



# UHPC Application in Cladding Panels

Luke Pinkerton, PE  
Founder and Chief Technology  
Officer  
TSMR Steel

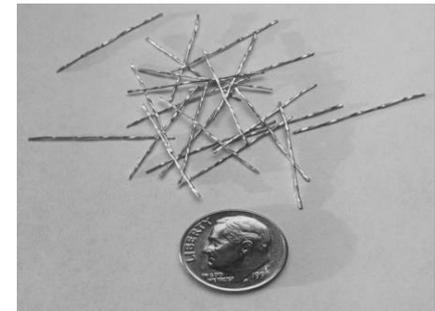
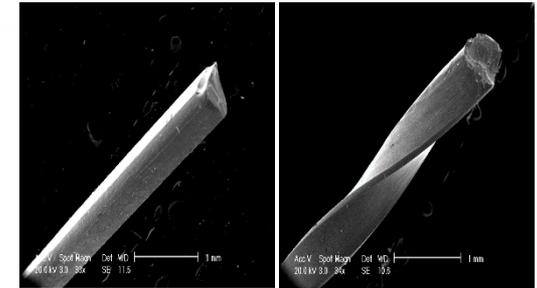
# Tornado Resistance: The Pensmore Estate



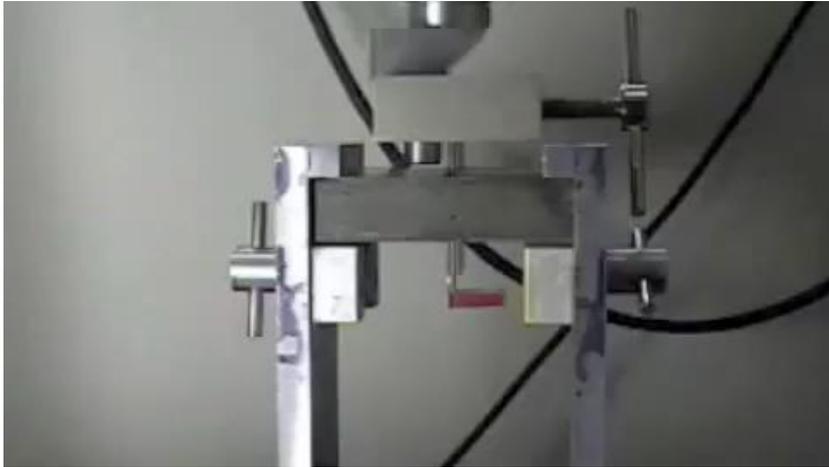
Category:	Residential
Contractor:	Huff Construction
Location:	Highlandville, Missouri
Application:	Walls, Slabs, Precast Trim and Cladding
TSMR Dosage:	Walls - 22.5 - 45 lbs/yd, (27 kg/m <sup>3</sup> )
	Slabs - 37.5 lbs/yd (20 kg/m <sup>3</sup> )
	Roof - 60 lbs/yd (36 kg/m <sup>3</sup> )
	Cladding – 150 (90 kg/m <sup>3</sup> )

## Twisted Steel Micro Reinforcement History

- Mid 1990's: Early Research: Pullout, Small Beams, Direct Tension at University of Michigan – “Torex”
- 2003 TSMR Steel Licenses Torex Technology
- Early 2000's: UHPC research on “Torex”,
- 2009: UHPC Research with “TSMR”: UAE University, Amer El Diab
- 2014-2017: Implementation of “TSMR” UHPC at Pensmore – Cladding

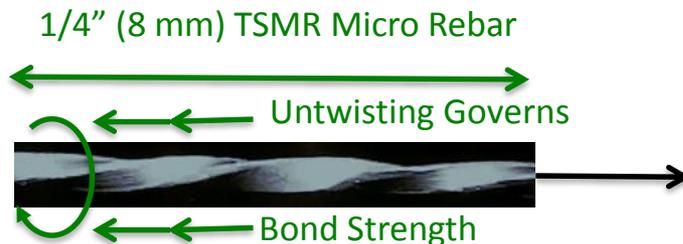


# TSMR: Stiff / Strong Bond

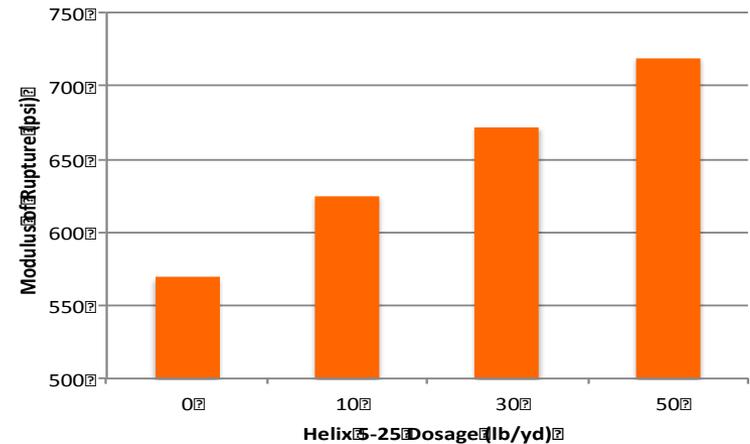


## Twisted Steel Micro Reinforcement

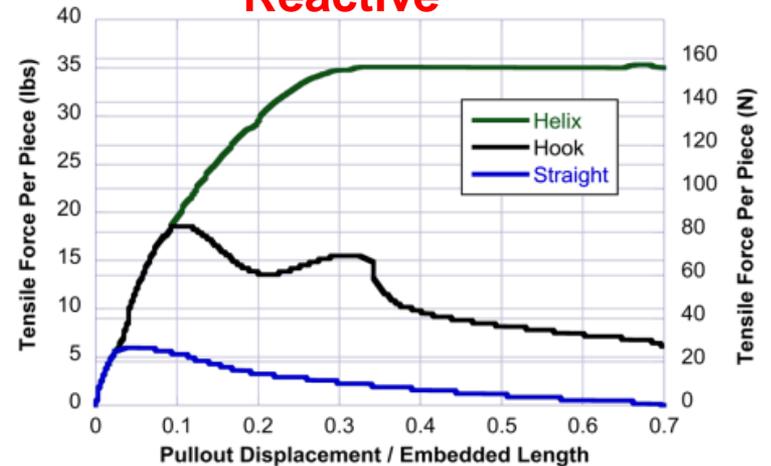
- ✓ High Tensile Strength ~ 300 times Concrete
- ✓ High Modulus – 6 Concrete Modulus of Elasticity
- ✓ Strong Bond – Engages Concrete before cracking



## Proactive



## Reactive



**TSMR 5-13**

Galvanized Steel

Length: 0.5 in / 12.5 mm

Diameter: 0.02 in / 0.5 mm

**TSMR 5-25**

IAPMO ER 279

Proven Design Method

Galvanized Steel

Length: 1 in / 25 mm

Diameter: 0.02 in / 0.5 mm

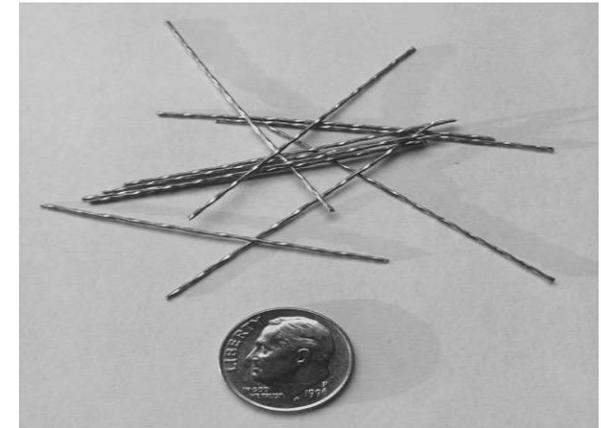
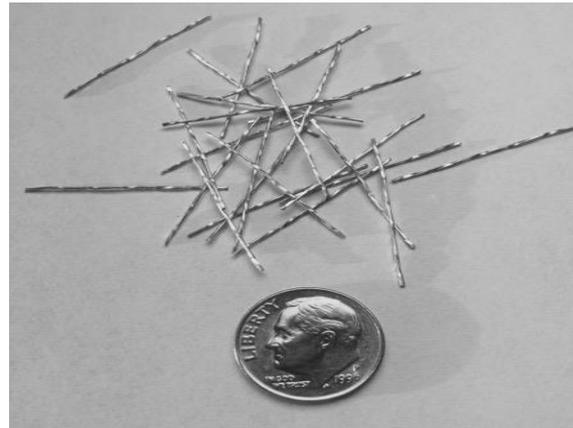


