

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

DESCRIPTION

Under this work, the Contractor shall furnish and install fiberglass reinforced plastic (FRP) piles for the fender system as shown on the Contract Plans and as described herein. The installed piles will become part of a complete composite lumber fender system. This work shall include all equipment, materials, labor and all else necessary to install the FRP piles as shown on the plans. FRP piles shall be one continuous piece with no splices permitted. The Contractor shall furnish equipment and personal for dynamic pile tests as required. Pile types other than FRP piles are not covered under this specification.

Work shall be performed in conformance with all regulations and requirements of the U.S. Coast Guard, the Army Corp of Engineers, the New York City Department of Transportation, the New York State Department of Environmental Conservation and other agencies for construction activities in the waterway. The navigation channel shall be maintained at all times, and shall not be restricted during construction except as permitted by the U.S. Coast Guard.

Under this work, the Contractor shall furnish equipment at the site for driving piles. The Contractor shall submit to the Engineer, Form BD 138, "Pile Driving Equipment Data," for approval. The Engineer shall be allowed fifteen (15) working days upon receipt for review. Each separate combination of pile and pile driving equipment proposed by the Contractor shall require the submission of corresponding Form BD 138.

All the provisions of Section 551 pertaining to Piles and Pile Driving Equipment shall apply with the following modifications.

Submittals shall include the following:

1. Names and addresses of all Suppliers/Fabricators to be utilized in the Work.
2. Six copies of the Contractor's Work Plan and Schedule of Operation to be submitted at 30 days prior to commencing any work in or over the navigable waterway to the Engineer and the U.S. Coast Guard for approval.
3. Shop Drawings/Catalog sheets.
4. Certified copies of mill reports covering the chemical and physical properties of all metal furnished under this item.
5. Copies of the FRP Pile manufacturer's standard and most recent product brochure for the product covered by this item.
6. Independent test lab report confirming FRP Pile meets the Plastic Material Properties found in Table 1.
6. Independent test lab report and calculations confirming the FRP Piles meets the structural property requirements found in Table 3.
8. Independent test lab report confirming the FRP Piles meets the Recoverable Deflection requirements.
9. Manufacturer owner's field guide with recommendations on handling, storage, cutting, drilling and driving. Driving recommendations shall include recommended hammer energies.

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

10. Written certification from the manufacturer that their FRP Piles satisfies the requirements of specification and has been in service for a minimum of five (5) years on a minimum of three (3) other bridge pier protection applications in the United States. This written certification shall include project owner information, project names, locations, contacts and phone numbers.
11. A written warranty signed by an authorized representative of the manufacturer shall be submitted, warranting that the composite pile is of good quality, free from defects, and in conformance with the specifications, and further promising to repair or replace defective materials during a ten year period following completion of that portion of the work, at no additional cost to the owner. Defective is defined as, but not limited to:
 - a. Failure of the product through overstress under design loads.
 - b. Excessive deflection or creep.
 - c. Deterioration, discoloration, or bleeding of color.
 - d. Splintering.
 - e. Cracking.

The Contractor shall maintain and submit to the Engineer a complete and accurate record of all driven piles, including:

1. The date and time of driving.
2. The pile number, location, size, length, elevation of tip and top of pile, the depth of augering (if used), and the number of blows required for each foot of penetration throughout the entire length of the pile, or the number of blows per distance penetrated when refusal is met. In addition, for the test piles and production piles selected for dynamic pile testing, the number of blows per inch for at least the last meter of penetration.
3. For variable stroke steam, air, or hydraulic hammers, the hammer stroke used, and the depth at which the hammer stroke is changed. For diesel hammers, the blow rate, stroke, bounce chamber pressure, and fuel setting throughout the entire length of driving. For all types of hammers, the blow rate shall be determined by the Engineer using a Saximeter furnished by the Contractor. One Saximeter shall be provided for each pile driving rig. For open-ended diesel hammers, hammer stroke shall be determined using a Saximeter.
4. The type and size of hammer, the type and dimensions of hammer and hammer cushion.
5. Any unusual occurrence during driving of the pile.
6. The time and duration of interruptions in driving, if any.
7. Record/As-Built Drawings.

The Contractor shall take care to prevent damage to the piles during delivery, storage, and handling. Store piles in orderly groups above ground, blocked during storage to minimize possible distortion. Piles exhibiting variations beyond tolerances stated in the specifications will be considered distorted and shall not be used. Carefully handle piles with no sudden dropping, breaking of outer skin, bruising, or penetrating the surface with tools. Handle by means of rope slings or other means that will not damage the pile surface. Do not use cant hooks or other sharp tools on the piles.

