For more information, contact ***Master Builders Solutions***; 23700 Chagrin Blvd., Beachwood, OH 44122; Phone: (800) 628-9990; Website: <https://master-builders-solutions.com/en-us/specifications/>

Options are provided in square brackets. Delete those that are not necessary.

To see the hidden notes to specifier, press Show/Hide feature ¶

**SECTION 03 24 00**

**FIBROUS REINFORCING**

\*\* NOTE TO SPECIFIER \*\*

This section is based on the products of Master Builders Solutions Admixtures US, LLC. which is located at:

 23700 Chagrin Blvd.

 Cleveland, OH, USA, 44122

 Telephone: (800) 628-9990

 Fax: (216) 839-8821

 Internet: www.master-builders-solutions.com/en-us

Synthetic microfibers are used primarily to reduce plastic shrinkage cracking of concrete. They can be either monofilament or fibrillated fibers. Fibrillated fibers can also be used as shrinkage and temperature reinforcement in place of 6x6 W1.4 x W1.4 (152x152 MW 9.1 x MW 9.1) welded-wire reinforcement (WWR), particularly in slab-on-ground applications. Based on the recommendations of the Steel Deck Institute (SDI), fibrillated synthetic microfibers should not be used to replace temperature and shrinkage reinforcement in composite metal deck applications.

Synthetic macrofibers are typically used as shrinkage and temperature reinforcement in place of welded-wire reinforcement (WWR) and light-gage steel reinforcement. They can also reduce plastic shrinkage cracking of concrete depending on type.

1. **GENERAL**
	1. **SECTION INCLUDES**

* + 1. Section includes synthetic fiber reinforcement for concrete.
	1. **RELATED SECTIONS**

\*\* NOTE TO SPECIFIER \*\* Add or delete Sections as necessary.

1. Section 01 10 00 - Summary
2. Section 01 45 00 - Quality Control
3. Section 03 01 30 - Maintenance of Cast-in-Place Concrete
4. Section 03 10 00 - Concrete Forming and Accessories
5. Section 03 20 00 - Concrete Reinforcing
6. Section 03 30 00 - Cast-in-Place Concrete
7. Section 03 31 26 - Self-Consolidating Concrete
8. Section 03 35 00 - Concrete Finishing
9. Section 03 40 00 - Precast Concrete
10. Section 03 39 00 - Concrete Curing
11. Section 32 13 13 - Concrete Paving
	1. **REFERENCES**

\*\* NOTE TO SPECIFIER \*\* Delete references from the list below that are not actually required by the text of the edited section; add others as required. Standards listed here shall be the most current ones.

1. ASTM International (ASTM):
	* 1. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
		2. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete
		3. ASTM C1550 - Standard Test Method for Flexural Toughness of Fiber-Reinforced Concrete (Using Centrally Loaded Round Panel)
		4. ASTM C1579 - Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber-Reinforced Concrete (Using a Steel Form Insert)
		5. ASTM C1609/C1609M - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete
		6. ASTM C1812/C1812M - Standard Practice for Design of Journal Bearing Supports to be Used in Fiber-Reinforced Concrete Beam Tests
		7. ASTM D7508/D7508M - Standard Specification for Polyolefin Chopped Strands for Use in Concrete
2. American Concrete Institute (ACI):

\*\* NOTE TO SPECIFIER\*\* The ACI reports and guides are intended to provide guidance only and reference to these documents shall not be made in contract documents. If items found in such documents are required to be a part of the contract documents, they shall be rewritten in mandatory language.

1. ACI PRC-544.1 Report on Fiber-Reinforced Concrete
2. ACI PRC-544.3 Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete
3. ACI PRC-544.5 Report on the Physical Properties and Durability of Fiber-Reinforced Concrete