**TSMR 8-52**

Bright Steel

Length: 2 in / 50 mm

Diameter: 0.03 in / 0.8 mm

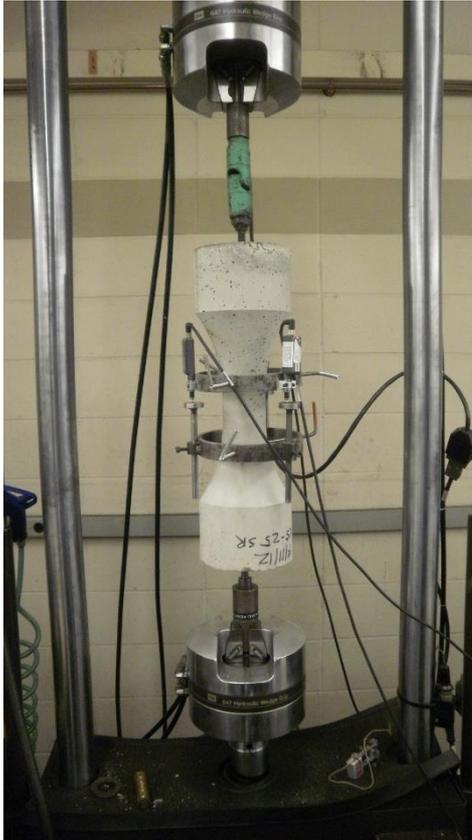


Steel wire tensile strength: 270 ksi / 1800 MPa

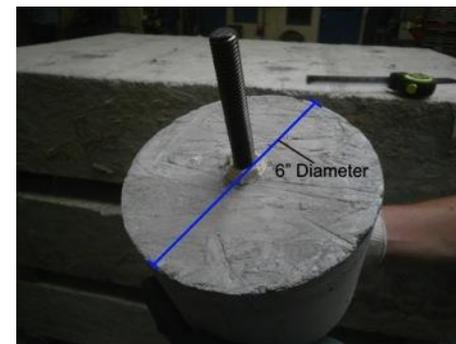
15 Years and 36 Countries

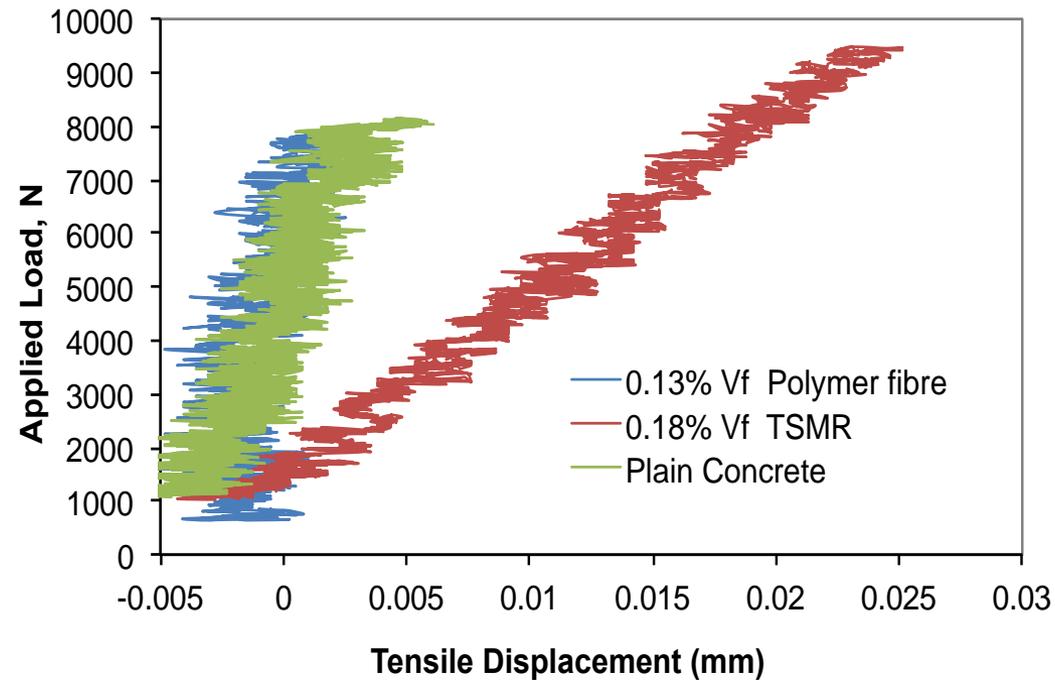


# Tensile Resistance ASTM E111 Rebar Test



- Helix Micro Rebar Tensile measured the same way as rebar 6" (150 mm) sample
- Proactive Phase – Micro Cracking 140 micro-strain (Plain concrete 60)
- Reactive Phase – Post Dominant Crack to 1000 micro-strain





- Helix increases tensile strength
- Helix is more flexible in tension
- Helix promotes micro cracking



## Uniform ES Report # 0279 : All Inclusive Guidance for Helix Design

- Design Instructions
- Restrictions
- Examples
- QC Requirements

## Uniform ES

- Assurance
- Resource for Building Official

**EVALUATION SUBJECT:**  
HELIX 5-25 MICRO-REBAR CONCRETE  
REINFORCEMENT SYSTEM

**REPORT HOLDER:**  
Polytorx, LLC d.b.a. Helix Steel  
2300 Washtenaw Ave  
Suite 201  
Ann Arbor, MI 48104  
734-322-2114  
[www.helixsteel.com](http://www.helixsteel.com)  
[info@helixsteel.com](mailto:info@helixsteel.com)

CSI Division: 03 00 00 - CONCRETE  
CSI Section: 03 20 00 - CONCRETE REINFORCEMENT

### 1.0 SCOPE OF EVALUATION

#### 1.1 Compliance to the following codes & regulations:

- 2015, 2012 and 2009 International Building Code® (IBC)
- 2015, 2012 and 2009 International Residential Code® (IRC)

#### 1.2 Evaluated in Accordance with:

- IAPMO UES EC015-2016, Adopted -November 2013, Revised - January 2016
- ICC-ES AC208, approved October 2005, editorially revised January 2016

#### 1.3 Properties Assessed:

- Shrinkage and temperature crack control in concrete
- Structural tension and shear resistance in concrete
- Fire Resistance

### 2.0 PRODUCT USE

Helix 5-25 Micro-Rebar functions as tensile reinforcement for concrete.

2.1 Helix Micro-Rebar may be used to reduce shrinkage and temperature cracking of concrete. Helix Micro-Rebar may be used as an alternative to the shrinkage and temperature reinforcement specified in Section 24.4 and Chapter 14 of ACI 318-14 and Section 7.12 and Chapter 22 of ACI 318-11 and ACI 318-08 (as referenced in Section 1901.2 of the IBC and Sections R404.1.2 and R611.1 of the IRC).

2.2 Helix Micro-Rebar may be used as tension and shear reinforcement in other structural concrete as detailed in this report, which satisfies the requirements of ACI 318-14 Section 1.10, ACI 318-11 Section 1.4 and Section 104.11 of the IBC and IRC.

2.3 Use in Seismic Design Categories C, D, E, and F is subject to the restrictions listed in Section 5.2 of this report.

### 3.0 PRODUCT DESCRIPTION

Helix 5-25 Micro-Rebar reinforced concrete consists of two materials, as described in Sections 3.1 and 3.2 of this report.

**3.1 Product Information:** Helix 5-25 Micro-Rebar is made from cold-drawn, deformed wire complying with ASTM A 820, Type I. The steel wire has a tensile strength of 268.3 ksi +/- 21.8 ksi (1850 MPa +/-150 MPa) and a minimum of 3 g/m<sup>2</sup> zinc coating. The length (l) is 1.0 inch +/- 0.1 inch (25 mm +/- 0.004 mm), equivalent diameter is 0.020 inch +/-0.007 inch (0.5 mm +/- 0.02 mm), and cross sectional area is 0.0003 square inches (0.196 mm<sup>2</sup>). Each Helix Micro-Rebar has a minimum of one 360-degree twist. Helix Micro-Rebars are packaged in 22.5 pound (10.2 kg) boxes, 45-pound (20.4 kg) boxes or 2450-pound (1111 kg) bags.

3.2 Normal Weight Concrete with a minimum 28day compressive strength of 3,000 psi (20.67 MPa).

### 4.0 DESIGN AND INSTALLATION

**4.1 Design Class Selection:** The Helix design class shall be selected based on the application and consequence of failure. The registered design professional shall select the design class based on the criteria in Sections 4.2 through 4.5 of this report. Figure 1 of this report provides guidance in making the design class selection.

#### 4.2 Class A - Shrinkage and Temperature Reinforcement

**4.2.1** Helix 5-25 Micro-Rebar replaces deformed reinforcement bars (rebar) or welded wire reinforcement for shrinkage and temperature reinforcement specified in Section 24.4 of ACI 318-14 and Section 7.12 of ACI 318-11 and ACI 318-08 in members complying with the requirements of Section 14.1.3 (a or b) of ACI 318-14 and Section 22.2.1 (a or b) of ACI 318-11 and ACI 318-08. This application includes plain concrete structures designed in accordance with Chapter 14 of ACI 318-14 or Chapter 22 of ACI 318-11 and ACI 318-08 (as referenced in Section 1901.2 of the IBC and Sections 404.1.3 and R608.1 of the 2015 IRC or Sections 404.1.2 and R611.1 of the 2012 or 2009 IRC).

**4.2.2** Helix 5-25 Micro-Rebar replaces shrinkage and temperature reinforcement in non-composite stay in place form steel deck applications.

**4.2.3** Helix 5-25 Micro Rebar may be used in any concrete structure where reinforcement is not required by the IBC or

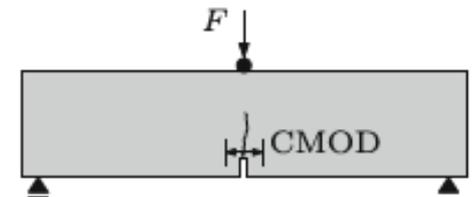
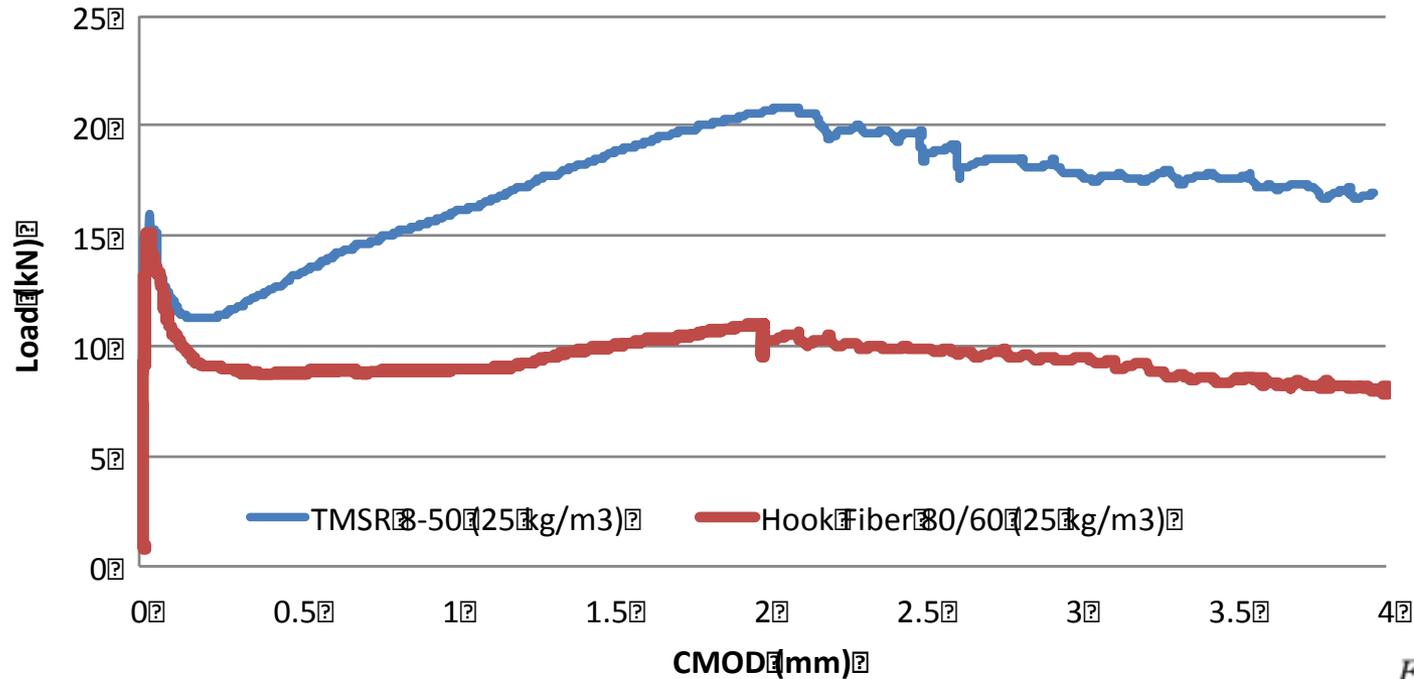
The product described in this Uniform Evaluation Service (UES) Report has been evaluated as an alternative material, design or method of construction in order to satisfy and comply with the intent of the provisions of the code, as noted in this report, and for at least equivalence to that prescribed in the code in quality, strength, effectiveness, fire resistance, durability and safety, as applicable, in accordance with IBC Section 104.11.

