

{Note to Specifier: The paragraphs below are meant to be incorporated into Parts 2 and 3 of a standard CSI 3 Part Format specification, project's General Structural Notes or directly onto the plans. They must be carefully reviewed by a qualified design professional and edited to meet the particular requirements of the project at hand, assure compliance with any governing building codes, and coordinate with other specification sections and drawings. In no case shall these Guide Specifications be considered to be Contract Documents or serve as installation instructions for the product being discussed. In any cases of discrepancy the manufacturer's most recently published data sheet shall take precedent.}

TUF-STRAND SF Synthetic Macrofibers

TUF-STRAND SF is a patented polypropylene / polyethylene synthetic macrofiber successfully used to replace steel fibers, welded wire mesh and conventional reinforcing bars in a wide variety of applications. TUF-STRAND SF fibers are specifically designed to provide equivalent tensile and bending resistance to conventional reinforcement requirements.

PART 1: GENERAL

1._ PRE-CONCRETE MEETING

- A. Prior to the start of concrete placement General Contractor is to conduct a meeting to review required methods and procedures to achieve required concrete placement. General Contractor is to send a meeting agenda to all attendees 20 days prior to scheduled date of meeting.
- B. Responsible representatives of every party concerned with concrete work are to attend meeting, including but not limited to the following: Contractor's Superintendent, Ready-Mix Company, Concrete Contractor, Testing Lab, Fiber Manufacturer Representative, and Owner's Representative.
- C. Minutes of meeting are to be recorded, typed, and distributed by General Contractor to all concerned parties, including but not limited to Owner's representative, Architect, and all attendees within 5 days of the meeting.

{Note to Specifier: Retain "Mockups" Paragraph below if required. If retaining, indicate location, concrete type, and other details of mockups on Drawings or by inserts. Revise wording if only one mockup is required or if mockup of concrete in another location in a building is required.}

1._ MOCK UP

- A. Mockups: Cast concrete **[slab-on-grade] [and] [formed-surface]** panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

{Note to Specifier: Revise size of panel in first subparagraph below if required. Panel for slab-on-grade may need to be enlarged if powered riding trowels are used and if it is a portion of the floor slab.}

1. Build panel approximately **[200 sq. ft. (18.6 sq. m) for slab-on-grade] [and] [100 sq. ft. (9.3 sq. m) for formed surface] <Insert area>** in the location indicated or, if not indicated, as directed by Architect.

{Note to Specifier: Retain subparagraph below if the intention is to make an exception to the default requirement in Section 014000 "Quality Requirements" for demolishing and removing mockups.}

2. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1._ SUBMITTALS

- A. Submit documentation from synthetic macrofiber manufacturer showing that proposed fiber dosage will meet or exceed specified f_{e3} value per ASTM C1609.
- B. Submit ICC Evaluation Service Report from fiber manufacturer indicating that synthetic macrofiber has been tested in concrete to meet the requirements of ICC-AC383.

{Note to Specifier: Insert paragraph below if UL rating will be required}

- C. **<<Where synthetic macrofibers are to be used in composite metal decks, Contractor shall submit UL (ULC) Product Certification that synthetic macrofibers are Underwriters Laboratories (UL) (ULC) rated for Floor-Ceiling D700, D800, and D900 Series Designs for assemblies having a 2-hour maximum fire resistance rating.>>**

{Note to Specifier: Retain "Environmental Product Declaration (EPD) Verify, with manufacturer, that EPDs are available for each product.}

- D. **<<Environmental Product Declaration (EPD): For each product.>>**

PART 2: PRODUCTS

2._ FIBER REINFORCEMENT

- A. Synthetic Macrofiber: Polypropylene/polyethylene synthetic macrofiber complying with ASTM C 1116 Type 3, minimum 2 inch length, aspect ratio 50 to 90.
 1. Basis of Design:
 - a) **Euclid Chemical Company (The); TUF-STRAND SF;
www.euclidchemical.com**
 2. Fiber manufacturer shall have ISO 9001 certification.
 3. Synthetic macrofiber shall be tested in concrete to meet the requirements of ICC-AC383
 4. **<<Provide Environmental Product Declaration (EPD) for Synthetic Macrofiber>>**

