EUCLID CHEMICAL

TUF-STRAND SF
FIBRE-REINFORCED CONCRETE

Macro Synthetic Fibre Solutions for Fibre-Reinforced Concrete (FRC) Construction

Part of TREMCO
Construction Products Group


LONDON
1011T 95
TUF-STRAND SF

Introducing Tremco Construction Products Group

We know that the success of a construction project relies on more than the products that are used, as it takes a lot of skill, knowledge, understanding, and expertise to ensure that those products are applied in the best way possible.

At Tremco Construction Products Group (CPG), we're committed to shaping the future through innovative approaches and sustainable solutions.

This commitment is backed up by the fact that we bring together first-class technology with a customer-focused approach, along with skills that have been built up over multiple decades within very specialised fields across Asia Pacific, to provide a truly unique service.

From joint sealing, façade bonding and insulation through to passive fire protection, performance resin flooring, waterproofing, and roofing solutions — our broad range makes us the ideal partner to solve the complex challenges faced by today's architects, contractors, developers, and trades.

With expertise in a range of product technologies, Tremco CPG provides solutions to help you engineer structures that are more efficient to build and maintain, are virtually impervious to the elements, and can provide a multitude of finishes.

Introducing The Euclid Chemical Company

For more than 100 years, The Euclid Chemical Company has served as a leading supplier to the concrete and masonry industry, offering a full line of engineered concrete admixture and construction products marketed under the EUCO brand name. These products include concrete admixtures, block and masonry additives, curing and sealing compounds, epoxy adhesives, floor and wall coatings, structural grouts for columns, equipment and machinery, joint fillers and repair products. The Euclid Chemical Company strives to bring innovative technologies and products to the concrete market with industry-leading customer service. Euclid Chemical is a brand of Tremco Construction Products Group, a global manufacturer and service provider of high performance building materials.


PAUCH
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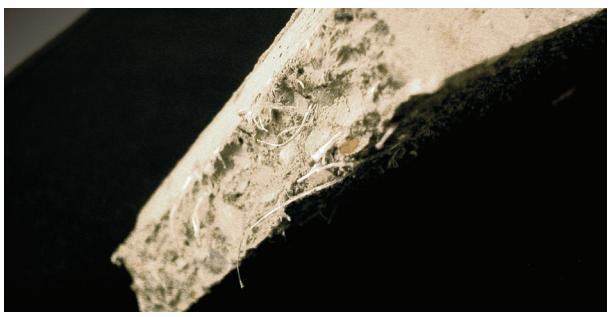
TUF-STRAND SF

Polypropylene/Polyethylene Macro Synthetic Fibres

TUF-STRAND SF is a patented, macro-synthetic fibre specifically engineered for use as a replacement to conventional reinforcement such as wire mesh and steel rebar for slabs on ground, precast concrete, composite steel decks and shotcrete applications. Engineered dosage rates are based on strength-to-strength calculations and supported by standardised test methods and industry practices. This non-corroding, three dimensional reinforcement will also provide abrasion, fatigue and impact resistance while increasing service life through improved toughness and durability.

Features & Benefits

- Equivalent strengths to Welded Wire Mesh (WWM) and rebar provided by engineering calculations
- Controls and mitigates plastic shrinkage cracking and reduces segregation and bleed-water
- Provides three-dimensional reinforcement against micro and macro-cracking
- Reduces equipment wear, fibre rebound and increases build-up thickness compared to steel fibres for shotcrete applications
- Increases overall durability, fatigue resistance and flexural toughness
- Reduction of in-place cost versus wire mesh for temperature/shrinkage crack control
- Easily added to concrete mixture at any time prior to placement



Rigid Concrete Pavements/Roads

Fiber-Reinforced Concrete using TUF-STRAND SF offers a cost-effective, sustainable solution for resurfacing and rehabilitating existing pavements and bridge decks. American State DOTs and other transportation agencies are promoting macro-synthetic fibers and developing performance-based specifications for overlays and full depth replacement systems to increase service life and reduce long-term maintenance costs.

By using macro-synthetic fibers, the expense and installation time of conventional reinforcing are eliminated while providing a concrete that is easily placed with a reduction of the environmental impact on the jobsite.

TUF-STRAND SF can be used to produce high flexural strength pavement quality concrete and can be placed by paving machine. This will enhance the long term durability with increased flexural strength and toughness. This allows to reduce the overall thickness of the pavement, thus reducing the construction cost with huge positive impact on the environment due to lower usage of cement and aggregates. Lower pavement thickness also translates to faster construction process and reduced vehicular movement, another direct positive impact to the environment.

Increase Speed, Improve Safety, and Design Sustainably

Reinforcement is supplied by the concrete producer to provide a more durable and longer-lasting concrete with reduced evironmental impact.