Copyright © 2016 by International Association of Plumbing and Mechanical Officials. All rights reserved. Printed in the United States. No part of this publication may be reproduced, stored in an electronic retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the publisher. Pn: 1-877-4IESRPT • Fax: 909-472-4171 • web: www.uniform-es.org • 4755 East Philadelphia Street, Ontario, California 91761-2616 - USA



# Failed Section Testing – EN 14651

## EN14651:2005



Performs 100% better than leading (80/60) hook ended fiber in notched Beam Test in Normal Strength Concrete (Testing done by Sika)

**Table 1**  
Variation of main mix composition and compressive strength.

Mix composition	A	B	C	D	E
Total cementing materials (kg/m <sup>3</sup> )	775	775	900	900	900
Silica fume (%)	15%	15%	17.5%	17.5%	17.5%
Water/Binder ratio	0.23	0.23	0.23	0.24	0.24
Water/Cement ratio	0.27	0.27	0.27	0.28	0.28
Fine aggregate (%)	45%	60%	60%	50%	100%
- Coarse sand (%)	76%	100%	70%	70%	70%
- Dune sand (%)	24%	0%	30%	30%	30%
Coarse aggregate (%)	55%	40%	40%	50%	0%
28 days compressive strength (MPa)	88	92	110	95	85
91 days compressive strength (MPa)	105	110	135	115	100

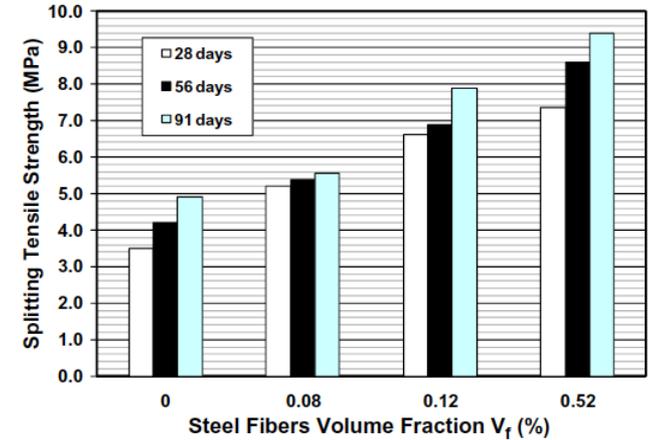
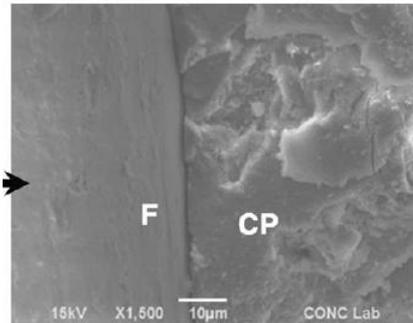
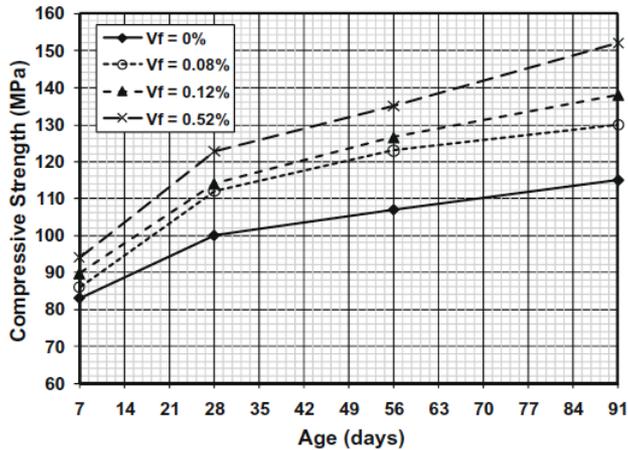
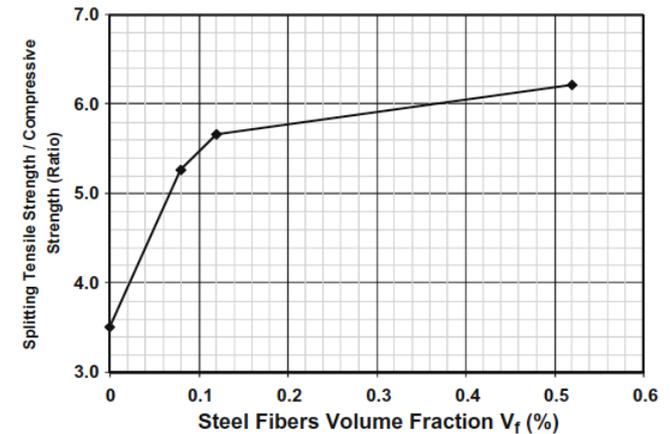
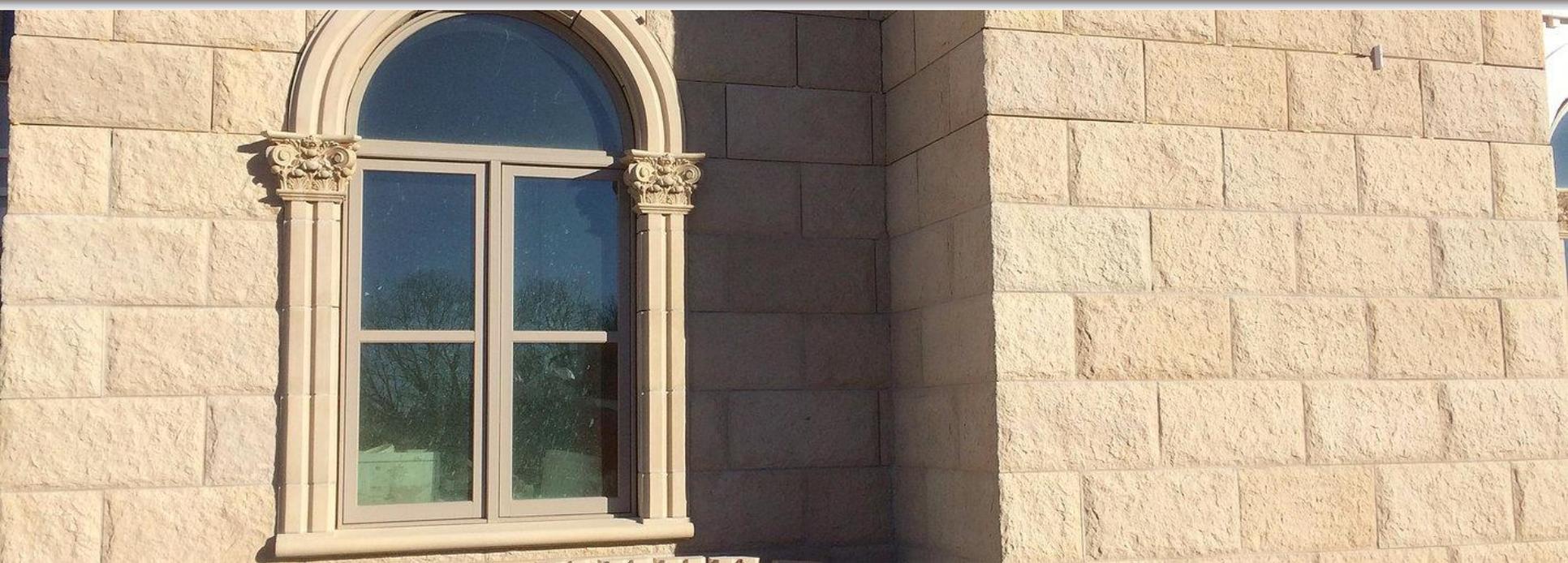


Fig. 5. Splitting tensile strength for different steel fiber volume fraction.