2._ CONCRETE MIXTURES FOR BUILDING ELEMENTS

{Note to Specifier: Dosage rates for synthetic macrofiber and steel fiber are calculated based on equivalent residual strength (f_{e3}) values determined through ASTM C1609 flexural beam testing. The f_{e3} value should be equal to or exceed the calculated equivalent residual strength provided by the reinforcing steel that is being replaced. See ACI 544.4R-18 Guide for Design with Fiber-Reinforced Concrete and/or Contact your Euclid representative for assistance in determining appropriate f_{e3} value.}

(f_{e3}) values shown below are based on replacement of temperature and shrinkage steel in the following assembly examples. A table is attached to this specification to show calculated equivalent residual strength various slab on grade designs. See ACI 544.4R-18 Guide for Design with Fiber-Reinforced Concrete and/or Contact your Euclid representative for assistance in determining appropriate f_{e3} value.

4" deep 4,000 psi concrete with 6"x 6" W1.4 x W1.4

6" deep 4,000 psi concrete with 6"x 6" W2.9 x W2.9

8" deep 4,000 psi concrete with #4's at 16" OCEW

A. Synthetic Macrofiber Reinforcement.

1. Synthetic Macrofiber Reinforcement may be used to replace reinforcing steel in concrete slabs on grade and topping slabs where indicated on drawings.
2. Slab on Grade and Topping Slabs: Submit fiber manufacturer's documentation indicating that proposed fiber dosage will provide a minimum F_{e3} value as follows in accordance with ASTM C 1609. Under no circumstances shall dosage rate be less than 3.0 LBS per cubic yard of concrete.

a. Slabs on Grade and Topping Slabs

- 1) 4" deep slab: $f_{e3} = \langle\langle 57 \rangle\rangle$ psi.
- 2) 6" deep slab: $f_{e3} = \langle\langle 78 \rangle\rangle$ psi.
- 3) 8" deep slab: $f_{e3} = \langle\langle 149 \rangle\rangle$ psi.

{Note to Specifier: Synthetic macrofibers do not replace the short rebars placed over beams to control cracks from negative moments nor short rebars at re-entrant corners. The Steel Deck Institute states in ANSI/SDI-C1.0 that any Synthetic macrofiber may be used at minimum dosage of 4.0 pounds per cubic yard of concrete to provide temperature and shrinkage steel reinforcement.}

3. Composite Metal Deck: Uniformly disperse in concrete at minimum dosage rate of 4.0 pounds per cubic yard of concrete per IBC2015 and ANSI/SDI-C1.0. ***\langle\langle as indicated on drawings \rangle\rangle***.

PART 3: EXECUTION

3._ FINISHING FLOORS AND SLABS

- A. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

a. Finish fiber reinforced concrete so as to minimize visible fiber at surface of concrete.

- 1) Broom once in one direction only - such as with a fresno/broom.
- 2) Do not overlap broom strokes.
- 3) Broom finishing shall be timed as necessary to minimize fiber being pulled from concrete.
- 4) Keep broom clean and damp.

- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces **[indicated] [exposed to view] [or] [to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system] <<Insert locations>>**.
 2. Finish fiber reinforced concrete so as to minimize visible fibers at the surface of the concrete.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces **[indicated] [to receive trowel finish] [and] [to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo] <Insert locations>**.
 2. Finish fiber reinforced concrete so as to minimize visible fibers at the surface of the concrete.

3. JOINTS

- A. Contraction Joints in Slabs-on-Grade: Utilizing one of the methods below, form weakened-plane contraction joints, sectioning concrete into areas as indicated.
1. Early Entry Saw - For slabs on grade and topping slabs up to 9 inches thick use an early entry saw to cut control joints to a minimum depth of 1-1/4 inches immediately after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Concrete containing synthetic macrofiber or steel fiber shall be cut to 1/3 slab thickness (d/3).
 2. Conventional Concrete Saw – Use a conventional saw to cut control joints to a minimum depth of 1/4 slab thickness (d/4), or 1/3 slab thickness (d/3) if concrete contains synthetic macrofiber or steel fiber. Begin cutting as soon as possible after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