C. American National Standards Institute/ Steel Deck Institute (ANSI/SDI):

 1. C - 2017 Standard for Composite Steel Floor Deck - Slabs

* 1. **DEFINITIONS**
		1. Equivalent diameter: Diameter of a circle having an area equal to the average cross-sectional area of a fiber.
1. Fibrillated: A slit film fiber where sections of the fiber peel away, forming branching fibrils.
2. Monofilament: Single filament fiber typically cylindrical in cross-section.
3. Plastic shrinkage: A reduction in volume of concrete prior to its final set.
4. Synthetic macrofiber: Synthetic fibers with diameters or equivalent diameters greater than 0.012 in. (0.3 mm). These also have longer lengths and are used at higher dosages than synthetic microfibers.
5. Synthetic microfiber: Synthetic fibers with diameters or equivalent diameters less than 0.012 in. (0.3 mm).
	1. **SUBMITTALS**
		1. Submit under provisions of Section 01 33 00 Submittal Procedures.
		2. Product Data: Manufacturer's data sheets of fibers to be used.
		3. Samples: For each type of fiber specified, submit samples representing actual product.
		4. Manufacturer's Certificate: Certificate showing the conformance of fibers to specified performance requirements.
	2. **QUALITY ASSURANCE**
		1. Provide products from one manufacturer.
		2. Pre-construction trial mixtures using proposed ingredients shall be evaluated to ensure that specified concrete properties are achieved, particularly, the workability of the mixture. This is specifically important when dosages of 5 lb/yd3 (3 kg/m3) or more of the synthetic macrofibers are used. Consult the manufacturer of synthetic macrofibers for details.

\*\* NOTE TO SPECIFIER \*\* Synthetic macrofiber dosages of over 5 lb/yd3 (3 kg/m3) can affect the workability of concrete. Modifications may have to be made to the mixture proportions to achieve the target workability, including adjustment of paste volume and amount of coarse aggregate. Master Builders Solutions provides proportioning guidance to ready-mixed concrete producers to achieve adequate workability for placement and finishing purposes.

* + 1. A meeting shall be held two weeks prior to placement of fiber reinforced concrete to discuss the Project and materials. Fiber Manufacturer's Representative shall be present at the meeting.
	1. **DELIVERY, STORAGE AND HANDLING**
1. Synthetic fibers shall be delivered to the manufacturer of concrete in a ready-to-use package such as in pre-weighed degradable bags.
2. User of synthetic fibers shall store the fibers in a dry, covered area free of contamination.
3. Use of synthetic fibers shall be as recommended by the manufacturer.
4. **PRODUCTS**
	1. **MANUFACTURER**
		1. Master Builders Solutions, 23700 Chagrin Blvd., Cleveland, OH 44122. Telephone: (800) 628-9990. Fax: (216) 839-8821. Internet: www.master-builders-solutions.com/en-us
	2. **SYNTHETIC FIBERS**
5. Synthetic Monofilament Microfibers: ASTM D7508/D7508M, monofilament polypropylene microfibers engineered and designed for use in producing Type III Synthetic Fiber-Reinforced Concrete meeting the requirements of ASTM C1116/C1116M.

1. Shall provide a minimum crack reduction ratio (CRR) of [40] [ ] percent when tested in accordance with ASTM C1579.

\*\* NOTE TO SPECIFIER \*\* ICC-ES AC32 requires a minimum CRR of 40% for qualifying microfibers for mitigation of plastic shrinkage cracking. However, the specified value could be higher. For example, some DOTs specify CRR of over 80%.

2. Dosage shall be as recommended by the manufacturer.

3. Products:

* + 1. MasterFiber M Series by Master Builders Solutions.
		2. Synthetic Fibrillated Microfibers: ASTM D7508/D7508M, fibrillated polypropylene microfibers

 engineered and designed for use in producing Type III Synthetic Fiber-Reinforced Concrete meeting

 the requirements of ASTM C1116/C1116M.

 1. Shall provide a minimum crack reduction ratio (CCR) of [40] [ ] percent when tested in

 accordance with ASTM C1579.

 2. Dosage shall be 1.5 lb/yd3.

 3. Products:

 a. MasterFiber F Series by Master Builders Solutions.

* + 1. Synthetic Macrofibers: ASTM D7508/D7508M, polypropylene macrofibers engineered and

 designed for use in producing Type III Synthetic Fiber-Reinforced Concrete meeting the

 requirements of ASTM C1116/C1116M.

* + - 1. Shall provide a minimum average residual strength, , of [ ] psi (or a minimum average equivalent flexural strength, , of [ ] psi) when tested in accordance with ASTM C1609/C1609M, using the roller support system in ASTM C1812/C1812M.

\*\* NOTE TO SPECIFIER \*\*ICC-ES AC383 requires a minimum average residual strength of 80 psi (689 kPa) for use of a synthetic macrofiber as temperature and shrinkage reinforcement in concrete.

It is preferable to use *fe,3*for slab-on-ground applications.

[Shall have a toughness of [ ] Joules when tested in accordance with ASTM C1550]

\*\* NOTE TO SPECIFIER \*\*Typical values of toughness are 350 to 450 Joules.

