With **Synthetic Concrete Reinforcement Products from FORTA Corporation**, you can control cracking and add long-term durability to a wide variety of concrete applications. Since FORTA's beginning in 1978, its fibers have played an important role in the design and construction of many different types of projects, including airports, tennis courts, swimming pools, warehouses and public schools.

More than a product manufacturer, FORTA Corporation is a worldwide leader in synthetic fiber research and development. From a single grade of fiber, FORTA has expanded its product line to include an entire family of reinforcement fibers, each tailored to specific applications and demands of the international concrete community. Coupled with a dedicated and knowledgeable management, staff and workforce, FORTA Corporation will continue to lead the way in building a better and more durable concrete future.

**SPECTRUM OF FORTA PRODUCTS:**

1) **MACRO-FIBERS**

   - **FORTA- FERRO**

FORTA-FERRO® is an easy-to-finish, color blended fiber, made of 100% virgin copolymer/ polypropylene consisting of a twisted bundle non-fibrillating monofilament and a fibrillating network fiber, yielding a high-performance concrete reinforcement system. FORTA-FERRO® is used to reduce plastic and hardened concrete shrinkage, improve impact strength, and increase fatigue resistance and concrete toughness. This extra heavy-duty fiber offers maximum long-term durability, structural enhancements, and effective secondary/temperature crack control by incorporating a truly unique synergistic fiber system of long length design. FORTA-FERRO® is non-corrosive, non-magnetic, and 100% alkali proof!

This patented fiber is actually a blend of two fibers:

1) A standard fibrillated polypropylene fiber to reduce and control shrinkage and temperature cracking

2) A very heavy-duty twisted-bundle monofilament fiber made of a strong synthetic copolymer, to increase load-transfer and post-crack performance. This pre-blended fiber is typically used in long lengths (2-1/4”) and in high dosages (5 to 30 lbs./cubic yard) to affect a higher replacement level of
reinforcing steel than standard synthetic fibers. FORTA-FERRO®, which means "Strong As Steel", is also extremely user friendly, having gained a reputation as the best mixing and finishing fiber of its kind in the industry.

APPLICATIONS

FORTA-FERRO® has been tested by scores of agencies, laboratories, and testing facilities in a wide variety of performance areas, such as toughness, impact resistance, flexural strength, and residual strength. FORTA-FERRO® has also been compared in residual strength (ASTM C-1399) to the major brands of steel fibers, resulting in an average replacement value of 1:10 (FORTA-FERRO®: steel fibers). FORTA-FERRO® has been involved in composite-product vacuum testing in precast tanks and boxes, and tested under crushing loads in vaults and manholes. This laboratory and real-world field testing has allowed FORTA-FERRO® to gain widespread acceptance and use in septic tanks, burial vaults, manholes, and other precast products where the reduction of steel and placement labor has resulted in a sizable savings to the producer. And FORTA-FERRO® has also been used in scores of flatwork projects as well to reduce and/or eliminate the need for reinforcing steel, such as streets, bridge decks, and manufacturing and commercial floors. Continuing research programs and pilot field trials are also being performed to investigate the possibilities of joint-space extension and reduction, due to the tremendous reduction in shrinkage and slab curling afforded by these high-volume, high-strength fibers.

INSTALLATION

Recommended dosage rate of FORTA-FERRO® is 0.2% to 2.0% by volume of concrete (3 to 30 lbs. per cubic yard) added directly to the concrete mixing system during, or after, the batching of the other ingredients and mixed at the time and speed recommended by the mixer manufacturer (usually four to five minutes).

