471 FIBER REINFORCED POLYMER FENDER SYSTEMS.
(REV 10-20-23) (FA 11-7-23) (FY 2024-25)

SECTION 471 is deleted and the following substituted:

471-1 Description.

Construct fiber reinforced polymer (FRP) fender systems using components in accordance with this Section and the Plans.

Submit design calculations, shop drawings, and test reports for the FRP fender system in accordance with the Plans, the FDOT Structures Manual noted in the Plans and this Specification.

471-2 Materials.

Meet the following requirements:

Fiber reinforced polymer composites (Piles, Wales, Spacer-blocks, Decking & Splice Plates) ..... Section 973
Concrete used to fill hollow piles ..... Section 347

Use only SAE Type 316 stainless steel metallic fastening and connection hardware.

471-3 Product Acceptance.

Obtain fender system components from a producer that is currently on the list of Producers with Accepted Quality Control Program for Fiber Reinforced Polymer Composites. Producers seeking inclusion on the list shall meet the requirements of 105-3.

Submit to the Engineer the manufacturer's certification in accordance with Section 6 that the FRP components meet the material requirements of Section 973.

471-4 Shop Drawings and Design Calculations.

471-4.1 Shop Drawings: Submit shop drawings in accordance with Section 5. Include the following, as a minimum, in the shop drawings:

1. General notes.
2. Energy absorption capacity (EAC) of the fender system (in units of kip-ft).
3. Fender system deflection (in units of feet).
4. Minimum pile tip elevation.
5. The name and address of the manufacturer for each component, including the physical address where the fabrication is performed.
6. Pile configuration and layout based on, and compatible with, the geometry shown in the Plans.
7. Pile and wale material properties including fill material used for hollow piles and required admixtures. If the material properties are defined in the Standard Specifications, a reference to the applicable Sections.
8. Pile and wale section properties used in the design.

9. Flexural and shear resistance of the pile and wale components.

10. Pile-to-wale and pile-to-pile connection details.

11. Sections, views, details, and dimensions required to successfully complete the construction of the fender system.

12. Any supplier required limitations regarding pile installation techniques or other typical construction practices permitted by Section 455 (e.g., full length pile driving versus jetting/driving combination).

471-4.2 Design Calculations: Submit design calculations. Design fender system piles, wales, and connections in accordance with the Plans, this Specification, and the FDOT Structures Manual edition noted in the Plans.

471-5 Performance and Testing Requirements.

An independent laboratory must perform all testing and produce the test report. Submit a test report with the following information:

1. Written certification that the fender system components meet the requirements of this Section.

2. Verification of the flexural properties of the pilings and wales as derived from ASTM D6109 using characteristic values in accordance with ASTM D7290 with the following modifications:

a. Supports shall be located to provide a minimum span-to-depth ratio of 16:1 and a maximum span to depth ratio of 20:1.

b. Three-point bending tests are acceptable.

c. Test a minimum of 5 of the same sample of the FRP piling(s) and FRP wale(s) shown on the Shop Drawings.

d. Do not include adhesive bonding of individual components within a system during verification testing.

3. For hollow FRP sections, verification of shear properties as derived from ASTM D2344. Test a minimum of 5 of the same sample of the hollow FRP sections shown in the Shop Drawings.

4. Detailed material specifications showing material type, quality, certifications, acceptance and rejection criteria and placement procedures.

5. Other information pertinent to the design and performance of the fender system as necessary.

471-6 Design Criteria.

471-6.1 Wales: Wales must meet the following minimum design criteria:

1. Be structurally continuous across a minimum of two spans.

2. Recess all hardware a minimum of 1/2-inch from the front face of wales.

3. Provide fasteners and connection hardware that prevent loosening over time.

4. Provide adequate stiffness to distribute vessel impact loading to meet the minimum required energy absorption capacity (EAC) of the system.

5. Use wales that meet or exceed the flexural and shear demands of the minimum EAC. The minimum flexural resistance must not be less than 40 ft-kip.

6. Meet the following criteria for hollow wale sections:

a. Provide a minimum of 1/4-inch wall thickness.

b. Provide a minimum bolt pull-through and crushing resistance greater than or equal to the maximum connection reaction force. Pull-through and crushing resistance is defined at the point of first yield and/or the load at which an audible crack occurs.

c. Must be capable of resisting crushing loads perpendicular to the axis of the member as required for the impact force applied to the fender in the analysis used to determine the associated EAC of the system. This impact force may be equally distributed between two lines of wales and over a longitudinal distance of five feet.

d. The minimum shear resistance must not be less than 40 kip.

7. Provide black wales unless otherwise shown in the Plans.

8. Wales, other than RTSS as defined in Section 973, must include minimum 1-1/2" thick UHMW-PE wearing surface.

471-6.2 Piles: Piles must meet the following minimum design criteria:

1. Provide fasteners and connection hardware that prevent loosening over time.

2. For hollow pile sections, provide a minimum bolt pull-through and crushing resistance greater than or equal to the maximum connection reaction force. Pull-through and crushing resistance is defined at the point of first yield and/or the load at which an audible crack occurs.

3. Provide black piles unless otherwise shown in the Plans.

471-7 Storage, Handling and Installation.

Unless otherwise shown in the manufacturer's approved field construction manual, use the following construction details.

Protect materials at all times against exposure to extreme heat or impact. Transport products in a manner that will minimize scratching or damage to the outer surfaces, stack on dunnage above ground so that it may be easily inspected and store in a manner that will avoid damage. Handle and lift products with nylon slings. Do not use sharp instruments in handling the product. Products damaged in shipping or handling will be rejected.

Products containing cracks in the reinforcing rods, or cracks or splits (partial or full depth) across the section will be rejected.

Cut, bevel, drill, countersink and otherwise install products in accordance with the manufacturer's recommendations. Set all material accurately to required levels and lines, with members plumb and true and accurately cut and fitted. Securely attach all materials to substrate by anchoring and fastening as shown in the shop drawings. Perform all cutting and drilling in a manner that allows for the collection of all debris and dispose of properly.

Field installation of grout or concrete inside of hollow wales is not allowed. Install piles in accordance with Section 455.

471-8 Method of Measurement.

The quantity for the entire fender system to be paid will be lump sum.

471-9 Basis of Payment.

471-9.1 Price and payment for fender system will be full compensation for the work specified in this Section including all labor, equipment and materials required to furnish and install the piles to the pile cut-off elevations shown in the Plans, and all wales, dimensional lumber, material, storage costs, disposal of unused material and waste, transportation costs, fasteners and other necessary items required for completing the work.

Payment will be made under:

Item No. 471- 3- Fender System Polymeric - lump sum.