



## Florida Department of Transportation

RICK SCOTT  
GOVERNOR

605 Suwannee Street  
Tallahassee, FL 32399-0450

JIM BOXOLD  
SECRETARY

### **STRUCTURES DESIGN BULLETIN 15-10**

*(FHWA Approved: November 30, 2015)*

DATE: December 1, 2015

TO: District Directors of Transportation Operations, District Directors of Transportation Development, District Design Engineers, District Construction Engineers, District Structures Design Engineers, District Maintenance Engineers

FROM: Robert V. Robertson, P. E., State Structures Design Engineer

A blue ink signature of Robert V. Robertson, the State Structures Design Engineer.

COPIES: Brian Blanchard, Tom Byron, Tim Lattner, David Sadler, Bruce Dana, Gregory Schiess, Trey Tillander, SDO Staff, Jeffrey Ger (FHWA)

SUBJECT: Prestressed Concrete Piles with Fiber Reinforced Polymer and Stainless Steel Reinforcing and Prestressing Strand

This bulletin introduces policy for the use of Prestressed Concrete Piles with stainless steel and fiber reinforced polymer (FRP) strand and reinforcing. This bulletin also announces the release of the following items:

- *Specifications* for FRP strand and reinforcing, stainless steel strand and reinforcing, and low-carbon chromium steel reinforcing.
- *Design Standards* for Square and Cylinder Prestressed Concrete Piles with Carbon Fiber Reinforced Polymer (CFRP) and Stainless Steel Strand and Reinforcing

### **REQUIREMENTS**

1. Replace *Structures Design Guidelines* Section 1.4.3.G.2 with the following:
2. Specify the use of silica fume, metakaolin or ultrafine fly ash in all:
  - a. Piles of pile bents with carbon or stainless steel strand, spirals and/or reinforcing.
  - b. Retaining walls, including MSE walls located within the splash zone and within 50 feet of the shoreline.
  - c. Substructure elements, excluding footings, located within the splash zone.

2. Replace *Structures Design Guidelines* Section 3.5.1.F with the following:

F. Minimum size and material requirements:

1. Fender Systems: 14-inch square piles with uncoated strand per *Specifications* Section 933, carbon steel reinforcing bar and spiral per *Specifications* Section 931, and concrete and admixtures per *SDG* Table 1.4.3-1 and *SDG* 1.4.3.G.2.
2. Vehicular and Pedestrian Bridges and Fishing Piers per Table 3.5.1-1:

ARCHIVED

**Table 3.5.1-1 Concrete Pile Size and Material Requirements**

Pile Location			Minimum Square Pile Size (inches)		Minimum Cylinder Pile Diameter (inches)	Material Properties for All Pile Sizes <sup>1</sup>		
			Vehicular Bridges	Pedestrian Bridges & Fishing Piers		Strand Type	Spiral Type	Reinforcing Bar Type
Pile Bents	On land or in water in environments that are Extremely Aggressive due to chlorides	Widenings	24 <sup>2</sup>	18	54	Carbon steel, Spec 933	Carbon steel, Spec 931	Carbon steel, Spec 931
		New bridges and fishing piers <sup>3</sup>	24	18	54	Carbon steel, Spec 933	Carbon steel, Spec 931	Carbon steel, Spec 931
			18	14	54	CFRP, Spec 933	CFRP, Spec 932	GFRP or CFRP, Spec 932
	On land or in water in all other environments		18	14	54	Stainless steel, Spec 933	Stainless steel, Spec 931	Stainless steel, Spec 931
			18	14	54	Carbon steel, Spec 933	Carbon steel, Spec 931	Carbon steel, Spec 931
Footings	In water (waterline or mudline) in environments that are Extremely Aggressive due to chlorides		24 <sup>2</sup>	18	54	Carbon steel, Spec 933	Carbon steel, Spec 931	Carbon steel, Spec 931
	On land or in water (waterline or mudline) in all other environments		18	14	54	Carbon steel, Spec 933	Carbon steel, Spec 931	Carbon steel, Spec 931

<sup>1</sup> See *SDG* Table 1.4.3-1 and *SDG* 1.4.3.G.2 for concrete class and admixture requirements.