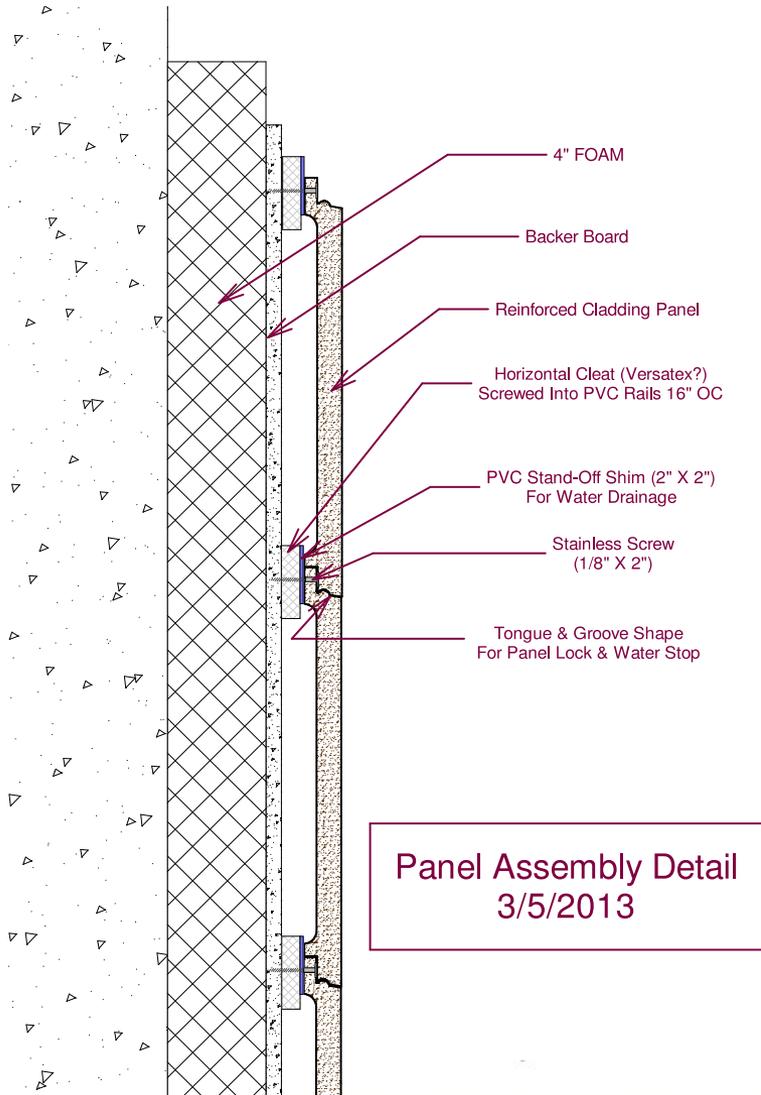


## Cladding: The Pensmore Estate



Category: Precast  
Contractor: Huff Construction  
Location: Highlandville, Missouri  
Application: Cladding  
Original Design: 1" thick Cladding Panels  
TSMR Dosage: 1" thick Cladding Panels with 150 lb/yd<sup>3</sup>  
(100 kg/m<sup>3</sup>)

# Cladding System



High Strength  
Mortar

$w/c = 0.35$   
150 lb/yd TSMR  
 $F'c = 13,000$  psi



# Cladding System



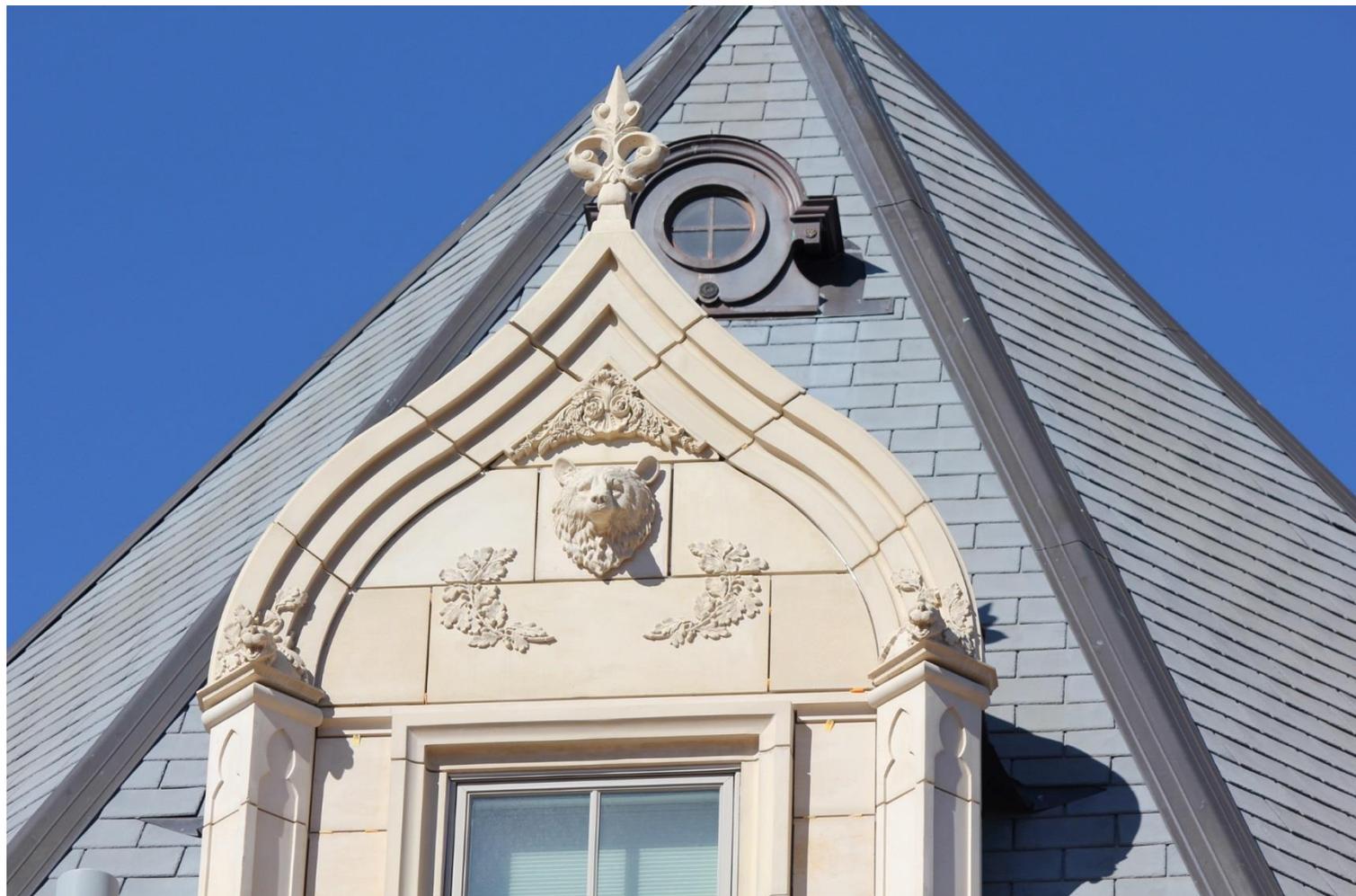
# Cladding System



# Cladding System



# Cladding System



# Twisted Steel Micro Reinforcement



Rebar Only  
2 Layers #3 at 100 mm  
100 mm thick Panel

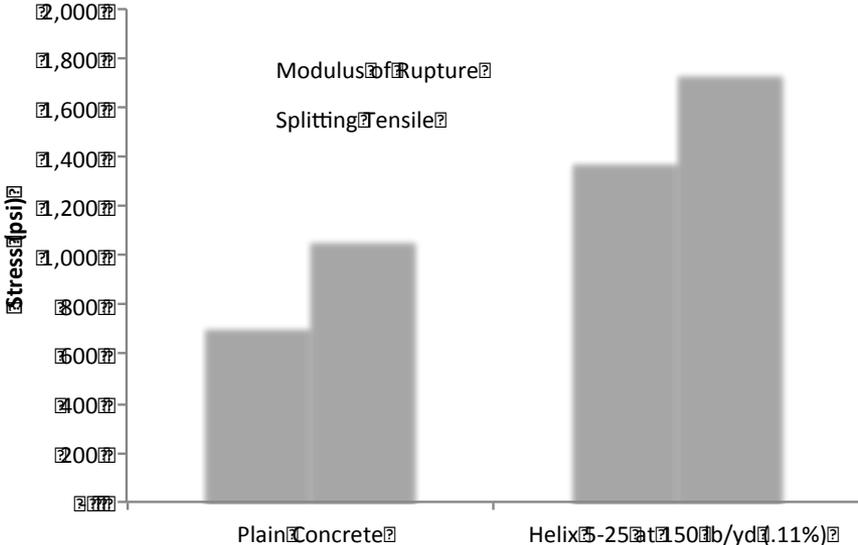
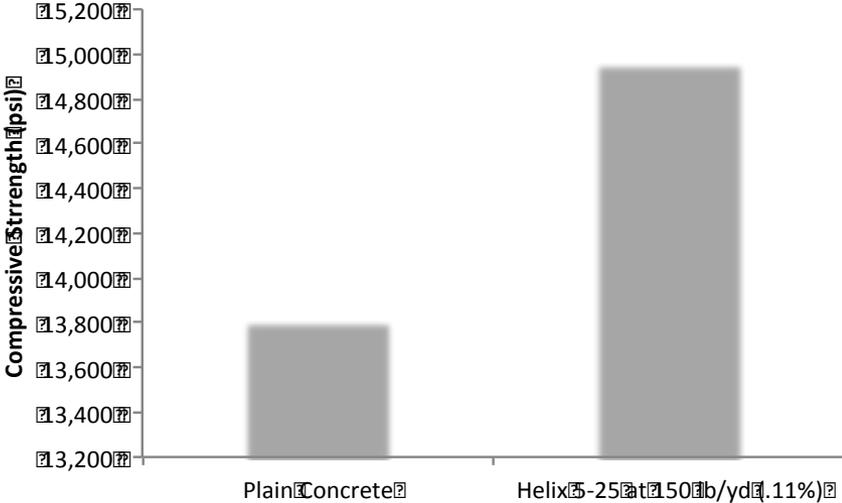