Concrete Mix Design

Experienced assistance to develop mix designs in combination with chemical admixtures, cement additives, air entrainment and other specialty products.

Engineered Calculations and Specification Development

Design aids and mobile tools to determine correct dosage rates with specification review for correct fiber selection and performance.

Fiber Resources

Technical and marketing materials for the education and training of owners, engineers, contractors and ready-mix producers.

Projects with TUF-STRAND SF for rigid concrete pavements/road applications

Slab-on-Grade (Based on ACI 360)

Reinforcement is used in slabs on ground/grade to improve performance of the slab under certain conditions. These include: limiting width of shrinkage cracks; use of longer joint spacing than unreinforced slabs; and providing moment capacity and stability at cracked sections. The use of reinforcement will not prevent cracking, but will actually increase crack frequency while reducing crack widths. Crack width is controlled through redistribution of stresses. Properly proportioned and positioned, reinforcement will limit crack widths such that the cracks will not affect slab serviceability. Slab reinforcement can consist of bars, wire mesh or macro fibers (steel or synthetic). Reinforcement (rebar, mesh, or macro fibres) also imparts post-cracking residual strength to the slab.

Macro fibres are used at dosage rates required to provide post cracking residual strength equivalent to that of the rebar or mesh that is being replaced. These dosage rate typically ranges from 1.8–7.2 kg/m^3 for macro synthetic fibres for slabs on grade.

Depending on the quantity of the required reinforcement, various levels of post-crack residual strength may be used for calculating the fibres dosage rate. For example, W1.4 × W1.4 – 6″ × 6″ (150mm x 150mm) wire mesh in a 6″ (150mm) slab on grade provides a reinforcement ratio of 0.04% which only serves in controlling shrinkage/temperature cracks. In this case, the residual strength ratio, $R_{e,3}$ is about 6%. The minimum dosage rate for macro synthetic fibres is 1.8 kg/m^3 that can provide the same (in fact better) crack control. However if the designed reinforcement is No. 4 bars @12″ (300mm) o.c., then the reinforcement ratio is 0.27%. The residual strength ratio, $R_{e,3}$ is approximately 38%. In this case the dosage rate for TSSF fibers would be about 3.6 kg/m^3. ASTM C1399, C1550, and C1609 provide quantitative measures that are useful in evaluating performance of synthetic FRC in the hardened state. The results of these test methods can be used to optimise the proportions of fibres-reinforced concrete.

The addition of macro synthetic fibres to concrete slabs also provides the benefits of improved durability and long term performance, and an increase the resistance of concrete slabs to fatigue, impact and abrasion. Concrete with synthetic fibres does not require a cover for reinforcement and, therefore, the thickness can potentially be reduced based on the design calculations **(FIGURE 1)**.

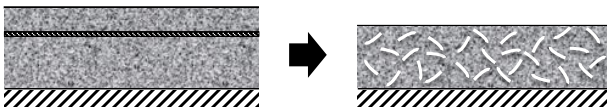


FIGURE 1
Potential reduction in slab thickness when macro fibres are used at higher dosage rates.

Projects with TUF-STRAND SF for slab on ground applications

FedEx distribution center (warehouse floor and loading dock), Bell, CA. More than 20,000m^2 sqft of slab on grade was reinforced with 3.0 kg/m^3 TUF-STRAND SF.

Yankee Stadium, Bronx, NY. Slab on grade and elevated slabs were reinforced with 2.4 kg/m^3 TUF-STRAND SF (40,000m^2)

Canal lining, Bakersfield, CA. The 6″ poured concrete was reinforced with 5.4 kg/m^3 TUF-STRAND SF to replace #5 @ 12″ (300mm) bars (Fast-track construction).


ROBEX200W-2

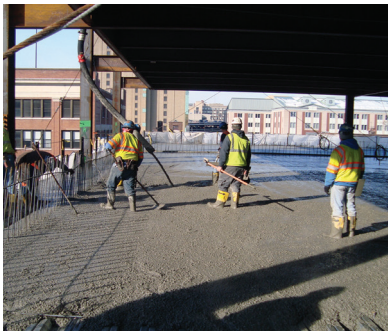
Composite Steel Decks

Where steel reinforcement is used for the concrete in a composite steel deck, a minimum cover of 50 mm is required. This reinforcement is typically considered for controlling shrinkage/temperature cracks ($A_s < 0.075\%$) and may be replaced with macro synthetic fibres. According to the Steel Deck Institute (SDI), synthetic fibres are allowed at a minimum dosage rate of 2.4 kg/m^3. In many projects, a UL approval is required for a 2-hour fire resistance for a composite steel deck. TUF-STRAND SF fibre has been tested under loads for fire rating and been certified with a UL approval at a minimum of 2.4 Kg/m^3 for D900 series deck design.