PHYSICAL PROPERTIES

- **Materials:** Virgin Copolymer/Polypropylene
- **Form:** Monofilament/Fibrillated Fiber System
- **Specific Gravity:** 0.91
- **Tensile Strength:** 83-96 ksi. (570-660 MPa)
- **Length:** 2.25" (54mm), 1.5" (38mm)
- **Color:** Gray
- **Acid/Alkali Resistance:** Excellent
- **Absorption:** Nil
- **Compliance:** A.S.T.M. C-1116

---

- **FERRO GREEN**

FRP FIBER REINFORCED PERVIOUS

Pervious concrete has been used in many countries for many years, and is now becoming more than just an oddity in the United States. The impetus behind this surge in application is a growing need to take full advantage of shrinking building sites, and to accommodate storm-water runoff in the process. Inherent to the air-void nature of pervious, or porous concrete, is the potential for a lack of durability and toughness, which often impacts application choices and project volume. Experts in the art of pervious materials and practice have long sought out ways to improve the material’s durability, and to add to the
long-term comfort level of owners that choose it and architects that specify it. Synthetic fibers have been tested and used for many years to add an element of crack control, however these fibers have been somewhat limited by shape and dosage, and have not offered a contribution level that could be considered as significant to this long-term durability goal. The advent of second-generation synthetic macro fibers has opened a door of opportunity for this application, one that continues to morph and change with new project experience and laboratory study.

2) FIBRILLATED MICROFIBER CONCRETE REINFORCEMENT

- **ULTRA-NET**

FORTA ULTRA-NET is an easy to finish, color blended, fully oriented, 100% virgin homopolymer polypropylene fiber reinforcement for concrete in a unique twisted-bundle, collated fibrillated (network) form. FORTA ULTRA-NET is used to reduce plastic and hardened concrete shrinkage, improve impact strength, increase fatigue resistance and concrete toughness. This extra heavy-duty fiber offers ULTRA-NETWORKING power, maximum long-term concrete durability, and true secondary/temperature control by incorporating a fibrillated pattern and long length option. Non-corrosive, non-magnetic and 100% Alkali Proof!

- **SUPER-NET**

FORTA SUPER-NET is an easy to finish, color blended, fully oriented, 100% virgin homopolymer polypropylene fiber reinforcement for concrete in a collated fibrillated (network) form. FORTA SUPER-NET is used to reduce plastic and hardened concrete shrinkage, settlement cracking, improve impact strength, increase fatigue resistance and concrete toughness. This heavy-duty fiber offers SUPER-NETWORKING power, long-term durability, and true secondary/temperature control by incorporating a fibrillated pattern and long length option. Non-corrosive, non-magnetic and 100% Alkali Proof!

- **ECO-NET**

FORTA ECONO-NET is an easy to finish, fully oriented, 100% virgin homopolymer polypropylene fibrous reinforcement in a collated fibrillated (network) form. FORTA ECONO-NET is used to reduce plastic and hardened concrete shrinkage, improve impact strength, increase fatigue resistance and concrete toughness. This medium-duty fiber offers good-bonding power, long-term concrete durability, and true secondary/temperature control by incorporating a fibrillated pattern and long length option. Non-corrosive, non-magnetic, chemically inert, and 100% Alkali Proof!

3) MONOFILAMENT MICROFIBER CONCRETE REINFORCEMENT

- **MIGHTY-MONO**

FORTA MIGHTY-MONO is an easy-to-finish, fully oriented, 100% virgin homopolymer polypropylene monofilament fibrous reinforcement. This fiber offers long-term concrete durability, and increased impact resistance. FORTA MIGHTY-MONO is used to reduce plastic and settlement shrinkage. Non-corrosive, non-magnetic, chemically inert, and 100% Alkali Proof!
• **NYLO-MONO**

FORTA NYLO-MONO is an easy-to-finish, fully oriented, 100% virgin nylon fibrous monofilament designed to function as a plastic shrinkage reinforcement intended to reduce shrinkage cracks prior to initial set and to reduce settlement shrinkage. Non-corrosive, chemically inert, and resistant to alkali attack.