10 lb (4.5 kg) C4



TSMR 5-25 at 30 kg/m<sup>3</sup>  
2 layers #3 at 150 mm  
100 mm thick panel

# Basic Properties



# Cladding Fabrication



# Cladding Fabrication



## Detail/Decorative Panels



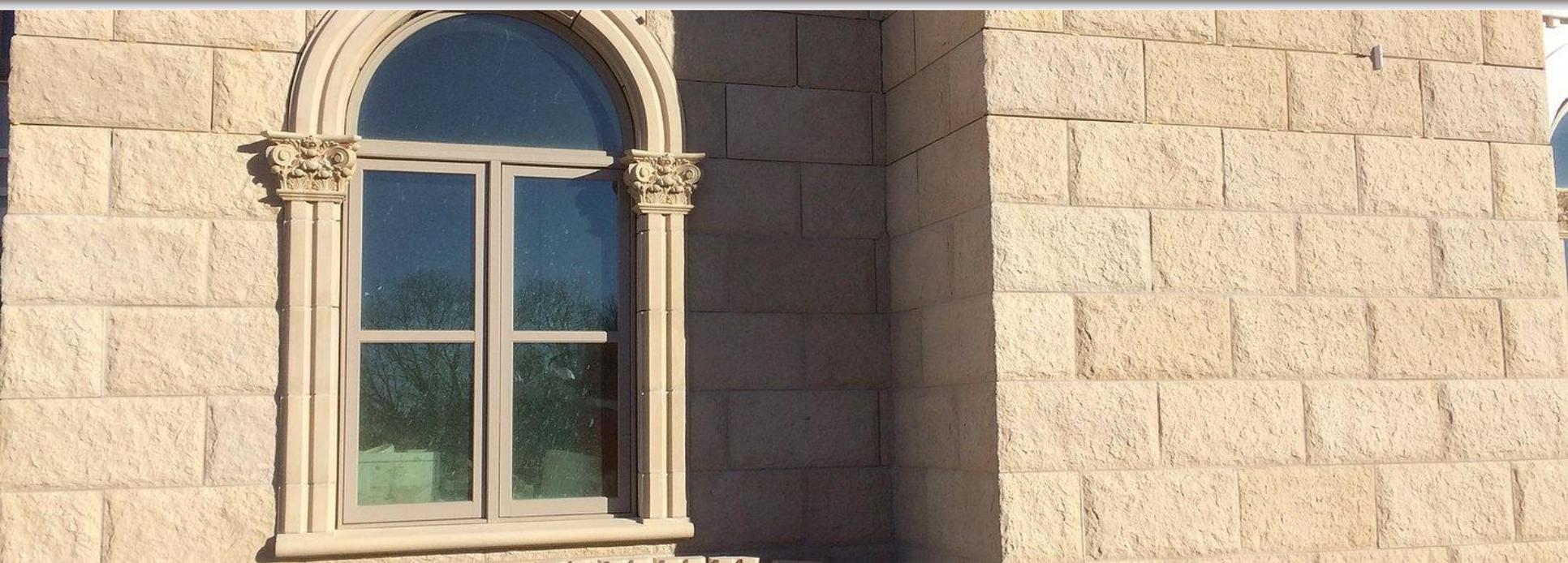
## Detail/Decorative Panels



# Gargoyles



## Cladding: The Pensmore Estate



Category: Precast  
Contractor: Huff Construction  
Location: Highlandville, Missouri  
Application: Cladding  
Original Design: 1" thick Cladding Panels  
TSMR Dosage: 1" thick Cladding Panels with 150 lb/yd<sup>3</sup>  
(90 kg/m<sup>3</sup>)

- Naaman, Antione, E. “New Fiber Technology”, Concrete International, American Concrete Institute, July 1998
- C Sujivorakul, “Development of high performance fiber-reinforced cement composites using twisted polygonal steel fibers”.- 2002
- Wille, K., Parra-Montesinos, G.: Effect of Beam Size, Casting Method and Support Conditions on Flexural Behavior of Ultra High Performance Fibre Reinforced Concrete. ACI Materials Journal, May June (2012) 379-388
- A.S. El-Dieb, Mechanical, durability and microstructural characteristics of ultra-high-strength self-compacting concrete incorporating steel fibres, Materials and Design, 30 (2009) 4286–4292.
- Pinkerton, L., Stecher, J., Novak, J., Twisted Steel Micro Reinforcement. Concrete International, Vol 35, No. 10 (2013).

Thank you to Steve Huff for providing access to Pensmore and allowing photographs of cladding manufacture

# Tunnel Linings: East Side Access NYC



Category: Underground  
Contractor: Frontier-Kemper  
Location: Manhattan, New York  
Application: Cast in Place Tunnel Lining  
Helix Dosage: 50-70 lb/yd<sup>3</sup> (30-42 kg/m<sup>3</sup>)

Helix Steel has been able to meet both the concrete reinforcement specification for the MTA's East Side Access project and deliver on the demanding supply schedule.  
– Leon "Lonnie" Jacobs, Frontier Kemper

# Shear Walls: Icon 330

Increased Speed of Construction by 16 days,  
while Reducing Carbon Footprint by 186 tons.

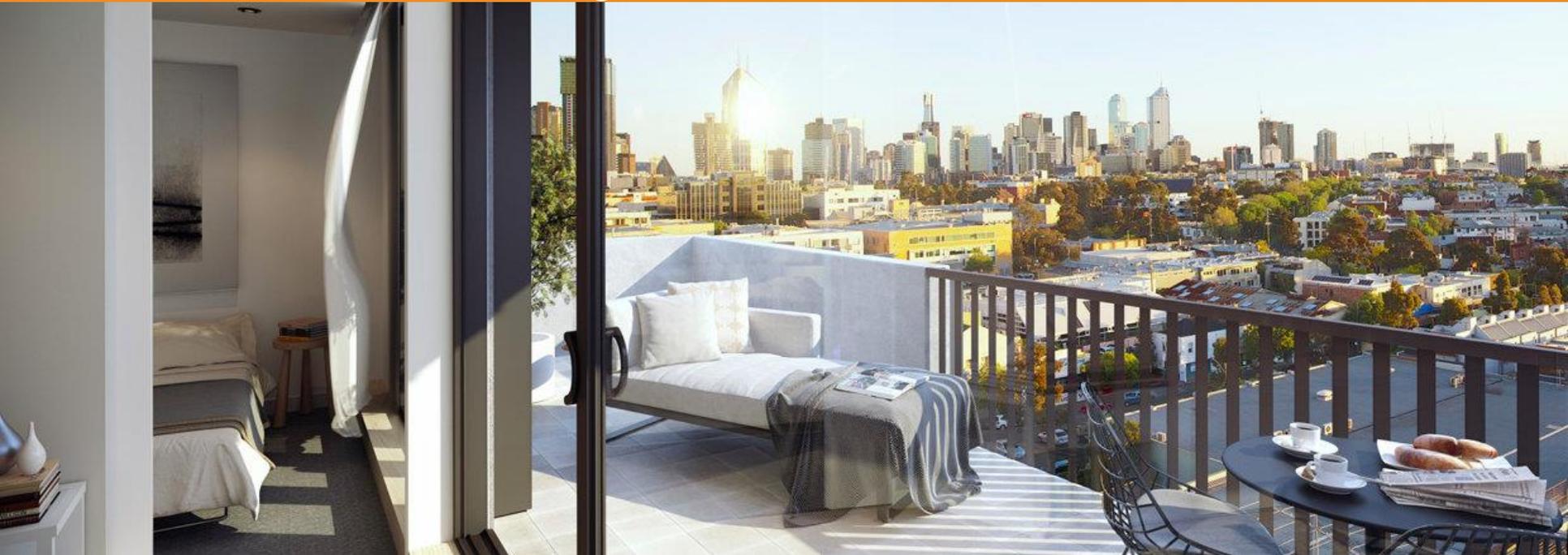


Category: Residential High Rise  
Contractor: XDG Construction  
Location: Waterloo, Ontario, Canada  
Application: Shear Walls  
Original Design: 10'' Wall with 2-Layers 15M @24''  
OCEW  
Helix Dosage: 10'' Wall w/10 lbs/yd<sup>3</sup> (6 kg/m<sup>3</sup>)  
15M @ 15'' OC Horizontal,  
15M @ 21'' OC Vertical

## ADDED HELIX STEEL VALUE IN WALLS

Increase in Shear Strength:	70%
Increase in Modulus of Rupture:	18%
Increase in Durability:	19%
Increase Speed of Construction:	16 Days
Reduction in Carbon Footprint:	186 Tons

# High-rise Foundation, Slab and Wall: Helios



Category: Commercial  
Partner: Helix Australia  
Location: North Melbourne Victoria, Australia  
Application: Slab on Grade, Slab on Metal Deck Pad, Crane and Strip Footings, AFS Walls  
Helix Design: SOG - 8 kg/m<sup>3</sup>. (13.5 lb/yd<sup>3</sup>)  
SOMD - 20 kg/m<sup>3</sup> . (33 lb/yd<sup>3</sup>) and N12-200 EW TOP and N16-200 EW BTM Pad & Crane Footings Helix Hybrid Design Strip Footings - 8 kg/m<sup>3</sup>. (13.5 lb/yd<sup>3</sup>)



Helix Steel has enabled us to accelerate our construction timelines by eliminating a lot of the steel.

– Anthony Edwards

**HELIX**<sup>TM</sup>  
A Pensmore<sup>TM</sup> Company

# Slab on Metal Deck: Behr Automotive



Category: Commercial  
Contractor: Barnes & Sweeney  
Location: Troy, Michigan  
Application: Slab on Grade, Slab on Metal Deck  
Original Design: 4" SOG with 6x6, W2.1/W2.1 mesh  
4" SOMD with 6x6, W2.1/W2.1 mesh  
Helix Dosage: SOG and SOMD with 9 lb/yd<sup>3</sup> (6 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 194%  
Increase in Modulus of Rupture: 9%  
Increase in Durability: 22%  
Increased Speed of Construction: 10 Days

# Tornado Resistance: The Pensmore Estate

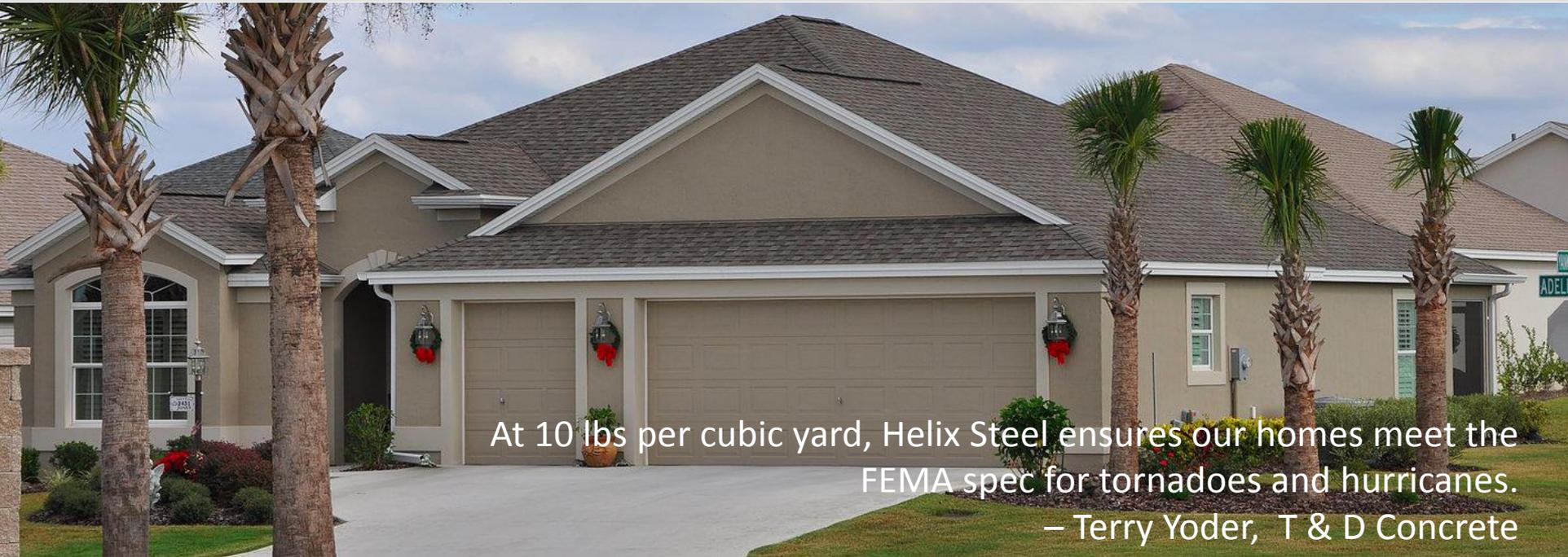


Category: Residential  
Contractor: Huff Construction  
Location: Highlandville, Missouri  
Application: Walls, Slabs, Precast Trim and Cladding  
Helix Dosage: Walls - 22.5 - 45 lbs/yd, (27 kg/m<sup>3</sup>)  
Slabs - 34 lbs/yd (20 kg/m<sup>3</sup>)  
Roof - 60 lbs/yd (36 kg/m<sup>3</sup>)  
Cladding - up to 140/lbs/yd<sup>3</sup> (85 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE IN WALLS

