MMFX STEEL

MMFX Steel Corporation of America

This is your future.

MMFX Microcomposite (MMFX 2) Steel Bars for Concrete Reinforcement

Product Applications

The technology that makes MMFX steel five times as corrosion-resistant and twice as strong as conventional steel is today's reality. Not confined to testing labs and research facilities, MMFX steel products are used in structures across North America including bridges, highways, parking structures, and residential and commercial real estate projects. Projects using MMFX steel can be completed with 20-40% less steel and 20-50% lower labor costs.

Testing and approval from the Federal Highway Administration (FHWA) and DOTs has resulted in contracts won from Super Agencies and more than 24 state DOTs using MMFX steel in highway and bridge construction.*

- U.S. Navy Hybrid Modular Piers – structures constructed in Washington and floated to San Diego, California
- U.S. Army Corps of Engineers – Oklahoma Spillway – Phase II - Channel bridge
- Sacramento Regional Transit Authority – Sacramento County – New bridge structure
- New Haven, Connecticut - Church St Extension - Bridge deck
- New Castle County - Delaware - State Route 82 over Red Clay Creek - Bridge deck
- Grundy County - Cedar Hills, Iowa - U.S. 20 over South Beaver Creek - Bridge deck
- Lexington, Kentucky - Scott County Road 1218 - Bridge deck
- East of Pittsburgh, Pennsylvania - Exit 9 - Interstate Highway I-70-76 - Bridge deck
- Wayne County, Pennsylvania – Bridge deck
- Cabo Rojo, Puerto Rico - Bridge No. 106 on PR-102 over Laguna Channel - New bridge structure
- Amarillo, Texas - Washington St Overpass, located over I-40 - New bridge structure
- Derby Township, Vermont - SR105 over the Clyde River - Bridge deck
- Swan River, Manitoba - Province Highway 10 over East Favel River - Bridge deck

MMFX offers competitive pricing and a superior product when compared to less successful alternatives, making it a viable solution in myriad construction applications.*

- Low and High-rise Condominiums – renovation and new construction
- Coastal Residences – multiple U.S. projects
- Marineland of Florida – dolphin and sea life lagoon
- Dupont – Louisville, Kentucky, plant reconstruction
- City of Chicago – Millenium Park renovation
- Airport Control Tower – east central coast of Florida

* This is a partial list of representative projects featuring MMFX steel.

Lockwood Greene chose MMFX over traditional alternatives for the dolphin and sea life lagoon at **Marineland of Florida** after determining that MMFX, in conjunction with standard concrete cover practices, would result in an **up-front savings of 8%.**

U.S. Navy - Hybrid Modular Piers - San Diego, California

High-rise Condominiums in Aventura, Florida

Bridge over I-40 – Amarillo, Texas

Corrosion Resistance

The corrosive effects of salt from seawater and the mitigation of snow and ice are rapidly deteriorating our nation's bridges, highways, and structures, creating a nationwide problem. Using groundbreaking, proprietary micro- and nanotechnology, MMFX has developed an uncoated steel that is structurally different from conventional steel, affording design engineers an effective and economically viable solution to this epidemic problem.

MMFX Microcomposite (MMFX 2) rebar's corrosion performance has been verified at numerous public agencies and universities including the Virginia Transportation Research Council (VTRC), Iowa State University, Louisiana DOT, New Jersey DOT, the American Concrete Institute's (ACI's) Concrete Innovations Appraisal Service (CIAS), and others.

The cost of corrosion to U.S. industries and the American public is currently estimated at $276 billion per year.

Source: U.S. Department of Transportation Federal Highway Administration (U.S. FHWA), NACE, and U.S. Congress

MMFX's proprietary methods and processes control material properties at the atomic level, reducing or eliminating carbide formation in the steel's microstructure, enhancing its performance.

"The epoxy-coated and uncoated reinforcement exhibits the greatest corrosion potential… MMFX specimens had the least corrosion risk potential."

- Iowa State University
  Sponsored by the U.S. FHWA and Iowa Department of Transportation

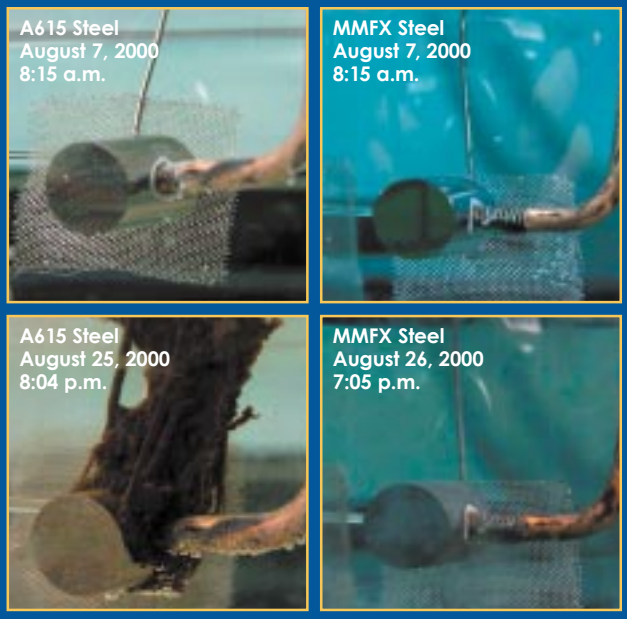
  Re: Comparative Corrosion Resistance testing of MMFX 2, epoxy-coated and uncoated mild steel reinforcement

