Steel Fibers
Composite Metal Deck

Fibercon: We do not claim — We Prove

Fibercon International
100 South Third Street Evans City, PA 16033
Tel: 724-538-5006 Fax: 724-538-9118
www.fiberconfiber.com
We want to thank you for considering the use of FIBERCON steel fiber reinforced concrete on your upcoming composite metal deck project.

For many years, the Steel Deck Institute has recommended the use of welded wire reinforcement or reinforcing bars for temperature and shrinkage reinforcement. In May of 2003, a change to the SDI Design Manual was made to include the use of steel fibers for shrinkage and temperature reinforcement in these applications.

Steel fibers have proven themselves for many years to provide excellent crack containment on these structures. The random distribution of steel fiber reinforcement means that micro-cracks that increase in size through normal development are subjected to a steel fiber barrier. Thus, small cracks are intercepted before developing into larger cracks. Add to this the safety factor of not tripping over the mesh laying on the decks and the ease of delivering the reinforcement with the concrete not cranes the day before, you can see the benefits of using steel fiber reinforcement on these applications.

Looking to the Future

Serving the concrete industry since 1972, Fibercon’s Research and Development department is continually refining its products and developing solutions to industry problems, both in the lab and in real-world conditions. In this way, FIBERCON plans to remain the leader in providing steel fiber for the concrete industry for the next 35 years.

We look forward to working with you in the future.

George N. Mitchell  
President

Nicholas C. Mitchell Jr.  
VP of Operations
Composite Metal Deck

Composite metal decks are designed as a reinforced concrete slab with steel decking acting as the positive reinforcement. Although a crack free floor is always desirable, random cracks are to be expected in this type of floor system. Cracks develop from the restraint of movement on any concrete cast on a metal frame and deck system. When the concrete shrinks, the steel frame does not. This restraint causes tensile stresses to develop in concrete which ultimately leads to cracking.

The normal method used to control cracks in composite metal deck assemblies has been to use shrinkage and temperature reinforcement to distribute cracks uniformly and holds them tightly closed. Until now welded wire reinforcement was specified by the Steel Deck Institute as the required shrinkage and temperature reinforcement.

In May 2003, the SDI Board of Directors voted to amend the Steel Deck Institute Design Manual to permit the use of fibers to provide this reinforcement.
Which crack control method is most effective on metal decks? Many engineers recommend using a relatively light welded wire fabric. This amount of steel controls cracking if it is placed near the top of the slab with ¾” to 1” cover.

But as J. Tom Ryan, consultant and author of Composite Construction Design for Buildings, writes: “It’s virtually impossible to keep the welded wire fabric near the top of slab because it gets pushed down by the worker’s feet, pump lines and the weight of the concrete. The fabrics’ final resting place is usually the top of metal decking where it is of no value.”

Instead of welded wire fabric, Ryan suggests using steel fiber reinforced concrete to control shrinkage cracking. And now so does the Steel Deck Institute. The SDI Design Manual states, “Steel fibers meeting the criteria of ASTM A820, at a minimum dosage rate of 25lb/cy and possessing an average residual strength of at least 80 psi when tested in accordance with ASTM C1399 may be used as a suitable alternative to the welded wire fabric specified for temperature and shrinkage reinforcement.”
Since 1981, FIBERCON has been supplying steel fiber to the construction industry. Using technology developed by US Steel in the 1950’s, FIBERCON steel fibers have been used on millions of square feet of floors around the world. All FIBERCON steel fibers meet ASTM A820-06 requirements. These fibers are manufactured in our own plant. The unique geometry of these fibers provides excellent performance while maintaining excellent mixing and placement properties. FIBERCON steel fibers carry UL fire ratings.

Steel fibers have been used successfully in containing crack widths for many years. Their effectiveness has been documented in several ACI publications:

ACI 544.1R Section 2.2.5
Shrinkage Cracking
Using a ring type specimen, “It can be seen that the addition of even a small amount (.25 vol. percent) of straight smooth steel fiber 1 inch long and .016 inch in diameter can reduce the average crack width significantly.”

