighter, denser paste
- Minimal to no negative impact to plastic properties of FRC
- Provides enhanced curing by the gradual release of water to unhydrated cement
- FRC strength properties are improved from internal curing
- Reduced water absorbency and permeability
- Improved freeze/thaw durability performance
- Cellulose fibers do not create placement & finishing problems
- Processed cellulose fibers from renewable resources



UltraFiber 500®: Dispensing

IMPROVE PROFITABILITY, efficiency, and safety with UltraFiber 500 Automated Gen2 Dispenser. As the only truly automated system on the market, our UltraFiber 500 automated dispenser is as unique and innovative as UltraFiber 500 itself.

CONTROL

The UltraFiber 500 automated dispenser seamlessly integrates with most existing control systems; a computer slot module or optional timer box for automation is required. Batch managers can dose exact amounts of fiber without leaving the workstation. Batch tickets confirm fiber dosage.

SOLOMON ADVANTAGE

All UltraFiber 500 dispensers are designed and built by Solomon Colors in the United States. Designated Solomon Colors service technicians are available nationwide for troubleshooting, preventative maintenance, and repair to keep your plant up and running. Call (866) 985-8324 for a qualified technician during normal business hours and an afterhours paging system.

FLEXIBILITY

An UltraFiber 500 automated dispenser can be easily placed in most plants. The dispenser can be placed up to 100 feet from

the discharge point and the flexible auger can bend around corners up to 60 degrees. Beyond that, the UltraFiber 500 automated dispenser only requires a stable base, electrical hookups, and compressed air.

SPEED & ACCURACY

UltraFiber 500 automated dispensers have a high feed rate and can satisfy as much as 10 cy of concrete in a minute. High capacity storage holds enough fiber for over 1000 cy at a 1.5 lb./cy rate. 600-lb. super sacks and convenient loading designs make it easy to refill in a matter of minutes.



The UF500 Automated Gen2 Dispenser

Our UltraFiber 500 Automated Gen2 Dispenser brings higher safety standards to the simple and highly successful original design, allowing for top or front loading. It allows for lifts from the bottom of the sack to a 4' height, from above the sack or over the top of the bin. When frontloading, there is no need to empty the super sack, as this design allows for gravity

feed directly from the bottom of the bag. Whether front loading through the locking weatherproof doors, or using the included hanger rack to refill, your operators can refill the system safely and easily. New technology features, such as flow detection of the fiber and low voltage wiring, also make the system easier to install and increases reliability and operation.

AUTOMATED ULTRAFIBER CABINET DISPENSER SPECIFICATIONS:

- 1000 lb. capacity
- Feed rate: Approx 15 lbs./min
- Max auger length: Up to 100'
- Max auger angle: 60 degrees

FOOTPRINT

- Height: 108"
- Length/width: 52" x 52"

REQUIREMENTS

- Base: 5'x 5' concrete pad for stability
- Electricity: 110 V, 15 AMP
- Compressed air
- Electrician, man-lift and welder at installation (provided by customer)