<sup>2</sup> If approved by the District Structures Maintenance Engineer, a minimum pile size of 18" may be allowed for minor widenings of substructures that will be exposed to wet/dry cycles. This decision is dependent upon site-specific conditions, anticipated structure life and the history of piles in the vicinity.

<sup>3</sup> The use of FRP or stainless steel strand and reinforcing is preferred for use in splash zones. If approved by the District Structures Maintenance Engineer, piles of the minimum sizes shown and constructed using carbon steel strand, carbon steel reinforcing and concrete with admixtures may be acceptable for substructures that will be exposed to wet/dry cycles. This decision is dependent upon site-specific conditions, anticipated structure life, the history of piles in the vicinity and project specific requirements.

**Modification for Non-Conventional Projects:**

Delete Footnotes 2 and 3 of *SDG* Table 3.5.1-1 and insert the following:

<sup>2</sup> See the RFP for minimum pile size requirements.

<sup>3</sup> See the RFP for minimum pile size and material requirements.

**3. Replace *Structures Design Guidelines* Section 9.2.1.A with the following:**

**A. Prestressed Concrete Piling; cost per linear foot (furnished and installed)**

<b>Size of Square Piling</b>	<b>Driven Plumb or 1" Batter <sup>1</sup></b>	<b>Driven Battered <sup>1</sup></b>
18-inch w/ carbon steel strand <sup>2</sup>	\$80	\$110
24-inch w/ carbon steel strand <sup>2</sup>	\$90	\$130
30-inch w/ carbon steel strand <sup>2</sup>	\$120	\$175
18-inch w/ CFRP or Stainless Steel Strand	\$122	\$152
24-inch w/ CFRP or Stainless Steel Strand	\$146	\$186
30-inch w/ CFRP or Stainless Steel Strand	\$191	\$246

<sup>1</sup> When silica fume, metakaolin or ultrafine fly ash is used, add \$6 per LF to the piling cost.

<sup>2</sup> When heavy mild steel reinforcing is used in the pile head, add \$250.

**4. Replace *Structures Design Guidelines* Section 9.2.1.F.1 with the following:**

1. Carbon Reinforcing Steel; cost per pound: \$0.90  
 Low-Carbon Chromium Reinforcing Steel; cost per pound: \$1.25  
 Stainless Reinforcing Steel; cost per pound: \$4.00

**5. Replace *Structures Design Guidelines* Section 9.2.2.D.1 with the following:**

1. Carbon Reinforcing Steel; cost per pound: \$0.95  
 Low-Carbon Chromium Reinforcing Steel; cost per pound: \$1.30  
 Stainless Reinforcing Steel; cost per pound: \$4.05

**BACKGROUND**

The use of carbon fiber strand in prestressed concrete piles has been evaluated and documented in the FDOT sponsored research report entitled: [Investigation of Carbon Fiber Composite Cables \(CFCC\) in Prestressed Concrete Piles](#).

Design and detailing criteria for the use of FRP reinforcing bars and prestressing strands were added to the *Structures Manual* as Volume 4 *Fiber Reinforced Polymer Guidelines* in January 2015. *Developmental Specifications* for FRP reinforcing bars and strands, and *Developmental Design Standards* for precast concrete sheet piles and 14", 18" and 24" square precast concrete piles have been available for use since 2014.

Over the years, stainless steel reinforcing bars have been used for specific applications on several Department owned structures located in marine environments. However, a *Standard Specification* was never developed for stainless steel reinforcing bar and neither were any *Design Standards* that included stainless steel reinforcing bars.

The use of stainless steel strand in prestressed concrete piles has been evaluated and documented in the following research reports.

Florida DOT Sponsored Report:

[Design And Construction of Precast Piles With Stainless Reinforcing Steel](#)

Georgia DOT Sponsored Reports:

1. [Corrosion-Free Precast Prestressed Concrete Piles Made With Stainless Steel Reinforcement: Construction, Test And Evaluation](#)
2. [Durability of Precast Prestressed Concrete Piles in Marine Environment, Part 2 Volume 1: Concrete](#)
3. [Durability of Precast Prestressed Concrete Piles in Marine Environment, Part 2 Volume 2: Stainless Steel Prestressing Strand and Wire](#)

## **IMPLEMENTATION**

1. These requirements are effective immediately on all design-bid-build projects in the pre-design phase. These requirements may be implemented immediately on all design-bid-build projects in Design Phase I, II, III or IV at the discretion of the District.