ACI 302 3.2.4
Reinforcement for crack width control
“This reinforcement is normally furnished in the form of deformed steel bars, welded wire reinforcing, steel fibers…”

The following graph shows the effectiveness of 25 pounds of our CAR25CDM steel fibers in controlling crack width openings. Tests were conducted using ASTM C1581 for concrete under restrained shrinkage.
Pumpability

FIBERCON steel fiber reinforced concrete is easily pumped to multi-story elevations. Because the fibers will not let the material segregate, SFRC will move through the pump lines without slugs. Plus with SFRC concrete, you will not have to fight the WWF with the pump lines.

The addition of steel fibers to the concrete mix will not cause excessive wear to the pump or hoses. The effect of the aggregates play a larger role in wearing these components.

What’s missing in this photo? The WWR
Reference Documents

ACI 544-3R
Guide for Mixing, Placing and Finishing Steel Fiber

ASTM A820-06

ASTM C1399

ASTM C1581

Neuber, Joseph
Support Requiremtns for Welded-Wire Reinforcement in Slabs

Ryan, J. Thomas
Composite Construction Design for Buildings

Steel Deck Institute Design Manual

Shah, S.P.
Comparison of Shrinkage Cracking Performance of Different Types of Fibers and Wiremesh
Steel fibers are not only proven performers on composite metal deck but when compared to the cost of placing welded wire fabric on a composite metal deck correctly, they are cost effective. Remember the true cost of WWR is not the cost of the mesh itself but the cost of getting the mesh on site and up to the upper floors, the labor and cost to chair the mesh in proper position to meet SDI requirements.

The cost of the slab bolsters will equal the cost of the mesh. These time consuming and expensive steps are eliminated when you use FIBERCON steel fibers. Time is money on a construction site. On your next composite metal deck job, eliminate the cost of handling, placing, chairing and stumbling over welded wire fabric with steel fibers from FIBERCON.
MATERIAL DATA SHEET
ASTM A820 TYPE II
Steel Fiber Reinforcement for Concrete

Fiber Type: Low carbon cut sheet steel fiber
Product: CAR25CDM
Dimensions: Fibers are manufactured with tolerances set forth in ASTM A820-06
Aspect Ratio: 41
Tensile Strength: 50,000 psi
Specific Gravity: 7.86
Melting Point: 2760° F

Specification: The steel fiber specified shall be manufactured from a low carbon steel and meet physical property requirements of ASTM A820 Type II steel fiber. Fiber length shall be 25mm. The configuration required is continuous deformed mild. Aspect ratio required is 41. The steel fibers must be clean and free from rust, oil and deleterious material. The source should be certified under an ISO 9001 standard quality plan.
Fibercon® steel fibers are manufactured using a method known as “Slit Sheet” processing giving the product a rectangular cross-section. Fibercon® steel fibers are manufactured under a quality plan in compliance to ASTM A820-06 Type II.

Produced from low carbon steel and various grades of stainless steel, Fibercon fibers are available in lengths from $\frac{1}{2}”$ (13mm) to 2.0” (50mm). The fibers are available in straight, continuously deformed (wavy), or end-deformed versions.

The following are typical dimensions of the 3 most popular types:

**Product Nomenclature**

**CAR-25-CDM**
CAR - Low Carbon Steel
25 - 1.0” (25mm) in length
CDM - Continuous Deformed Medium

**CAR-35-EDM**
CAR - Low Carbon Steel
35 - 1 $\frac{3}{8}”$ (35mm) in length
EDM - End Deformed Medium

**CAR-50-EDM**
CAR - Low Carbon Steel
50 - 2” (50mm) in length
EDM - End Deformed Mild
Small Fibers are used where crack propagation is the most important design consideration. High fiber count (number of fiber per lb or kg) permits a better distribution of steel fiber throughout the concrete matrix and consequently, greater crack control.