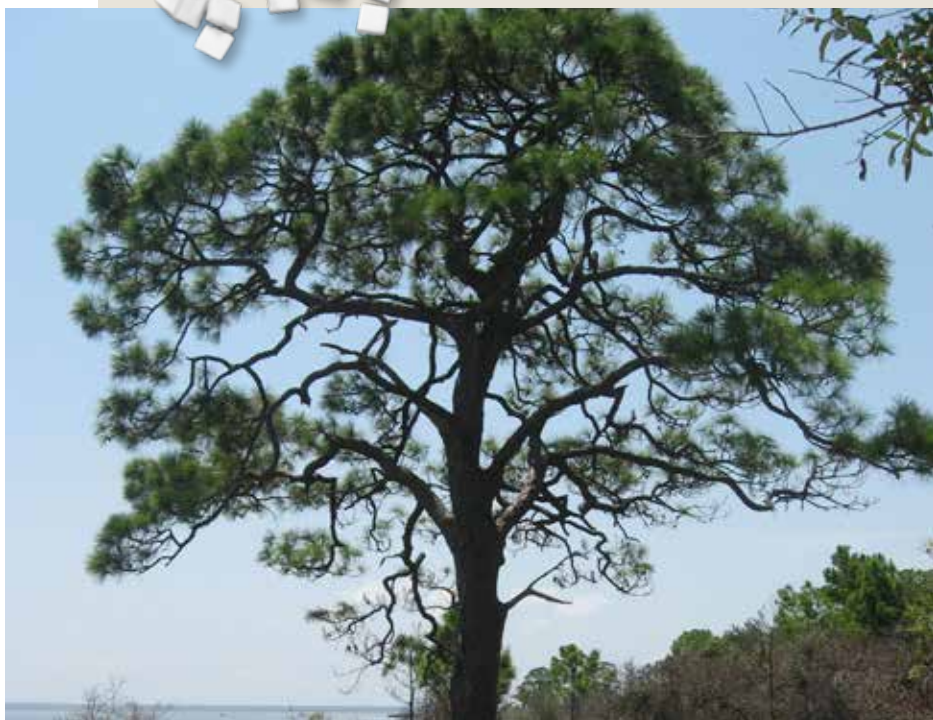


Dispensing Equipment & Packaging



UltraFiber 500®: Packaging Options

- Bulk Bags, 600 lb sacks;
2 sacks per pallet
- 1 lb water-soluble bags;
30 bags per box
- 1.5 lb water-soluble bags;
20 bags per box
- 300 gram water-soluble bags,
metric sized; 45 bags per box
- 32 boxes of bags per full pallet



UltraFiber 500®: Sustainability

100% of the cellulose in UltraFiber 500 is sustainably sourced from responsibly managed forests. For every tree harvested to make UltraFiber 500, several more are planted in its place. Using UltraFiber 500 actively promotes healthy, growing forest ecosystems that help the environment and animal habitats.

Unlike synthetic fibers derived from polluting, nonrenewable petroleum, the cellulose fibers in UltraFiber 500 help the environment. Trees absorb carbon dioxide found in the atmosphere. These greenhouse gasses are essentially sequestered in the concrete when UltraFiber 500 is used. Not only does UltraFiber 500 improve concrete, it helps protect the environment and manage natural resources.



UltraFiber 302®: Natural Cellulose Fiber Blend with CFS Cold Drawn Steel Fibers

ADVANTAGES

ACI 302 recognizes the benefits of using a natural cellulose micro fiber and steel fiber blend to reduce early age plastic shrinkage and provide long term crack control. Additionally, this fiber blend improves the tensile strength/capacity of the concrete. UltraFiber 302 Blend can replace traditional continuous steel for temperature and shrinkage reinforcement. UltraFiber 500 is the fiber of choice for decorative concrete and is a proven performer, reducing plastic drying shrinkage in residential, light commercial, overlays and structurally reinforced concrete. CFS 150-5 steel fibers have long been a solution for longer term concrete crack control and added tensile capacity in the same applications. Combining these two fibers creates peace of mind in overlays and traditional 4" to 6" building slabs and pavement designs within ACI joint guidelines.

PRODUCT USES

Commercial pavements, pervious pavements, bridge decks, steel decks, overlays & industrial slabs.

MIX CONSIDERATIONS & ADDITION

UltraFiber 302 Blend requires mechanical mixing, generally accomplished by incorporating it into the mixer truck drum. UltraFiber 302 Blend generally does not require any special admixtures or additional water.

COMPATIBILITY

UltraFiber 302 Blend is compatible with all commonly used concrete admixtures and traditional mix designs. No additional admixtures are required for workability.

DOSAGE

The standard dosage of UltraFiber 302 Blend is one 16.5 lbs. (7.48 kg) bag per cubic yard of concrete.

FINISHING

UltraFiber 302 Blend can be placed and finished using traditional tools, equipment and techniques. It is ideal for pumping, vibrating screeds, laser screeds, troweling equipment and hand tools.

GUIDELINES

UltraFiber 302 Blend is a secondary reinforcement that reduces plastic shrinkage, drying shrinkage, and crack retention. It will not replace structural or load bearing reinforcement. UltraFiber 302 Blend is not intended to be used in thin slab sections or to extend joint spacing past that which is recommended by ACI.



PACKAGING

- Easy-to-use 16.5 lbs. (7.48 kg) water-soluble bags
- One bag per cubic yard
- Renewable materials & environmentally friendly