ORIGINATION FORM

THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR

☒ Modify Specification _____973_____.
Section/File number

☐ New Section _____.
Section number

Subject: Bridge Fender Systems

Origination date: 3-31-11

Originator: Gevin McDaniel
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Problem statement: Composite Piles (CP) are being removed from Specification Section 973; therefore, this specification will only cover the wales and dimensional lumber utilized in bridge fender systems. The piling will be handled by performance specification within Section 471, which is currently the construction specification for bridge fender systems.

Information source: Jerry Hocking, Robert Robertson, Andre Pavlov, Charles Boyd

Background data: Vendors producing various types of polymeric piling have approached the FDOT in hopes of being placed on the QPL for bridge fender system piling. Since there is no industry standard for polymeric piling and so many possible combinations of materials (fiberglass, plastic, vinylester resin, polyester resin, polyurethane resin, various coatings, various UV inhibitors, etc.) there is no efficient way to write a material specification and accommodate a fair playing field for each vendor. Therefore, the fender system piling will be specified based on the minimum performance criteria.

Recommended Usage Note: Use for projects with bridge fender systems

Estimated fiscal impact, if

Florida Department of Transportation

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OFFICE OF THE
SECRETARY

M E M O R A N D U M

DATE: April 13, 2011

TO: Specification Review Distribution List

FROM: Rudy Powell, Jr., P.E., State Specifications Engineer

SUBJECT: Proposed Specification: 9730000 Structural Plastics.

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Gevin McDaniel of the Structures Design Office to move the material requirements for polymeric piles to Section 471 and revise some of the testing requirements for wales and dimensional lumber.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965RP or rudy.powell@dot.state.fl.us. Comments received after **April 27, 2011** may not be considered. Your input is encouraged.

RP/cah
Attachment

STRUCTURAL PLASTICS.
(REV 4-11-11)

SECTION 973 (of the Supplemental Specifications) is deleted and the following substituted:

SECTION 973
STRUCTURAL PLASTICS

973-1 Description.

This work covers structural plastic (SP) components including ~~fiberglass structurally reinforced composite piles (CP),~~ fiberglass structurally reinforced composite lumber (SCL) and smaller dimensional fiberglass fiber reinforced composite lumber (FFRCL).

973-2 Product Acceptance.

Use only products listed on the Department's Qualified Products List (QPL). Manufacturers seeking evaluation of products must submit an application in accordance with Section 6 and include independently certified test reports that the material meets the requirements of this Section.

In accordance with Section 6, provide manufacturer's certification that the material meets the requirements of this section.

973-3 Materials.

Use polyethylene made from recycled post consumer or post industrial thermoplastics. Mix the plastic with appropriate colorants, UV inhibitors, hindered amine light stabilizers and antioxidants so that the resulting product meets the material property requirements specified in Tables 1 and 2. Structural plastic must not corrode, rot, warp, splinter or crack. The skin must be smooth and black in color unless otherwise specified in the Contract Documents. Skin is the surface material exposed to the atmosphere. Core is the material that surrounds and bonds to the fiberglass reinforcing rods. The use of separate materials for skin and core is at the discretion of each manufacturer; however, if a single material is used, that material must meet the requirements for both skin and core.

Manufacture structural plastic as one continuous piece with no joints or splices to the dimensions and tolerances in accordance with Table 3. Interior voids shall not exceed ¾ inch in diameter. Structural plastic *members* shall be free of twist and curvature.

Reinforce 10" x 10" fiberglass structurally reinforced composite lumber ~~for use in heavy duty and medium duty fender systems~~ with a minimum of four 1-1/2 inch fiberglass reinforcing rods placed in the corners of the section. ~~Reinforce 10" x 10" fiberglass structurally reinforced composite lumber for use in light duty fender systems with a minimum of four 1 inch fiberglass reinforcing rods placed in the corners of the section. Reinforce 16" O.D. components including fiberglass structurally reinforced composite piles for use in heavy duty fender systems with a minimum of sixteen 1-1/2 inch fiberglass reinforcing rods. Reinforce 16" O.D. components including fiberglass structurally reinforced composite piles for use in medium duty fender systems with a minimum of sixteen 1 inch fiberglass reinforcing rods.~~

Reinforcing rods must be continuous and offer a minimum flexural strength of 70.0 ksi when tested in accordance with ASTM D 4476 and a minimum compressive strength of 40.0 ksi when tested in accordance with ASTM D 695. Steel reinforcing rods are not permitted.