These requirements are effective immediately on all design build projects for which the final RFP has not been released. Design build projects for which the final RFP has been released are exempt from these requirements unless otherwise directed by the District.

2. The following *Specifications* which will be included in the [July 2016 Workbook](#) have been revised to include requirements for low-carbon chromium reinforcing steel, stainless steel strand and reinforcing, and FRP strand and reinforcing:

Specification 400 – Concrete Structures

Specification 407 – Three-Sided Precast Concrete Culvert

Specification 410 – Precast Concrete Box Culvert

Specification 415 – Reinforcing for Concrete

Specification 450 – Precast Prestressed Concrete Construction

Specification 931 – Metal Accessory Materials For Concrete Pavement And Concrete Structures

Specification 932 – Nonmetallic Accessory Materials For Concrete Pavement And Concrete Structures

Specification 933 – Prestressing Strand and Bar

3. The following new ***Design Standards*** and their associated ***Instructions for Design Standards*** will be included in the 2016 release of the FY 2016-17 ***Design Standards***:

Index 22600 – Notes and Details for Square CFRP & SS Prestressed Concrete Piles  
Index 22601 – Square CFRP & SS Prestressed Concrete Pile Splices  
Index 22612 – 12" Square CFRP & SS Prestressed Concrete Pile  
Index 22614 – 14" Square CFRP & SS Prestressed Concrete Pile  
Index 22618 – 18" Square CFRP & SS Prestressed Concrete Pile  
Index 22624 – 24" Square CFRP & SS Prestressed Concrete Pile  
Index 22630 – 30" Square CFRP & SS Prestressed Concrete Pile  
Index 22654 – 54" CFRP & SS Precast/Post-Tensioned Concrete Cylinder Pile  
Index 22660 – 60" CFRP & SS Prestressed Concrete Cylinder Pile

4. The following new Pay Items for low-carbon chromium steel reinforcing bars and FRP reinforcing bars are available:

415-3-A – Low-Carbon Chromium Reinforcing Steel  
415-10-AA – Fiber Reinforced Polymer Reinforcing Bar

5. The following new Pay Items for square and cylinder prestressed concrete piles are available:

455-34-A21 – 12" Sq. w/ FRP or Stainless Steel Strand and Reinforcing  
455-34-A22 – 14" Sq. w/ FRP or Stainless Steel Strand and Reinforcing  
455-34-A23 – 18" Sq. w/ FRP or Stainless Steel Strand and Reinforcing  
455-34-A25 – 24" Sq. w/ FRP or Stainless Steel Strand and Reinforcing  
455-34-A26 – 30" Sq. w/ FRP or Stainless Steel Strand and Reinforcing  
455-36-A1 – 54" Diameter  
455-36-A2 – 60" Diameter

6. The following ***Developmental Specifications*** related to Fiber Reinforced Polymer (FRP) strand and reinforcing will no longer be available after the July 2016 Workbook is in effect:

Dev400FRP – Concrete Structures  
Dev410FRP – Precast Concrete Box Culvert  
Dev415FRP – Reinforcing for Concrete  
Dev450FRP – Precast Prestressed Concrete Construction – Fiber Reinforced Polymer (FRP)  
Dev932FRP – Nonmetallic Accessory Materials For Concrete Pavement And Concrete Structures  
Dev933FRP – Prestressing Strand

**CONTACT**

Charles E. Boyd, P.E.  
Assistant State Structures Design Engineer  
Florida Department of Transportation  
605 Suwannee Street, MS 33  
Tallahassee, FL 32399-0450  
Phone (850)-414-4275  
[charles.boyd@dot.state.fl.us](mailto:charles.boyd@dot.state.fl.us)

RVR/CEB

ARCHIVED