END GUIDE SECTION

FIBER REPLACEMENT FOR TEMPERATURE AND SHRINKAGE REINFORCING STEEL IN CONCRETE SLABS ON GRADE		
Concrete Slab On Grade Design	Replace with Synthetic Macrofiber ₁ Providing the Following Required Performance per ASTM C1609	TUF-STRAND SF Dosage Rate Lbs/Cubic Yard of Concrete
4" thick SOG with 6" x 6" W1.4 (10 ga) WWF	$f_{e3} = 57$ psi	3.0 lbs per CY
4" thick SOG with 6" x 6" W2.9 (6 ga) WWF	$f_{e3} = 117$ psi	3.0 lbs per CY
4" thick SOG with 6" x 6" W4 (4 ga) WWF	$f_{e3} = 163$ psi	4.0 lbs per CY
4" thick SOG with #3 @ 18" OCEW	$f_{e3} = 149$ psi	3.5 lbs per CY
4" thick SOG with #3 @ 16" OCEW	$f_{e3} = 168$ psi	4.0 lbs per CY
4" thick SOG with #3 @ 12" OCEW	$f_{e3} = 224$ psi	5.5 lbs per CY
4" thick SOG with #4 @ 18" OCEW	$f_{e3} = 265$ psi	7.0 lbs per CY
6" thick SOG with 6" x 6" W1.4 (10 ga) WWF	$f_{e3} = 38$ psi	3.0 lbs per CY
6" thick SOG with 6" x 6" W2.9 (6 ga) WWF	$f_{e3} = 78$ psi	3.0 lbs per CY
6" thick SOG with 6" x 6" W4 (4 ga) WWF	$f_{e3} = 108$ psi	3.0 lbs per CY
6" thick SOG with #3 @ 18" OCEW	$f_{e3} = 100$ psi	3.0 lbs per CY
6" thick SOG with #3 @ 16" OCEW	$f_{e3} = 112$ psi	3.0 lbs per CY
6" thick SOG with #3 @ 12" OCEW	$f_{e3} = 149$ psi	3.5 lbs per CY
6" thick SOG with #4 @ 18" OCEW	$f_{e3} = 177$ psi	4.5 lbs per CY
6" thick SOG with #4 @ 16" OCEW	$f_{e3} = 199$ psi	5.0 lbs per CY
6" thick SOG with #4 @ 12" OCEW	$f_{e3} = 265$ psi	7.0 lbs per CY
8" thick SOG with 6" x 6" W1.4 (10 ga) WWF	$f_{e3} = 29$ psi	3.0 lbs per CY
8" thick SOG with 6" x 6" W2.9 (6 ga) WWF	$f_{e3} = 59$ psi	3.0 lbs per CY
8" thick SOG with 6" x 6" W4 (4 ga) WWF	$f_{e3} = 81$ psi	3.0 lbs per CY
8" thick SOG with #3 @ 18" OCEW	$f_{e3} = 75$ psi	3.0 lbs per CY
8" thick SOG with #3 @ 16" OCEW	$f_{e3} = 84$ psi	3.0 lbs per CY
8" thick SOG with #3 @ 12" OCEW	$f_{e3} = 112$ psi	3.0 lbs per CY
8" thick SOG with #4 @ 18" OCEW	$f_{e3} = 133$ psi	3.0 lbs per CY
8" thick SOG with #4 @ 16" OCEW	$f_{e3} = 149$ psi	3.5 lbs per CY
8" thick SOG with #4 @ 12" OCEW	$f_{e3} = 199$ psi	5.0 lbs per CY
8" thick SOG with #5 @ 18" OCEW	$F_{e3} = 201$ psi	5.0 lbs per CY
8" thick SOG with #5 @ 16" OCEW	$f_{e3} = 233$ psi	6.0 lbs per CY
8" thick SOG with #5 @ 12" OCEW	$f_{e3} = 311$ psi	8.5 lbs per CY
TABLE FOOT NOTES		
<p>1. Synthetic macrofiber shall be TUFSTRAND SF by Euclid Chemical or approved equal at manufacturer's recommended dosage rate to provide minimum f_{e3} value indicated. ASTM C1609 testing shall be provided. f_{e3} shall be defined as the R_D^{T150} or R_{e3} (as determined through ASTM C1609 testing) multiplied by the flexural strength (Fr) of the concrete tested. ($F_{e3} = RDT150 \times Fr$)</p>		