Reject any sections of structural plastic containing cracks or splits. Also, inspect the ends of the reinforcing rods and reject any sections containing reinforcing rods with voids or cracks.

Add a minimum of 15% (by weight) chopped fiberglass reinforcement to the polyethylene used for fiberglass structurally reinforced composite lumber~~, a minimum of 5% (by weight) chopped fiberglass reinforcement for components including fiberglass structurally reinforced composite piles~~ and a minimum of 15% (by weight) chopped fiberglass reinforcement for smaller dimensional fiberglass fiber reinforced composite lumber. The fiberglass reinforcement may be reduced when other means of controlling cracking are specified with test results which show long term cracking is nonexistent.

Fiberglass structurally reinforced composite lumber must meet the minimum structural properties listed in Table~~s 4A and 4B~~.

Smaller dimensional fiberglass fiber reinforced composite lumber must meet the minimum physical properties listed in Table 5.

~~Components including fiberglass structurally reinforced composite piles must meet the structural properties listed in Tables 6A and 6B.~~

Table 1 Plastic Material Properties- ~~CP and~~ SCL			
Density	ASTM D792	Skin	55-63 pcf
Density	ASTM D792	Core	48~~-56~~ *63* pcf
Water Absorption	ASTM D570	Skin	2 hrs:<1.0% weight increase 24 hrs:<3.0% weight increase
Brittleness	ASTM D746	Skin	Brittleness temperature to be less than -40 deg. C
Impact Resistance	ASTM D256 Method A (Izod)	Skin	Greater than 0.55 ft-lbs/in
Hardness	ASTM D2240	Skin	44-75 (Shore D)
Ultraviolet	ASTM D4329 UVA	Skin	500 hours<10% change in Shore D Durometer Hardness
Abrasion	ASTM D4060	Skin	Weight Loss: <0.~~02~~ *03* oz Cycles=10,000 Wheel=CS17 Load-2.2 lb
Chemical Resistance	ASTM D756 *or* *ASTM D543*	Skin/Core Sea Water Gasoline No. 2 Diesel	<1.5% weight increase < 9.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D638	Core	Minimum 2200 psi at break
Compressive Modulus	ASTM D695	Core	Minimum 40 ksi
Static Coefficient of Friction	ASTM D1894	Skin	Maximum 0.25, wet
Nail ~~Pull-Out~~*Withdrawal or*	ASTM D 6117	Skin/Core	Minimum 60 lb *(nail)* *Minimum 400 lb (screw)*

Screw Withdrawal			

Table 2 Plastic Material Properties FFRCL		
Density	ASTM D 792	50-65 pcf
Impact Resistance	ASTM D256 Method A (Izod)	Greater than 2.0 ft-lbs/in
Hardness	ASTM D2240	44-75 (Shore D)
Ultraviolet	ASTM D4329 (UVA)	500 hours <10% change in Shore D Durometer Hardness
Abrasion	ASTM D4060	Weight Loss: <0.02~~2~~*3* oz Cycles = 10,000 Wheel = CS17 Load -2.2 lb
Chemical Resistance	ASTM D756 *or ASTM D543* Sea Water Gasoline No. 2 Diesel	 <1.5% weight increase <7.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D638	Minimum 3000 psi at break
Static Coeffecient of Friction	ASTM D2394	Minimum 0~~.~~.25, wet or dry
Nail ~~Pull-Out~~*Withdrawal or* Screw Withdrawal	ASTM D 6117 ~~ASTM D6117~~	Minimum 250 lb *(nail)* Minimum 400 lb *(screw)*

Table 3 Dimensions and Tolerances		
Structural Plastic	Dimension	Tolerance
Length	Per order (80 ft Maximum)	0/+6 inch
Width – SCL Width – FFRCL	See Contract Plans	±1/2 inch ±1/4 inch
Height – SCL Width – FFRCL	See Contract Plans	±1/2 inch ±1/4 inch
~~Diameter – CP~~	~~See Contract Plans~~	~~±1/2 inch~~
~~Corner Radius – SCL~~ ~~Corner Radius – FFRCL~~	~~1 1/2 inch~~ ~~1/4 inch~~	~~±1/2 inch~~ ~~±1/16 inch~~
Skin Thickness	3/16 inch minimum	n/a
Distance from outer surface to center rebar elements (SCL)	2 inches	±1/4~~4~~*2* inch
~~Distance from outer surface to center rebar elements (CP)~~	~~1 3/8 inches~~	~~±1/4 inch~~
Straightness (gap, bend or inside while lying on a flat surface)		<1 1/2 inches per 10 feet