• **ECONO-MONO**

FORTA ECONO-MONO is an easy-to-finish, fully oriented, 100% virgin homopolymer polypropylene monofilament fibrous reinforcement. This economy grade fiber offers long-term concrete durability, and functions as a plastic shrinkage reinforcement intended to reduce the formation of shrinkage cracks prior to initial set and to reduce settlement shrinkage. FORTA ECONO-MONO is non-corrosive, chemically inert, and 100% Alkali Proof!

---

**4) SPECIALTY FIBERS FOR CONCRETE REINFORCEMENT**

• **STUCCO-BOND**

FORTA STUCCO-BOND is an easy to apply and finish, fully oriented, 100% virgin homopolymer polypropylene monofilament fibrous reinforcement for concrete. This engineered fiber provides a mini-reinforcing system forming a more cohesive, inner-supported mix that functions as a plastic shrinkage reinforcement intended to reduce shrinkage cracks prior to initial set. FORTA STUCCO-BOND is non-corrosive, non-magnetic, chemically inert, and 100% Alkali Proof!

• **CAST-MASTER**

FORTA CAST-MASTER is an easy to place, fully oriented, 100% virgin homopolymer polypropylene fibrous reinforcement. FORTA CAST-MASTER is a fiber specifically designed and engineered by FORTA for the precast concrete industry. It is used to reduce plastic and hardened concrete shrinkage, improve impact strength, reduce handling stresses, and increase fatigue resistance and concrete toughness. This extra heavy-duty fiber offers optimum bonding power, maximum long-term concrete durability, sharper edge control and quick and uniform fiber distribution by incorporating a unique twisted-bundle fiber technology with a fibrillated pattern and long length fiber option. Non-corrosive, chemically inert, and 100% Alkali Proof!

• **ECONO-CAST®**

FORTA® ECONO-CAST® is an easy to place, fully oriented, 100% virgin homopolymer polypropylene fibrous reinforcement. FORTA® ECONO-CAST® is a fiber specifically designed and engineered by FORTA® for the precast industry. It is used to reduce plastic and hardened concrete shrinkage, improve impact strength, reduce handling stresses, and increase fatigue resistance and concrete toughness. This medium-duty fiber offers superior bonding power, long-term durability, and sharper edge control by incorporating a fibrillated pattern and long length fiber option. Non-corrosive, chemically inert, and 100% Alkali Proof!
• **GREEN-NET®**

FORTA® GREEN-NET® is made from 100% recycled polypropylene. It is an easy to finish polypropylene fibrous reinforcement in a collated fibrillated (network) form. FORTA® GREEN-NET® is used to reduce plastic and hardened concrete shrinkage, settlement cracking, improved impact strength, increase fatigue resistance and concrete toughness. This heavy-duty fiber offers long-term durability, and true secondary/temperature control by incorporating a fibrillated pattern and long length option. Non-corrosive, non-magnetic, 100% alkali proof, and 100% recycled.

• **FORTA ULTRA-LITE®**

FORTA ULTRA-LITE® is a specially treated, 100% virgin homopolymer polypropylene monofilament fiber that provides unique suspension characteristics in a variety of cementitious mixes and applications. Due to the special patent-pending fiber treatment, FORTA ULTRA-LITE® offers valuable suspension capabilities to gasified or aerated cementitious products, acting as a stabilizing and cohesive agent in very flowable lightweight mixes. In addition, FORTA ULTRA-LITE® contributes considerable reductions of plastic and settlement shrinkage that are common to these mixes and applications.

• **PE-2®**

FORTA® PE-2® fiber is an easy to apply, fully oriented, 100% virgin copolymer polyethylene monofilament fibrous reinforcement. This engineered fiber provides a mini-reinforcing system forming a more cohesive, inner-supported mix intended to reduce the formation of shrinkage cracks prior to initial set, as well as provide a rapid burn-out characteristic in the hardened mass after initial set as well as provide a rapid burn-out characteristic in the hardened mass after initial set. FORTA® PE-2® fiber is non-corrosive and non-magnetic.