Increase in Shear Strength: 247%  
Increase in Modulus of Rupture: 23%  
Increase in Durability: 38%

# Above Grade Walls: The Villages Florida



At 10 lbs per cubic yard, Helix Steel ensures our homes meet the FEMA spec for tornadoes and hurricanes.  
– Terry Yoder, T & D Concrete

Category: Residential  
Contractor: T & D Concrete  
Location: The Villages, Florida  
Application: Poured Walls, Floors, Foundations  
Original Design: 6x6, W2.9 /W2.9 WWF Wire Mesh  
Helix Dosage: 10 lbs/yd<sup>3</sup> (6 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	96%
Increase in Modulus of Rupture:	18%
Increase in Durability:	17%
Number of Homes:	8032 Homes
Reduction in Carbon Footprint:	117,000 Tons

# ICF Condos: Indigo Green Development



Category: Residential  
Contractor: Indigo Green Development  
Location: Indigo Bay, St Maarten, Caribbean  
Application: Walls, Slabs, Stairs  
Helix Dosage: 8" Walls -15 lb/yd<sup>3</sup> (9 kg/m<sup>3</sup>) with 1 Layer  
#3 @ 18'  
Slabs , Stairs - 9 lbs/yd<sup>3</sup> (6 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE IN WALLS

Increase in Shear Strength:	96%
Increase in Modulus of Rupture:	18%
Increase in Durability:	19%

# Foundations and Slabs: Kone Central



Category: Commercial  
Contractor: Ryan Companies & Treiber Construction  
Location: Moline, Illinois  
Application: Slab on Grade, Slab on Metal Deck,  
Topping  
Original Design: SOG - 13.5" with #5@12" OCEW T&B  
SOMD - 10" section with #5@15" OC  
Topping - 4.25" with plastic fibers  
Helix Dosage: SOG 18 lb/yd<sup>3</sup> + #5@12" OC;  
SOMD 13.5 lbs/yd<sup>3</sup>, Topping 5 lbs/yd<sup>3</sup>

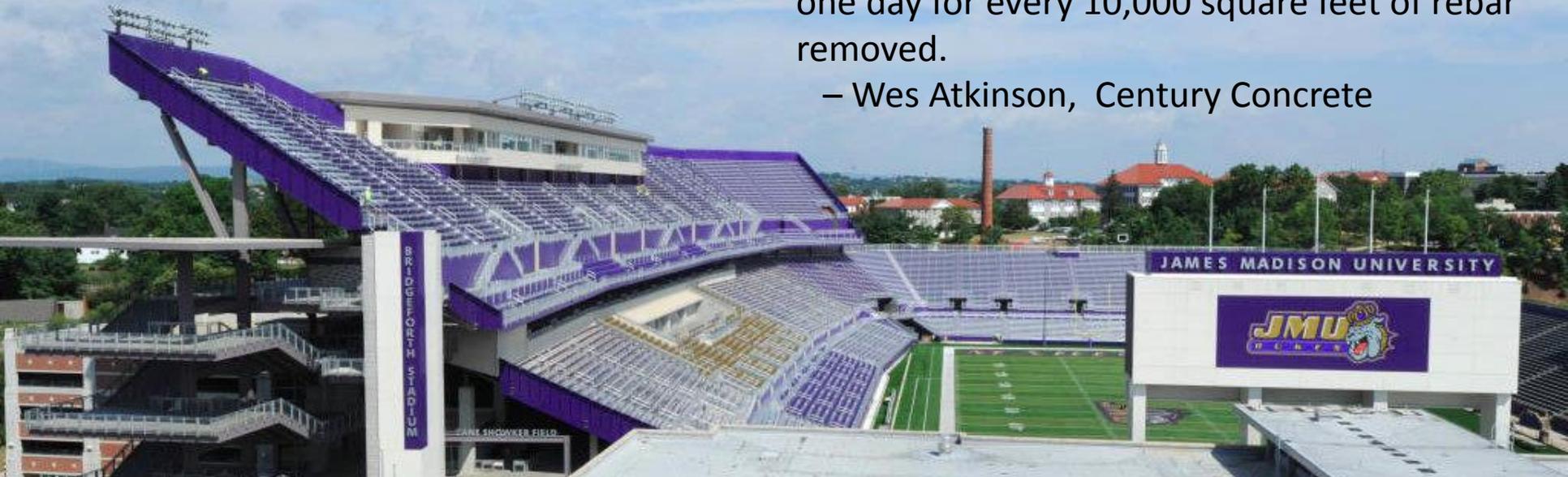
## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 243%  
Increase in Modulus of Rupture: 25%  
Increase in Durability: 44%  
Increased Speed of Construction: 11 Days  
Reduction in Carbon Footprint: 55 Tons

# Slab on Grade and Deck: JMU Stadium

By using Helix Steel, Century Concrete saved one day for every 10,000 square feet of rebar removed.

– Wes Atkinson, Century Concrete



Category: Infrastructure  
Contractor: Century Concrete  
Location: Harrisonburg, Virginia  
Application: Slab on Grade, Slab on metal deck, Topping & Stairs  
Original Design: SOG with 6x6, 2.9W x 2.9W  
SOMD with 4x4, 3.5W x 3.5W  
Helix Dosage: SOG & SOMD, 15 lb/yd<sup>3</sup> (8 kg/m<sup>3</sup>)  
Topping & Stairs, 9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	291%
Increase in Modulus of Rupture:	29%
Increase in Durability:	20%
Increased Speed of Construction:	25 Days
Reduction in Carbon Footprint:	175 Tons

**HELIX**<sup>™</sup>  
A Pensmore<sup>™</sup> Company

# Slab on Grade & Metal Deck: Landmark Hospital



Category: Commercial  
Contractor: Hoffman Construction Company  
Location: Missouri  
Application: Slab on Metal Deck  
Original Design: 4.5" (115 mm) thick section,  
1 layer of W2.0 bars at 5.7" (150 mm)  
Helix Dosage: 4.5" (115 mm) thick section,  
9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	177%
Increase in Modulus of Rupture:	3%
Increase in Durability:	15%
Increased Speed of Construction:	15 Days
Reduction in Carbon Footprint:	41 Tons

# Slab on Grade & Metal Deck: Wakefield High



Category: Commercial  
Contractor: Century Concrete  
Location: Arlington, Virginia  
Application: Slab on Grade, Slab on Metal Deck  
Original Design: 6" SOG with 6x6, 2.9W x 2.9W  
5.25" SOMD with 6x6, 2.9W x 2.9W  
4.5" SOMD with 6x6, 1.4W x 1.4W  
4" SOMD with 6x6, 1.4W x 1.4W  
Helix Dosage: 9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 192%  
Increase in Modulus of Rupture: 18%  
Increase in Durability: 22%  
Increased Speed of Construction: 30 Days  
Reduction in Carbon Footprint: 245 Tons

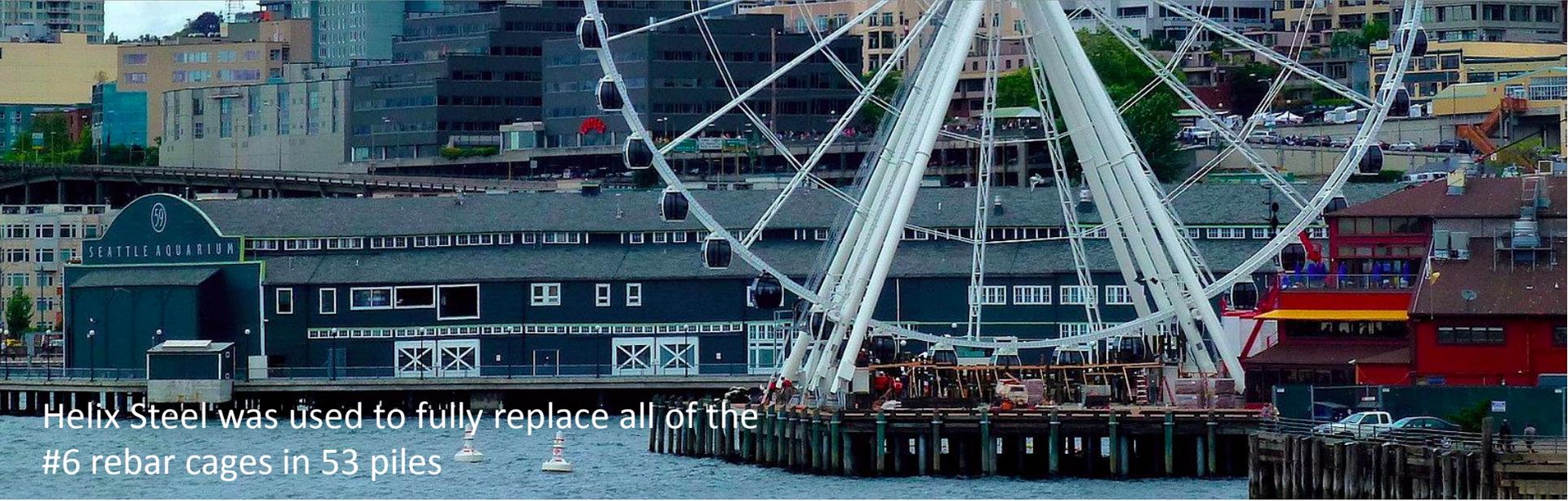
# Slab on Grand and Metal Deck: MSU Cyclotron