Correlative Corrosion Testing

Comparative Corrosion Performance

Rebar Material	CCTL Ratio to A615	Time to First Repair - Yrs[B]
MMFX 2	5[A]	>100
A615	1[A]	30
Epoxy-Coated Rebar	1	44

Notes: A - VTRC average critical chloride threshold level (CCTL) test results
B - Results from Lite 365® - Philadelphia, PA, surface chloride concentration (#/cy) ~ 27 @ 11 yrs



Corrosion Resistance Characterization

Corrosion test results indicate that MMFX 2 rebar has

- 5 times the corrosion resistance of ASTM A615 rebar
- MMFX 2 service life in excess of 100 years when used in conjunction with high performance concrete (HPC)

Complete test results are available upon request.

Test results found that the chloride threshold of MMFX 2 was 5 to 6 times greater than that of conventional A615 steel bars and 1.75 times greater than the 2101 solid stainless steel bars.

– The Virginia Transportation Research Council
In cooperation with the U.S. Department of Transportation Federal Highway Administration
December 2003

Structural & Design Properties

Along with its corrosion-resistant properties, MMFX 2 steels are inherently stronger than competitive, conventional steel products. Design engineers can maximize the benefits of MMFX steel by designing structures based on its higher strength – strength that results in 20-40% less steel needed and 20-50% lower labor costs. When considering the upfront savings associated with such a design, MMFX quickly becomes the most economic solution.

Setting the Standards for the Future

ASTM recently approved an MMFX-drafted specification: the ASTM A1035-04 low-carbon, chromium steel bars for concrete reinforcement at 100,000 pounds per square inch (psi).

MMFX 2 Rebar Qualifies as

ASTM A615 Grade 75, ASTM A1035-04 low-carbon, chromium steel bars for concrete reinforcement at 100,000 psi, and AASHTO M31 Grade 75

Structural Design Procedure

ACI 318-02 – maximum design yield stress – 80 ksi for flexural and axial members

Design Material Comparison

MMFX 2 allows 20-40% potential material savings when used as ASTM A615 Grade 75 vs. ASTM A615 Grade 60 designs.

"I was impressed with the material and believe it will be a great substitute for epoxy-coated reinforcing bars. Not having to repair damaged epoxy coating was a real treat."

– Robert Easley, Senior Project Manager
Concrete Technology Company

Re: MMFX steel used in U.S. Navy Hybrid Modular Pier construction

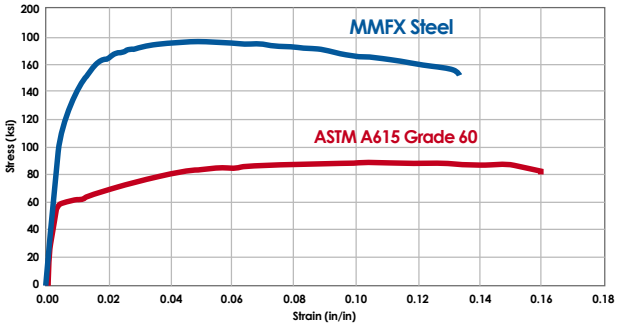
"…there is clearly evidence from different research studies that MMFX steel has a longer service life and is more cost-effective than the conventional ASTM A615 steel."

– Concrete Innovations Appraisal Service (CIAS) Appraisal Report, 2003

Louisiana DOT (LA DOT) recently completed a comparative corrosion study between MMFX 2 steel bars and conventional A615 black steel bars. In addition, tests for yield-strength, tensile-strength, elongation, and cold bend were run before and after testing.