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

MATERIALS

1. Fiberglass Reinforced Plastic (FRP) Piles shall meet the following requirements:
 - A. Use plastic consisting of a mixture of one or more of the following recycled post consumer or post industrial thermoplastics: high-density polyethylene, medium-density polyethylene, low-density polyethylene. 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 Table 1. FRP Piles must not absorb moisture, corrode, rot, warp, splinter or crack. The outer skin must be smooth and black in color unless otherwise specified in the Contract Documents.
 - B. Manufacture FRP Piles as one continuous piece with no joints or splices to the dimensions and tolerances in accordance with Table 2 and consisting of a dense outer skin surrounding a less dense core. Interior voids shall not exceed 0.75 inch [19.1 mm] in diameter. FRP Piles shall be free of twist and curvature.
 - C. The co-extruded, outer skin of the FRP Piles shall include a flame-retardant additive. The additive used shall be either aluminum trihydrate or borax. The minimum amount of additive included in the co-extruded skin shall be 10% (by weight). Each shipment of FRP Piles delivered to the job site shall include a quality control report from the manufacturer certifying these minimum requirements are satisfied.
 - D. Fiberglass Reinforced Plastic Piles
 1. Reinforce 400mm (nom.) [16"] OD FRP Pile with sixteen – 44mm [1.75" inch] diameter fiberglass rebar shall be provided for the fenders. Space the fiberglass rebar evenly around the inside perimeter of the pile. Rebar must be continuous and offer a minimum flexural strength of 482 MPa [70 ksi] when tested in accordance with ASTM D 4476 and a minimum compressive strength of 275 MPa [40 ksi] when tested in accordance with ASTM D695. Steel reinforcement bars shall not be permitted.
 2. Reinforce 330mm (nom.) [13"] OD FRP Pile with twelve – 41mm [1.625" inch] diameter fiberglass rebar shall be provided for the pile clusters. Space the fiberglass rebar evenly around the inside perimeter of the pile. Rebar must be continuous and offer a minimum flexural strength of 482 MPa [70 ksi] when tested in accordance with ASTM D 4476 and a minimum compressive strength of 275 MPa [40 ksi] when tested in accordance with ASTM D695. Steel reinforcement bars shall not be permitted.
 - E. FRP Piles must meet the structural properties ($\pm 10\%$) listed in Table 3.

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

Table 1 - Plastic Material Properties

Density ASTM D792	Skin	881-1009 kg/m ³ [55-63 pcf]
Density ASTM E12	Core	545-769 kg/m ³ [34-48 pcf]
Water Absorption ASTM D570	Skin	2 hrs: < 1.0% weight. increase 24 hrs: < 3.0% weight. increase
Brittleness ASTM D746	Skin	No break at -40°C [-40°F]
Impact Resistance ASTM D746 Modified	Skin	Greater than 4 ft-lbs/inch [213.5 N.m/m]
Hardness ASTM D2240	Skin	44-75 (Shore D)
Abrasion ASTM D4060	Skin	Weight Loss: < 0.57g [0.02 oz] Wear Index: 2.5 to 3.0 Cycles = 10,000 Wheel = CS17 Load - 1 kg [2.2 lbs.]
Chemical Resistance ASTM D543	Skin Sea Water Gasoline No. 2 Diesel	< 1.5% weight increase < 7.5% weight increase < 6.0% weight increase
Tensile Properties ASTM D638	Skin/Core	Minimum 3.447 MPa [500 psi] at break
Compressive Modulus ASTM D695	Skin/Core	Minimum 275.8 MPa [40 ksi]
Coefficient of Friction ASTM F489	Skin	Maximum 0.25, wet or dry
Nail Pull-Out ASTM D1761	Skin/Core	Minimum 267 N [60 lbs.]

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

Table 2 - Dimensions and Tolerances

FRP Piles	Dimension	Tolerance
Length	Per order (32.0m [105 feet] max.)	+150mm / -0mm [+ 6 / -0 inches]
Outside Diameter (O.D.)	400mm [16.00 inches] 330mm [13.00 inches]	± 6.4 mm [± 0.25 in] ± 6.4 mm [± 0.25 in]
Distance from outer surface to fiberglass rebar elements	13 mm [0.50 inches] for 400mm (nom.) [16.0"] O.D. 12 mm [0.49 inches] for 330mm (nom.) [13.0"] O.D.	± 6.4 mm [± 0.25 in] ± 6.4 mm [± 0.25 in]
Outer Skin Thickness	4.7 mm [0.1875 in]	± 3.2 mm [± 0.125 in]
Straightness (gap, bend or bulge inside while lying on a flat surface)		<38mm per < 38.1 mm per 3.05 m [1.5 inches < 10 feet length]