It should be noted that the steel deck does not function as a compression reinforcing steel in areas of negative moment. If a continuous slab is desired, the negative reinforcement must be designed using conventional reinforcement based on ACI 318 or other building codes. Published full scale test results have shown that shrinkage/temperature steel does not contribute to the structural performance of the shear diaphragms (unless they are connected to the shear studs). These studies also show that macro fibres can provide similar expected performance (or even better) to that of the shrinkage/temperature steel. Another important benefit of using FRC in lieu of steel mesh for composite steel decks is improved job safety and reduced risk of tripping for the construction workers.

Projects with TUF-STRAND SF for composite steel deck applications

Mercedes Benz- Scottsdale, AZ.
TUF-STRAND SF at 3.0 kg/m^3.



Prudential Tower- Newark, NJ
TUF-STRAND SF at 2.4 kg/m^3.

Precast Units

Using fibres in precast units is a popular choice by many producers due to its technical and economic benefits. A variety of precast units can be made with fibres-reinforced concrete. These include but are not limited to: structural segments (sound barrier walls, deck panels, tunnel lining), units used in water/waste management (pipes, septic tanks, nuclear waste tanks, flood retention), containers (burial vaults, storm shelters, utility boxes, garage/storage rooms), and decorative units (urban furniture, home furniture, wall panels, shades).

In some cases with heavy reinforcement, while it may not be possible to completely replace the steel reinforcement, there may be the potential to reduce the amount of steel when hybrid systems (steel bars+fibres) are used.

For heavier reinforcements and structural applications, macro fibres can be used at higher dosage rates to replace steel rebars.

Many precast units have relatively thin sections and/or heavy steel reinforcement. Therefore, placing steel rebar/mesh and pouring a good quality concrete can be time consuming and challenging.

Reinforcing with fibres allows for better automation of the production process, enhanced quality control, and improved characteristics of the final products. Also, by performing engineering calculations for the equivalent flexural capacity, the thickness of heavier units can be decreased when fibres are used at elevated dosages.

Another potential for reducing the thickness is the elimination of minimum concrete cover that is required for preventing corrosion of the steel reinforcement.

Projects with TUF-STRAND SF for precast unit applications

Typical precast concrete units made with macro fibres in lieu of steel rebar.

Shotcrete

New Construction

Fibre-reinforced shotcrete construction can often be completed faster and more economically than other conventional construction techniques for the reduced time associated with installation, inspection, and construction of steel shapes. For this reason, a growing number of new construction projects select this method because of the reduced costs, increased safety, and fast-track construction when steel reinforcement is eliminated.

Soil & Rock Excavations

Soil and rock excavations can effectively be stabilised with fibre-reinforced shotcrete. Shotcrete is ideal for ground support in tunneling and mining. With early development in compressive and flexural strength and toughness, fibre-reinforced shotcrete provides early ground support after blasting or excavating. This can provide flexibility to allow for ground stabilisation and the ability to conform to the natural irregular profile of the ground without formwork.

Underground Structures

Fibre-reinforced shotcrete can be used as a final or permanent lining for underground structures. Using fibre-reinforced shotcrete to eliminate most of the steel reinforcement for pools is a more recent development in the industry. This material is especially suitable for pools and skate parks with many curves, as it is shot against excavated soil, eliminating the cost of forms and steel installation. The flexibility of placement that fibre-reinforced shotcrete affords allows every pool owner to have a uniquely shaped pool.

Repair & Restoration

Fibre-reinforced shotcrete is an ideal technique when repair and restoration are being contemplated. From canals and pools to retaining walls and hydraulic structures, the opportunities are countless. In many cases, when fibres are used in repair shotcrete, the need for cutting and placing steel reinforcement for the repair areas is eliminated and the job can be done faster and at less cost.

Comparison with Steel Fibres

- Macro Synthetic Fibre reduces rebound waste approximately from 25% to 5% compared to steel fibre.
- Reduces equipment wear (eg. concrete mixer, trucks and pumps)
- Increases the buildup thickness compared with steel fibre.

Projects with TUF-STRAND SF for shotcrete applications

Fibre-reinforced shotcrete used for construction of a new swimming pool, Jacksonville, FL. TUF-STRAND SF at 3.6 kg/m^3.

Fibre-reinforced shotcrete used for the repair of a water canal, Phoenix, AZ. TUF-STRAND SF was used at a dosage of 3 kg/m^3.

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Tremco Construction Products Group (CPG) represents the combined power of brands including Dryvit, Nudura, Willseal, and Tremco, along with Tremco CPG affiliates Flowcrete, illbruck, Nullifire, Vandex, Euclid Chemical and USL Brands.

Our products and services empower teams to develop, design, restore and engineer structures that are more efficient to build and maintain, are virtually impervious to the elements and can provide any look desired.

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