- **A615 black steel experienced an estimated 16 times greater loss of tensile-strength than MMFX 2.**
- **A615 black steel experienced an estimated 7 times greater loss of yield-strength than MMFX 2.**
- **A615 black steel experienced an estimated 18 times greater mass loss than MMFX 2.**

Typical Stress - Strain Curve



Structural Properties Summary

Minimum tensile strength	150 KSI
Minimum specified yield strength (0.2% offset)	100 KSI
Design yield strength per ACI 318-02 (0.35% strain)	80 KSI
Minimum elongation in 8-inch (203.2 mm) bar sizes Numbers 3 through 11 (10 through 36)	7%

SMITH - EMERY LABORATORIES
An Independent Commercial Testing Laboratory, Established 1904

Project No.: 31227-5
Report Date: 8/4/04
MMFX 2 Rebar certified as ASTM A615 Grade 75 (520) meets the mechanical property requirements of ASTM A1035-04

Specifying MMFX 2 Rebar

The technology behind MMFX's superior steel products can change the way you do business. You will receive higher grade steel, with the corrosion-resistant properties you need, at a lower overall cost. The added strength of our steel results in an incremental decrease in the amount of conventional steel necessary to accomplish the same task. You can design structures with less congestion without adding additional concrete cover. By specifying MMFX 2 rebar, you can experience upfront cost savings, as well as lower life cycle costs.

MMFX Microcomposite (MMFX 2) Steel Rebar – Product Specification

Corrosion-resistant, uncoated, low-carbon, chromium steel bars for concrete reinforcement

How to Specify MMFX 2 Rebar

"MMFX 2 steel bars as shown on the plans shall be as manufactured by MMFX Steel Corporation of America."

Generic Specification

"Corrosion-resistant uncoated steel shall be low-carbon, chromium bar with a minimum of 8.0% by weight chromium, meeting all the requirements of ASTM A615 Grade 75 and ASTM A1035-04."

Contact MMFX for a copy of a CSI Format Product Guide Specification

1. Chemical Composition Chemical Constituents (Weight %)

Element	Maximum Amount[A]	Typical MMFX 2
Carbon	0.15%	0.08%
Chromium	8 to 10%	9%
Manganese	1.5%	0.5%
Nitrogen	0.05%	
Phosphorus	0.035%	
Sulfur	0.045%	
Silicon	0.50%	

Note:
[A] Maximum unless range is indicated

2. Tensile Properties Requirements

Description	Tensile
Tensile strength, min, psi [MPa]	150,000 [1030]
Yield strength (0.2 % offset), min, psi [MPa]	100,000 [690]
Stress corresponding to an extension under load of 0.0035 in./in. (0.0035 mm/mm), min, psi [MPa]	80,000 [550]

Elongation in 8 inch [203.2 mm] min. %

Bar Designation No.	Elongation
3 through 11 [10 through 36]	7
14, 18 [43, 57]	6

3. Bend Test Requirements

Bar Designation No.	Pin Diameter for Bend Tests[A]
3, 4, 5, [10, 13, 16]	3 ½ d[B]
6, 7, 8 [19, 22, 25]	5d
9,10,11 [29, 32, 36]	7d
14, 18 [43, 57] (90°)	9d

A – Test bends 180° unless otherwise agreed.
B – d = nominal diameter of specimen.

MMFX bending procedures and the requirements for the degree of bending and size of pins conform to ASTM A615 as well as A1035 specifications.

Your Future Is Now

MMFX Steel Corporation of America is a subsidiary of MMFX Technologies Corporation, a materials science company that has invented and patented world-changing breakthroughs in materials sciences, including its core technology that produces steel.

MMFX steel has a fundamentally different microstructure; in fact, this revolutionary technology has produced steel unlike any steel material ever introduced to the marketplace.

The origins of MMFX's proprietary technology were developed at the University of California-Berkeley under the guidance of world-renowned scientist and inventor, Professor Gareth Thomas. Professor Thomas founded the National Center for Electron Microscopy at the Lawrence Berkeley National Laboratory, one of the best facilities of its type in the world. In this laboratory, and with millions of dollars in funding, he was able to make fundamental advances in steel technology. MMFX currently uses its proprietary technology to produce state-of-the-art steel at competitive prices, lowering our customers' overall project costs.

The founders of MMFX worked closely with Ken Iverson – the "Father of Nucor Corporation," the most profitable steel company in the United States. Until his death in 2002, Mr. Iverson was a mentor to MMFX and predicted that the business model they developed together would allow MMFX to produce and sell steel in the millions of tons.

MMFX is the recipient of the 2002 Charles Pankow Award for Innovation for MMFX Microcomposite Steel Rebar.

MMFX received the 2004 NOVA Award for innovations recognized by the Construction Innovation Forum (CIF).

WORLD OF CONCRETE
2004 EXPERTS CHOICE AWARD

MMFX is a proud winner of the 2004 Experts Choice Award in conjunction with the 2004 World of Concrete.

MMFX Steel Corporation of America

A Subsidiary of MMFX Technologies Corporation
8000 Corporate Center Drive, Suite 207
Charlotte, North Carolina 28226
www.mmfxsteel.com

Sales Support
866.752.9155 (phone) • 704.752.9077 (fax)
sales@mmfxsteel.com

Technical & Engineering Support
866.466.7878 (phone) • 949.474.1130 (fax)
technical@mmfxsteel.com
engineering@mmfxsteel.com

MMFX STEEL

MMFX Steel Corporation of America