Higher fiber count FIBERCON steel fibers can yield as much as 9 times more reinforcing elements per unit of fiber weight than larger 2” fibers currently on the market. There is simply a greater quantity of shorter steel fibers per given unit of weight than with longer fibers. So as a crack progresses, the chance of it being physically stopped by the presence of a reinforcing fiber increases. This enhanced “crack arresting” ability holds the key to the outstanding performance of large numbers of shorter steel fibers in crack containment applications, such as slab-on-ground composite metal deck.

Fibercon CAR-25-CDM fiber gives the best compromise between high fiber count and the requirements for workability and finishability. This makes it ideal for industrial floor slabs, highway pavements, bridge deck overlays, floors over composite metal deck and other applications. These fibers mix easily and lays into the concrete surface much more effectively than longer, stiffer fibers facilitating easier placement and resulting in a more “fiber free” finish.

Fibercon CAR-35-EDM fiber gives the best fiber performance for shotcrete applications subjected to ASTM 1609 testing requirements.

### Standard fiber types

- CAR-25-CDM
- CAR-35-EDM
- CAR-38-CDM
- CAR-50-EDM

Other sizes available upon request.

---

**Fibercon International, Inc.**

100 South Third Street
Evans City, PA 16033
Tel: 800.521.9908
Tel: 724.538.5006
Fax: 724.538.9118
Email: info@fiberconfiber.com
Website: www.fiberconfiber.com

**Fibercon UK, LTD.**

Loughborough Technology Center
Unit 23-24 Epinal Way
Loughborough LE11 3GE
UK
Tel: 44 1509 211860
Changes to the SDI Design Manual as of May 2003

At the May 2003 meeting the SDI Board of Directors voted to amend the Steel Deck Institute Design Manual (publication number 30) to permit an alternate means of providing temperature and shrinkage reinforcement for composite steel floor deck. Section 5.5 of the SDI Specifications and Commentary for Composite Steel Floor Deck was amended as follows:

5.5 Temperature and Shrinkage Reinforcement: Temperature and Shrinkage reinforcement, consisting of welded wire fabric or reinforcing bars, shall have a minimum area of 0.00075 times the area of the concrete above the deck (per foot or meter of width), but shall not be less than the area provided by 6 x 6 - W1.4 x W1.4 welded wire fabric. Cold-drawn steel fibers meeting the criteria of ASTM A820, at a minimum addition rate of 25 lb/cu yd (14.8 kg/cu meter) and possessing an average residual strength of at least 80 psi (550 kPa) when tested in accordance with ASTM C1399, may be used as a suitable alternative to the welded wire fabric specified for temperature and shrinkage reinforcement.

Commentary: If welded wire mesh is used with a steel area given by the above formula, it will not be sufficient as the total negative reinforcement; however, the mesh has been shown that it does a good job of crack control especially if kept near the top of the slab (3/4 inch to 1 inch cover, 20 to 25 mm). If fibers are used for shrinkage and temperature reinforcement, the fibers will not be sufficient as the total negative reinforcement. If the service loads and slab response require lateral distribution, distribution steel may be required in addition to the steel fibers or welded wire fabric. Concentrated loads are the most common example of this service requirement.

Copyright © 2003 Steel Deck Institute, All rights reserved.
Types Fibercon Manufactured Steel Fibers and Matrix CS Steel Fibers for use as an alternate or in addition to the welded wire fabric used in Floor-Ceiling D700, D800 Series Designs. Fiber may also be used in Design Nos. G256 and G514. Fibers added to concrete mix at a rate of 20 to 50 lb of fiber for each cu yard of concrete.

Type Matrix W2.9 Hybrid Fibers for use as an alternate or in addition to the welded wire fabric used in Floor-Ceiling D700, D800 Series Designs. Fiber may also be used in Design Nos. G256 and G514. Fibers added to concrete mix at a rate of one 19-3/4 lb bag of fibers for each cu yard of concrete.
Fibercon On The Job

Jet Blue JFK new concourse

Jet Blue JFK getting ready to pump Fibercon reinforced concrete

Jet Blue JFK finished deck
Fibercon On The Job

Aisin Automotive, Clinton, TN

JoAnn Fabrics, Opelika, AL

Slope Stabilization, Jasper, AL