* + - 1. Dosage shall be as recommended by the manufacturer. Dosage of fiber for composite steel deck shall not be less than 4 lb/yd3 (2.4 kg/m3), as recommended in ANSI/SDI C - 2017.
			2. Products:
				1. MasterFiber MAC Series by Master Builders Solutions.
	1. **STEEL FIBERS**
		1. Carbon-Steel-Wire Fiber: ASTM A820/A820M, Type 1, cold-drawn wire, deformed, minimum of

 1.5 inches long, with minimum aspect ratio of 45, for use in producing Type 1 Steel Fiber-

 Reinforced Concrete meeting the requirements of ASTM C1116/C1116M.

 1. Shall provide a minimum average residual strength, , of [ ] psi (or a minimum average

 equivalent flexural strength, , of [ ] psi) when tested in accordance with ASTM

 C1116/C1116M, using the roller support system in ASTM C1812/C1812M.

 [Shall have a toughness of [ ] Joules when tested in accordance with ASTM C1550]

 2. Dosage shall be as recommended by the manufacturer. Dosage of fiber for composite

 steel deck shall not be less than 25 lb/yd3 (15 kg/m3), as recommended in ANSI/SDI C-2017

 3. Products:

 a. MasterFiber 510 and 515 by Master Builders Solutions.

* + 1. Carbon-Steel-Wire Fiber: ASTM A820/A820M, Type 2, cut sheet, deformed, minimum of

 1 inch long, with minimum aspect ratio of 45, for use in producing Type 1 Steel Fiber-

 Reinforced Concrete meeting the requirements of ASTM C1116/C1116M.

 1. Shall provide a minimum average residual strength, , of [ ] psi (or a minimum average

 equivalent flexural strength, , of [ ] psi) when tested in accordance with ASTM

 C1116/C1116M, using the roller support system in ASTM C1812/C1812M.

 [Shall have a toughness of [ ] Joules when tested in accordance with ASTM C1550]

 2. Dosage shall be as recommended by the manufacturer. Dosage of fiber for composite

 steel deck shall not be less than 25 lb/yd3 (15 kg/m3), as recommended in ANSI/SDI C-2017

 3. Products:

 a. MasterFiber 520 and 525 by Master Builders Solutions.

\*\* NOTE TO SPECIFIER \*\* Master Builders Solutions has developed a spreadsheet based on the data generated on MasterFiber MAC Series of synthetic macrofibers using ASTM C1609/C1609M tests. This spreadsheet can be used to determine the dosage of MasterFiber MAC Series of synthetic macrofibers based on the shrinkage and temperature reinforcement specified. Contact your local Master Builders Solutions representative or call (800) 628-9990 for assistance.

1. **EXECUTION**
	1. **BATCHING, MIXING AND TRANSPORTING**
		1. Batching of materials shall be in accordance with ASTM C94/C94M [ASTM C1116/C1116M].

\*\* NOTE TO SPECIFIER \*\* Synthetic macrofibers can also be used in self-consolidating concrete. A standard specification for self-consolidating concrete (Section 03 31 26) is provided on Master Builders Solutions’ web page.

* + 1. Introduce fibers into the mixing system at any time, except when the cement is being introduced. Mix for at least 5 minutes after the addition of the fibers.
			1. Fibers shall be dispensed into the mixing system in accordance with the recommendations of the manufacturer.

\*\* NOTE TO SPECIFIER \*\* Mixing time will vary depending on when the fibers are introduced into the mixer. The normal range is 3-5 minutes, with the higher number preferred when the fibers are added after all of the standard ingredients have been introduced and mixed.

For self-consolidating concrete, synthetic fibers should be introduced earlier in the batching process to promote better distribution of fibers and to prevent fibers from floating in the mixtures.

* + 1. Mixing and transporting concrete shall be in accordance with ASTM C1116/C1116M.

* 1. **PLACING, CONSOLIDATION AND FINISHING**
		1. Placing, consolidation and finishing of concrete shall be in accordance with the recommendations of ACI PRC-544.3.
			1. Additional water shall not be added in the field to increase workability based on the appearance of the mixture. A mid-range or high-range water-reducing admixture may be added to increase workability of the mixture in the field when authorized by the Architect/Engineer. Admixtures shall be as manufactured by Master Builders Solutions.

B. Vibrating screed, laser screed or roller screed shall be used for consolidating concrete in large square footage industrial and commercial interior slabs-on-ground.

* 1. **CURING AND PROTECTION**
		1. Curing and protection of concrete shall be in accordance with Section 03 39 00.

END OF SECTION