---

**5) TRANSPORT SYSTEMS FOR CONCRETE REINFORCEMENT FIBERS**

• **THE BIG SHOT**

The Big Shot® fiber transport system was designed to quickly and safely move synthetic fiber reinforcement from ground-level storage to upper-level concrete batching systems and concrete mixer trucks. The Big Shot® provides a simple and inexpensive way to add pre-weighed bags or even loose fiber to almost any concrete mixing system. With no moving parts and minimal, if any maintenance, this system requires only PVC pipe, a few hangers, and a supply of compressed air.

• **VM FIBER FEEDER**

The ELITE II is an automated dosing system for pre-chopped synthetic fiber. The system dispenses fiber by weight. The ELITE II bin is divided into two sections allowing the dispenser to deliver two types of fiber. The fiber is then delivered, pneumatically, anywhere in the plant it is required.
6) FLOWABLE FILL

FORTA® GoldenAir® Flowable Fill concrete mixes may be formulated to a wide range of flow, strength, and weight characteristics. Rather than searching for soil of a specific density, trucking it to the jobsite, trying to artificially control the water content, compacting with equipment, and facing quality control problems, simply fill the excavated void and all its small fissures completely with easy-to-use FORTA® GoldenAir® flowable fill.

FORTA - APPLICATIONS

A) CONCRETE TUNNELING & MINING

FORTA non-corrosive fibers have been used in a wide variety of air-placed concrete projects as a valuable performance-rated reinforcement that is extremely easy to add, mix, and shoot. In both above-ground artificial rock and waterscapes, and underground tunnel linings, the noncorrosive characteristic of FORTA-FERRO is extremely attractive. FORTA-FERRO has also been used successfully in thousands of cubic yards of wet-mix shotcrete that were produced from pre-blended dry-bagged materials, primarily in underground tunnel projects.

High dosages of polypropylene fibers have actually been utilized in shotcrete projects for many years, including the tunnel wall at the Oldman River Dam in southern Alberta, Canada. In this case, 10.1 lbs. of the FORTA polypropylene fiber served as a user-friendly and performance-surpassing alternative to the 118 lbs. of steel fiber per cubic yard that had been used to start the project. The synthetic fibers also eliminated any risk of injury from rebounding fibers, and were easy to add, mix, and shoot, without build-up in the mixer trucks or shotcrete lines.

Underground tunnel projects have become the largest volume users of the FORTA-FERRO structural fiber in shotcrete applications for municipalities, wineries, railroads, and utility companies. FORTA-FERRO’s non-absorptive and non-corrosive characteristics are very valuable in these underground project conditions both here in the United States and abroad.
B) SEPTIC TANKS

Three-dimensional synthetic fiber reinforcement for concrete provides an alternative handling/temperature reinforcement to labor-intensive wire mesh in precast applications. Our second-generation synthetic fiber, FORTA-FERRO, offers improved benefits that affect the actual structural properties of the concrete itself. This fiber truly lives up to its name, which means "Strong As Steel."

FORTA-FERRO has played an important role in the recent changes and development of testing and performance of precast septic tanks, allowing the tank-producing industry to realize a valuable goal in producing durable and cost-effective steel-free products.

In fact, FORTA-FERRO is approved by most states and sanitation districts for use in septic tanks. Please call your FORTA representative for information related to local guidelines in your service area, or for engineering services available.

C) MANHOLE AND CATCH BASINS

Structural synthetic fibers have gained alternate reinforcement approval in several areas of the United States, using the vacuum test process as a method to show compliance with ASTM and NPCA standards. Specifically, FORTA-FERRO has been proven to be an acceptable fiber reinforcement alternative to the normal rebar and/or wire mesh reinforcement.

As a starting point, in July of 2002, FORTA-FERRO was tested in Opelika, Alabama, at a dosage rate of 4.0 lbs per cubic yard of concrete. Alabama Precast and Pipe Supply LLC produced the standard manhole used for testing. The FORTA-FERRO-reinforced concrete reported a minimum strength of 4,000 psi at 28
days. ASTM C-1244 "Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure" was used to determine performance levels of the fiber-reinforced manhole. With no visible cracks during or upon completion of the test, the FORTA-FERRO-reinforced manhole held 10 inches of mercury for two minutes with no loss of vacuum, thereby exceeding any local and national code performance levels.