Table 3 - Structural Properties

400 mm (nom.) [16"] O.D. FRPP with 16 - 44mm (1.75") Diameter Fiberglass Rebar and
330 mm (nom.) [13"] O.D. FRPP with 12 - 41mm (1.625") Diameter Fiberglass Rebar

Member Size	400mm (nom.) [16"] Outside Diameter	330mm (nom.) [13"] Outside Diameter
Modulus of Elasticity, E, as derived below	10,096 MPa [1.464 x 10 ⁶ psi]	9,514 MPa [1.380 x 10 ⁶ psi]
Stiffness, EI	13,524 kN-m ² [4.71E+09 lb-in ²]	5,554 kN-m ² (1.93E+09 lb-in ²)
Yield Stress in Bending, Maximum	80 MPa [11,599 psi]	78 MPa [11,315 psi]
Weight	108 - 132 kg/m [73-89 lb/ft]	71 - 87 kg/m [48-59 lb/ft]

F. Modulus of Elasticity, E, for Fiberglass Reinforced Plastic (FRP) Piles.

- a. Determine the modulus of elasticity for FRP Pile using the following test:
 - i. Place a 16.5m [54-foot] long FRP Pile of manufacturer's standard commercial type horizontally in a clamping device so that 1.83m [6 feet] of the piling will be firmly fixed and unable to move and the other end simply supported.
 - ii. Gradually apply a vertical (downward) load to a point 3.67m [12 feet] from the simply supported end.

001591

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

- iii. Measure the deflection along the length of the piling at the load point, and 3 equidistant locations.
 - iv. Use the load and deflection data to calculate the flexural modulus of elasticity, maximum outer fiber stress, stiffness (EI), and the bending stress. The flexural modulus of elasticity is calculated by dividing EI by the moment of inertia of the cross section of the product.
- b. Calculate the properties in Table 3 utilizing standard elastic beam flexure formulas. Report the Stiffness (EI) as the average of the stiffness at all measurement locations, between zero load and half the load corresponding to the specification yield stress. The specified yield stress in bending shall be reached before failure of the product. Calculate the stress at the load point, on the tension side of the FRP Pile.
- c. As stated, conduct the tests on a full-scale FRP Pile of the specified size. The results of these tests may be extended through engineering calculations, to a product of another size only if the other size has the same or smaller cross section than the tested product. Do not use smaller cross sections to predict the performance of larger cross sections.
- G. FRP Piles shall exhibit recoverable deflection. FRP Pile shall not exhibit more than a 5% reduction in bending stiffness (EI) when cyclically load tested. The manufacturer of the FRP Pile shall provide cyclical, flexural load test results from an independent test laboratory. Cyclical load testing shall be conducted on either a 330mm OD pile or 406mm OD pile for a minimum of 200 load cycles. The test shall be a four point load condition with a minimum 9.3m [30.5'] clear span and a minimum 4.57m [15'] shear span. The applied load shall produce a minimum of 40% of the FRP Pile's bending moment at yield. The bending moment at yield shall be determined by the formula $M = f(I/c)$ where:

M = bending moment at yield (in-lbs)
 f = yield stress in bending (lb/in²)
 I = moment of inertia of cross-section (in⁴)
 c = distance from neutral axis to point where stress desired (inches)

- H. The following manufacturers are known to supply products that comply with these specification requirements:

- a. SEAWARD
 3470 Martinsburg Pike
 Clearbrook, VA 22624-0098
 Phone: (540) 667-5191

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

b. Plastic Pilings, Inc.
 1485 South Willow Avenue
 Rialto, CA 92376
 Phone: (919) 874-4080

c. Engineer Approved Equal

2. Pile Shoes

- A. Pile shoes shall be manufactured from steel conforming to ASTM A1011 / ASTM A1011M. Pile shoes shall be uncoated.
- B. The length of the joints formed by the intersection of the sides shall not be less than one-half of the height of the shoe and shall be fully welded.
- C. The tip of the FRP pile shall be carefully shaped so that the steel shoe or point will fit snugly and symmetrically. The shoe shall be secured to the pile with galvanized spikes of appropriate length and diameter.

3. Wire Rope Wrapping

- A. Wire rope for wrapping dolphins shall be 25mm diameter galvanized 6x19 L.W.R.C.
- B. Staples shall be 152mm overall length by 38mm inside, fabricated from 9.5mm round stock and hot dipped galvanized in accordance with ASTM A153.