Category: Commercial  
Contractor: Granger Construction  
Location: East Lansing, Michigan  
Application: Slab on Grade and Slab on Metal Deck  
Original Design: 3.5" thick sections, 6x6, W3.0/W3.0 mesh  
Helix Dosage: 3.5" thick sections with 9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

ADDED HELIX STEEL VALUE  
Increase in Shear Strength: 194%  
Increase in Modulus of Rupture: 18%  
Increase in Durability: 22%  
Increased Speed of Construction: 7 Days  
Reduction in Carbon Footprint: 33 Tons

# Pile Foundations: Seattle Pier 57



Helix Steel was used to fully replace all of the #6 rebar cages in 53 piles

Category: Infrastructure  
Contractor: Manson Construction  
Location: Seattle, Washington  
Application: Pier Foundation  
Original Design: 30" piles, 8- #6 w/ #3@12" hoop  
Helix Dosage: 25 lb/yd<sup>3</sup> (15 kg/m<sup>3</sup>) and 31.5 lb/yd<sup>3</sup> (19 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	111 %
Increase in Modulus of Rupture:	40 %
Increase in Durability:	45 %
Increased Speed of Construction:	4 Days
Reduction in Carbon Footprint:	40 Tons

# Foundation Slabs: Wind Farm



Category: Infrastructure  
Contractor: Leighton Constructions  
Location: Macarthur, Victoria AUS  
Application: Wind Turbine Foundation  
Original Design: N24 bar at 140mm each way  
Helix Dosage: 18 kg/m<sup>3</sup> (30 lb/yd<sup>3</sup>)



# Heavy Slab on Grade: Misa Steel



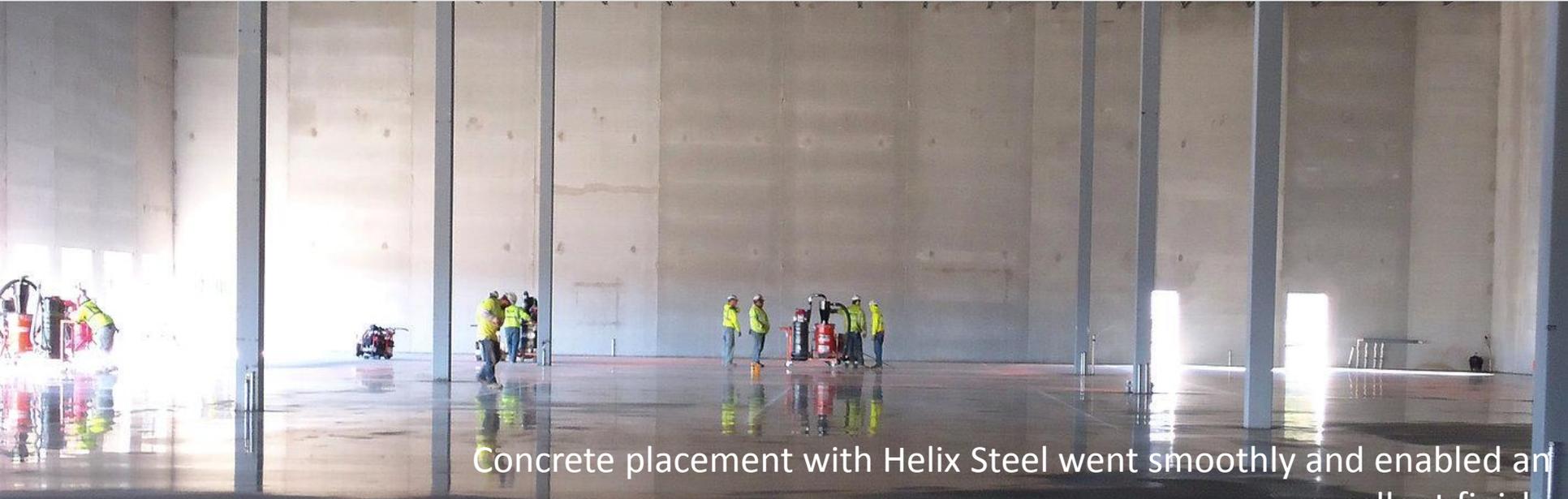
After more than two and a half years of daily usage, the SOG is in excellent condition, without a single crack. – Juan Aguilera Villarreal, Tecnor

Category: Industrial  
Contractor: Tecnor  
Location: Pesqueria, Nuevo Leon, Mexico  
Application: Exterior Slab on Grade  
Original Design: 1 layer of #6 rebar at 12"  
Helix Dosage: 30 lb/yd<sup>3</sup> (18 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 585 %  
Increase in Modulus of Rupture: 18 %  
Increase in Durability: 60 %  
Increased Speed of Construction: 40 Days  
Reduction in Carbon Footprint: 771 Tons

# Distribution Slab on Grade: FedEx Rogers



Concrete placement with Helix Steel went smoothly and enabled an excellent finish.  
– Kinghorn Construction

Category: Commercial  
Contractor: Kinghorn Construction  
Location: Rogers, MN  
Application: Slab on Ground, Interior and Exterior  
Original Design: Interior SOG 6" w/#3 Bars @ 18" OCEW  
Exterior SOG 8" w/#4 Bars @ 18" OC  
Helix Dosage: Interior & Exterior slabs; 9 lb/yd<sup>3</sup> (6 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	163 %
Increase in Modulus of Rupture:	21 %
Increase in Durability:	23 %
Increased Speed of Construction:	12 Days

# Foundation Slabs: Monterrey International Airport



Category: Infrastructure  
Contractor: Tecnor  
Location: Apodaca, Nuevo León, Mexico  
Application: Slab on Grade, Terminal Foundation  
Original Design: #3 Rebar @ 14" OCEW  
Helix Dosage: SOG 10 lb/yd<sup>3</sup> (6 kg/m<sup>3</sup>)  
Foundation Slab 10 lb/yd<sup>3</sup> (6 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	224%
Increase in Modulus of Rupture:	10%
Increase in Durability:	25%
Increased Speed of Construction:	20 Days
Reduction in Carbon Footprint:	88 Tons

# Pavements: BP Service Station

We required less resources on the job,  
including people, material and equipment.

– iCrete Commercial Concrete



Category: Industrial  
Contractor: iCrete Commercial Concrete  
Location: Melton, Victoria, Australia  
Application: Slabs, Footers, Heavy Pavements  
Original Design: Slabs and Heavy Pavement, SL92 mesh  
Footers, SL102 Mesh  
Helix Dosage: Slabs & Heavy Pavement, 7 kg/m<sup>3</sup> (12 lb/yd<sup>3</sup>)  
Footers, 11 kg/m<sup>3</sup> (18.5 lb/yd<sup>3</sup>)



# Industrial Slab on Grade: Detroit Diesel



Category: Industrial  
Contractor: Aristeo Construction  
Location: Detroit, Michigan  
Application: Slab on Grade  
Original Design: 2 layers of #4 @ 12"  
Helix Dosage: 15 lb/yd<sup>3</sup> (9 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 133 %  
Increase in Modulus of Rupture: 12 %  
Increase in Durability: 30 %  
Increased Speed of Construction: 10 Days  
Reduction in Carbon Footprint: 38 Tons

# Slab on Metal Deck: Helen Devos Hospital



Category: Commercial  
Contractor: Kent Companies  
Location: Grand Rapids, MI  
Application: Slab on Metal Deck  
Original Design: 4.5" thick section with  
1 layer of 6X6, W2.5/W2.5 mesh  
Helix Dosage: 4.5" thick section with 8 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 194%  
Increase in Modulus of Rupture: 18%  
Increase in Durability: 22%  
Increased Speed of Construction: 10 Days  
Reduction in Carbon Footprint: 63 Tons

**HELIX**<sup>TM</sup>  
A Pensmore<sup>TM</sup> Company

# Precast Pipe: Premarc



Category: Precast  
Contractor: Premarc Corporation  
Location: Durant, Michigan  
Application: Multi Compartment Tank  
Original Design: 12" Concrete Pipe, 1 layer W5 bars at 6  
Helix Design: 12" Concrete Pipe, 30 lb/yd<sup>3</sup> (18 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength: 465 %  
Increase in Modulus of Rupture: 28 %  
Increase in Durability: 62 %

## Muticompartment Precast Tans:Title



Category: Precast  
Contractor: Dalmaray Precast Concrete Products  
Location: Janesville, Wisconsin  
Application: Multi Compartment Tank  
Original Design: Custom Heavy Mesh equivalent to #3 rebar at 12" OCEW.  
Helix Design: 80 lb (36 kg) of Helix per tank along with a single "ring bar" around the top edge of tank.

Since using Helix Steel our work-force does not have to deal with the stress and strain of lifting and placing heavy rebar and mesh mats.  
– Vice President – Aaron Ausen

# 15,000 Gallon Tank: Old Castle Precast

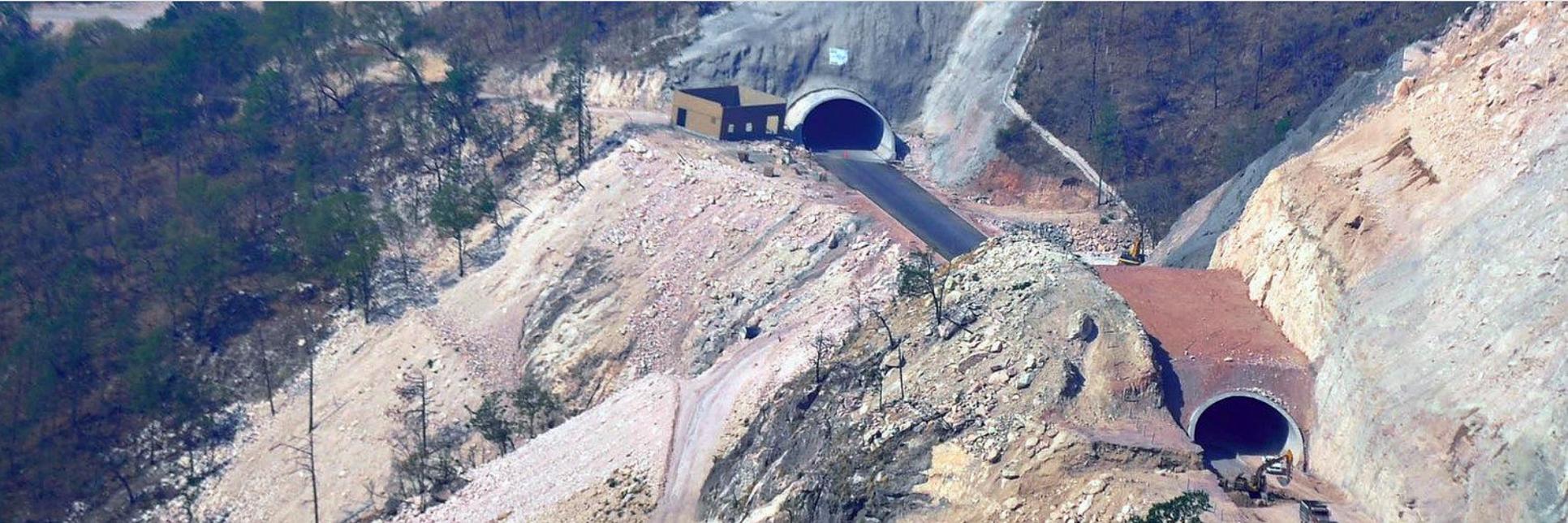
I'm pretty thrilled with how the Helix is working with our designs. It is saving a lot of labor.