Table 4~~A~~ Structural Properties for ~~Heavy Duty and Medium Duty~~ SCL		
Member Size		10 inches x 10 inches

Modulus of Elasticity ~~as derived below~~	*ASTM D 6109*	521 ksi
Stiffness, E.I.	*ASTM D 6109*	4.05E+08 lb-inch^2
Yield Stress in Bending	*ASTM D 6109*	5.8~~3~~ ksi
Weight		30-37 lb/ft

~~Table 4B~~ ~~Structural Properties for Light Duty SCL~~	
~~Member Size~~	~~10 inches x 10 inches~~
~~Modulus of Elasticity as derived below~~	~~307 ksi~~
~~Stiffness, E.I.~~	~~2.39E+08 lb-inch^2~~
~~Yield Stress in Bending~~	~~3.4ksi~~
~~Weight~~	~~28-35 lb/ft~~

Table 5 Properties for FFRCL		
Modulus of Elasticity	ASTM D 6109	~~306~~*300*,000 psi
Flexural Strength	ASTM D 6109	2,500 psi
Compressive Strength	ASTM D 6108	2,200 psi
Compressive Strength Perpendicular to grain	ASTM D 6108	700 psi

~~Table 6A~~ ~~Structural Properties for Heavy Duty CP~~	
~~Member Size~~	~~16 inch O.D.~~
~~Modulus of Elasticity as derived below~~	~~1,146 ksi~~
~~Stiffness, E.I.~~	~~3.69E+09 lb-inch^2~~
~~Yield Stress in Bending~~	~~9.1 ksi~~
~~Weight~~	~~68-83 lb/ft~~

~~Table 6B~~ ~~Structural Properties for Medium Duty CP~~	
~~Member Size~~	~~16 inch O.D.~~
~~Modulus of Elasticity as derived below~~	~~622 ksi~~
~~Stiffness, E.I.~~	~~2.0E+09 lb-inch^2~~
~~Yield Stress in Bending~~	~~4.9 ksi~~
~~Weight~~	~~61-74 lb/ft~~

~~The following bending test is required to d~~*D*~~etermine the structural properties listed in Tables 4A, 4B, 6A and 6B *per ASTM 6109*.~~ The values stated in these tables are the required minimums.

~~Determine the modulus of elasticity and yield stress for CP and SCL using the following test. The test specimens shall be full size and of manufacturers standard commercial type. Test the specimens using a three point bend test with the applied load at the center of a simply supported span. The distance between supports shall be 16 times the depth of the specimen with~~

~~an overhang distance beyond each support equal to 10% of the span length. The loading nose and supports shall have cylindrical surfaces for the SCL tests. In order to minimize excessive indentation at the nose and support locations the radius of the nose and supports shall be at least 0.5". The loading nose and supports for the CP tests shall be a saddle of same diameter as the pile and subtending an angle of 15 degrees and bearing length of 2". The loading shall be applied such that the deflection rate at the load location equals 2 inches per minute plus or minus 10%. Yield stress shall be evaluated at maximum P or at P for 1% strain, whichever is less. In the event a specimen will neither break nor show true yield point at outer fiber strains up to 3%, the yield stress shall be evaluated using the load P at 1% strain.~~

~~Yield stress Fy = (P*L)/(4*S)~~
~~Where:~~
~~P = Load as stated above~~
~~L = Span length~~
~~S = Section modulus of gross section~~

~~Stiffness EI = (P'*L^3)/(48*delta)~~
~~Where:~~
~~P' = Load that is ½ P yield~~
~~L = Span length~~
~~delta = Deflection at the location of load corresponding to P'~~

~~Modulus of Elasticity E = EI/Ig~~
~~Where:~~
~~EI = calculated from load deflection curve above~~
~~Ig = gross moment of inertia~~

implemented: None

Implementation of these changes, if and when approved, will begin with the January 2012 letting.