Since that time, numerous additional tests have been conducted around the country with similar results. FORTA-FERRO is approved by many states for use in manhole-related products.

D) SLAB ON GRADE

Benefits of Using Synthetic Fiber in Flatwork Concrete

- Synthetic fibers reduce plastic shrinkage cracking.
- Synthetic fibers increase impact resistance.
- Synthetic fibers provide three-dimensional reinforcement.
- Synthetic fibers reduce bleed water.
- Synthetic fibers increase abrasion resistance.
- Synthetic fibers arrive at the job site already in place.
- Synthetic fibers do not present any safety issues during placement.
- Synthetic fibers do not corrode
- Possible joint expansion.

History of Synthetic Fiber Reinforcement in Slab on Grade Concrete

FORTA Corporation introduced synthetic fiber reinforcement to the U.S. concrete market in 1978. The first of its kind in the industry, FORTA offered a variety of fiber characteristics - shape, length, chemistry, and dosage - to perform at varying levels of crack control in many concrete applications. Generally, short monofilament (angel-hair) fibers have been used at a dosage of 1.0 lb. per cubic yard to reduce plastic shrinkage cracking prior to the concrete’s initial set. Heavier fibrillated (net-shaped) fibers have been used at a higher dosage of 1.5 lbs./cubic yard to reduce plastic and hardened concrete shrinkage cracking and add durability as a viable alternative to conventional temperature steel such as wire mesh. These fiber types have enjoyed scores of successful flatwork project applications for over 30 years.

Next-Generation Fiber Today

FORTA has continued to strive for a higher level of performance by maximizing each of the critical fiber characteristics that contribute to that performance. After years of research and development, FORTA
introduced this next-generation fiber - **FORTA-FERRO®** - that is capable of a much higher replacement level of steel reinforcement.

---

**E) SLAB ON METAL DECK**

For more than 30 years, FORTA reinforcing fibers have been used in elevated slab concrete applications with much success. Designers and specifiers have discovered that cost savings are dramatic when FORTA three-dimensional fibers are used as an alternative to wire mesh reinforcement. The handling of the wire mesh, time necessary to place it, and additional provisions required during concrete placement to ensure the safety of the workers and equipment, all combine to justify the use of FORTA's family of fibers.

One characteristic important when considering fiber reinforcement in elevated slab applications is an appropriate fire rating (U/L Certification). FORTA's monofilament fibers and fibrillated fibers are approved at a dosage rate of 1.5 pounds per cubic yard for use in D700 and D800 series decks as an alternate or in addition to welded wire fabric. **FORTA-FERRO** macro synthetic fibers are approved for usage in all D700, D800 and D900 series decks as an alternate to welded wire fabric at a dosage rate up to 5.0 pounds per cubic yard.

---

**F) BURIAL VAULTS**

First generation reinforcement fibers for concrete have been used in precast burial vaults for nearly 30 years. These fibers, intended as crack-control reinforcement, were typically used at relatively low dosages of 1.0 - 1.5 pounds per cubic yard of concrete.

FORTA improved upon these fibers, offering second-generation structural synthetic fibers that combine heavier filaments, special chemistries, long lengths, and higher dosages to allow for a higher replacement of conventional steel reinforcement. These second-generation fibers, **FORTA-FERRO**, have been used around the country to improve the overall performance of burial vaults while eliminating the need for most traditional steel reinforcement.
For more information please contact

A.Sreekumar,
Marketing Manager

House of Development for Agricultural Contracting Co., W.L.L.
KUWAIT
Tel: +965-24758084/24756065 xtn 105
Fax: +965-24759853/22421713
Mobile: + 965-99714957
Website: www.hodagri.com