– Precast Engineer - Kim Fenstresserry

Category: Precast  
Contractor: Old Castle Precast/Colorado Precast  
Location: Loveland, Colorado  
Application: 15,500 gallon tank  
Original Design: Rebar & Mesh  
Helix Dosage: Hybrid with 45 lbs/yd<sup>3</sup> (27 kg/m<sup>3</sup>)



# Shotcrete: Durango Mazatlan Tunnels



Category: Underground  
Contractor: Tecnor  
Location: Mazatlan, Mexico  
Application: Shotcrete  
Helix Dosage: 9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

**ADDED HELIX STEEL VALUE**  
Increase in Shear Strength: 194%  
Increase in Modulus of Rupture: 18%  
Increase in Durability: 22%  
Increased Speed of Construction: 7 Days  
Reduction in Carbon Footprint: 33 Tons

## Underground Works: Rio Tinto



Category: Underground  
Contractor: Tecnor  
Location: Queensland, Australia  
Application: Slab on Grade, Roads, Walkways  
Original Dosage: Mesh & Rebar  
Helix Dosage: 9 lb/yd<sup>3</sup> (5 kg/m<sup>3</sup>)

Helix Steel creates a safer work environment, increases productivity, reduces our costs, produces a stronger slab and removes any issues with steel placement.

– Projects Co-ordinator, Kestrel Coal -Rio Tinto

# ICF Single Family Home: Carew Residence



Category: Residential  
Contractor: TF Forming Systems  
Location: Appleton, Wisconsin  
Application: Foundation Walls  
Helix Dosage: 9 lbs/yd<sup>3</sup>

By incorporating Helix Steel in our design, we attained a higher level of structural reinforcement.

– Richard Mortlock, TF Forming Systems

# *Suspended Residential Slabs: Acubuild*



Category: Residential  
Client: AcuBuild  
Location: New South Wales, Sydney, Australia  
Application: Foundation Walls, Slabs and Stairs  
Helix Dosage: 5 kg/m<sup>3</sup> (9 lb/yd<sup>3</sup>)

Helix Steel was designed into a suspended slab, ICF walls and the stairs.  
– Kevin Fuller, Helix Steel Australasia.

# Machine Foundation: Dowding Industries



Category: Industrial  
Contractor: Granger Construction Company  
Location: Eaton Rapids, Michigan  
Application: Industrial Slab on Grade  
Original Design: 36" SOG with 2 layers of #6 rebar at 15"  
Helix Dosage: 10 lb/yd<sup>3</sup> (6 kg/m<sup>3</sup>)



**HELIX**<sup>™</sup>  
A Pensmore<sup>™</sup> Company

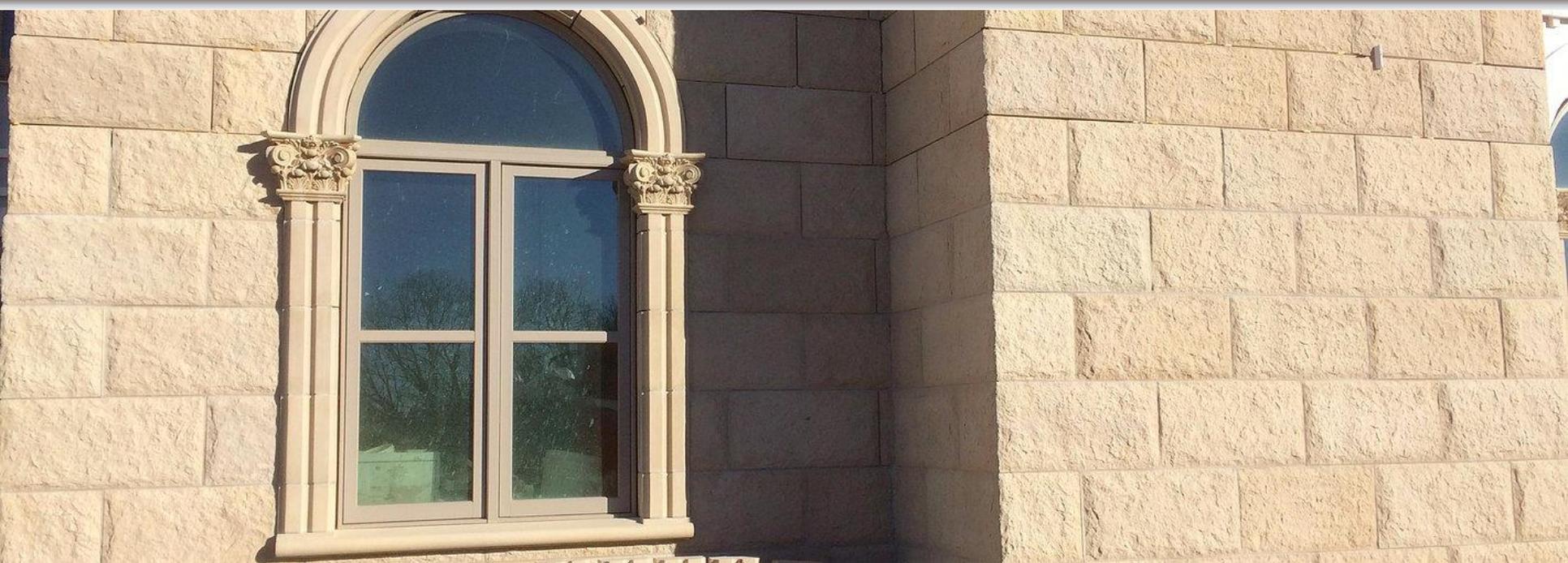
# Precast Walls: Aftec Wall Systems



Category: Precast  
Contractor: StoneTree Walls of Florida  
Location: Salt Lake City, Utah  
Application: Wall Systems  
Original Design: Rebar & Mesh  
Helix Dosage: Hybrid with 50 lbs/yd<sup>3</sup> (30 kg/m<sup>3</sup>)

At 50 lb/yd<sup>3</sup>, the Helix Steel design ensures the wall systems can withstand winds up to 150 mph.

## Cladding: The Pensmore Estate



Category: Precast  
Contractor: Huff Construction  
Location: Highlandville, Missouri  
Application: Cladding  
Original Design: 1" thick Cladding Panels  
Helix Dosage: 1" thick Cladding Panels with 166 lb/yd<sup>3</sup>  
(100 kg/m<sup>3</sup>)

### ADDED HELIX STEEL VALUE

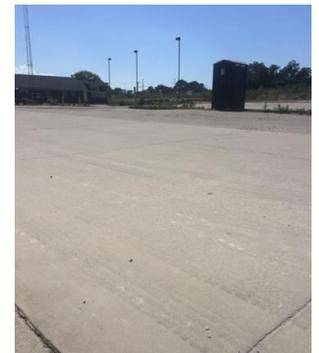
Increase in Shear Strength:	1191 %
Increase in Modulus of Rupture:	98 %
Increase in Durability:	302 %

# Pavements: Martin Marietta Aggregates



Category: Infrastructure  
Contractor: Capital Concrete  
Location: Columbia, South Carolina  
Application: Heavy Pavement  
Original Design: 12" Concrete Pavement  
Helix Dosage: 6" Concrete Pavement with 30 lbs/yd<sup>3</sup>  
(18 kg/m<sup>3</sup>)

By using Helix Steel, we were able to reduce the pavement thickness in half.



**HELIX**<sup>TM</sup>  
A Pensmore<sup>TM</sup> Company

# Jointless Slab on Grade: Alstom



Category: Industrial  
Contractor: Ryan Companies  
Location: Amarillo, Texas  
Application: Industrial Slab on Grade,  
Foundations  
Original Design: 2 layers of #5 @ 14"  
Helix Dosage: 25 lb/yd<sup>3</sup> (15 kg/m<sup>3</sup>)

## ADDED HELIX STEEL VALUE

Increase in Shear Strength:	264 %
Increase in Modulus of Rupture:	16 %
Increase in Durability:	51 %
Increased Speed of Construction:	6 Days
Reduction in Carbon Footprint:	30 Tons

**HELIX**<sup>™</sup>  
A Pensmore<sup>™</sup> Company

# Industrial Pavements: ABB High Voltage



Category: Industrial  
Contractor: Swederski Concrete Construction, Inc.  
Location: Charlotte, North Carolina  
Application: Exterior Pavements  
Original Design: 2 layers of #5 rebar @12"  
Helix Dosage: 27 lb/yd<sup>3</sup> (16 kg/m<sup>3</sup>)

ADDED HELIX STEEL VALUE  
Increase in Shear Strength: 283 %  
Increase in Modulus of Rupture: 51 %  
Increase in Durability: 36 %  
Increased Speed of Construction: 21 Days  
Reduction in Carbon Footprint: 600 Tons

## Precast Storm Shelters: Lee's Precast



Category: Precast  
Contractor: Lee's Precast Concrete, INC  
Location: Aberdeen, Mississippi  
Application: Precast Storm Shelter  
Helix Dosage: 18 lb/yd<sup>3</sup> (11 kg/m<sup>3</sup>)

We have used Helix Steel every day for years. It works, saves time and money, and our team loves it!

– General Manager - Allen Lee