4. Steel Plates and Hardware

- A. Structural steel shall conform to the requirements of ASTM A709 Grade 345.
- B. All structural steel shall be hot-dipped galvanized in accordance with ASTM A123 after fabrication.
- C. All bolts and nuts shall conform to ASTM A307 and ASTM A563, respectively and shall be hot dipped galvanized in accordance with ASTM A153.
- D. Dock or plate washers shall be a minimum 13mm thick and hot dipped galvanized in accordance with ASTM A123.

5. Blocking

- A. Blocking shall conform to fiberglass reinforced plastic composite lumber.

CONSTRUCTION DETAILS

1. Preparation

- A. Before fabricating any FRP Pile material, the Contractor shall submit shop drawings to the Engineer for approval.
- B. Materials shall be protected at all times against exposure to extreme heat or impact. FRP Pile shall be shipped in a manner that will minimize scratching or damage to the outer

001593

CONTRACT NO. BRCR076

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

surfaces. FRP Pile shall be stacked on dunnage above ground so that it may be easily inspected and stored in a manner that will avoid damage. Sharp instruments shall not be used in handling the product. FRP Pile damaged in shipping or handling will be rejected.

- C. FRP Piles shall be cut, beveled, drilled, countersunk, and otherwise fabricated in accordance with the approved shop drawings and the manufacturer's recommendations. Set all material accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
- D. Steel pile points shall be shop fitted and attached prior to shipment to the site.
- E. Equipment for driving the FRP piles shall be driven only with equipment which has the prior approval of the Engineer in accordance Section 551 of the NYSDOT Standard Specifications and as modified by the contract documents.

3. Installation

- A. Piles shall be driven to satisfy the driving criteria specified on the drawings and to the satisfaction of the Engineer. Carefully plumb the leads and the pile before driving. Take care during driving to prevent and to correct any tendency of piles to twist or rotate. Pulling of piles to get them into position will not be permitted.
- B. Continuously drive each pile at the locations and to the pile length shown on the drawings.
- C. Drive piles within the following tolerances:
 - a. Location: 76mm [3"] from the location indicated on the drawing for each pile.
 - b. Plumbness: maintain 25mm in 3.05m [one inch in ten feet] from the vertical to a maximum of 101.6mm [4"].
 - c. The final position of the driven pile shall not encroach into the navigable channel.
- D. Damaged or mis-driven piles:
 - a. Damaged piles and piles driven outside of the required driving tolerances will not be accepted.
 - b. Piles rejected after driving shall be pulled and discarded at the discretion of the Engineer.
 - c. Piles which cannot be completely removed due to damage or any other reason shall be replaced, at the Contactor's expense, in a manner directed by the Engineer.
 - d. Rejected piles shall not be reused.
 - e. Damaged or mis-driven piles not left in place shall be removed from the work site immediately.
 - f. Damaged or mis-driven piles that are within in the channel limits must be removed.

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

- E. Once the FRP Pile is installed, piles shall be cut at the cut-off elevation shown on the plans. Cutting shall be performed by sawing or other means as approved by the Engineer to provide a smooth level cut.

METHOD OF MEASUREMENT

The quantity of piles to be paid for under the work specified for the various diameters for Fiberglass Reinforced Plastic (FRP) Piles will be the number of linear meter of piles placed in the leads, and installed in accordance with the Contract documents for use in the fender system and dolphins that are both furnished and materials incorporated within the final construction. No allowance will be made for any length above the cut off elevation. Any additional lengths of pile above the cut off elevation necessary to facilitate the Contractor's operations shall be at his sole cost and expense. No additional payment will be made for redriving of piles that are forced up by any cause. Lengths of piles that are used to replace piles that have been previously accepted by the Engineer, but are somehow damaged before completion of the Project, will not be measured for payment.

No separate measurement will be made for dynamic pile testing, blocking, pile shoes, wire rope, steel, anchor bolts and hardware.

Furnishing Equipment for Driving Piles will not be measured for payment. Payment will be made for Furnishing Equipment for Driving Piles at the lump sum price bid for this item as follows: Seventy-five percent (75%) of the amount of the bid when the equipment for driving the piles is furnished and driving of satisfactory piles is commenced. The remaining twenty-five percent (25%) will be paid when the work of driving piles is completed.

BASIS OF PAYMENT

The unit price bid per meter for each diameter of Fiberglass Reinforced Plastic Pile complete and accepted in place shall include the cost of furnishing all labor, (including the manipulation of pile driving equipment and materials), materials and equipment necessary to complete the work as described herein. The unit price shall also include furnishing, delivery, storage and handling all materials, equipment, and labor incidental thereto. The costs incidental to the disposal of cutoff material will be included in the unit price bid of the FRP Pile.

No separate payment will be made for dynamic pile testing, blocking, pile shoes, wire rope, steel, anchor bolts and hardware.

The lump sum price bid for Furnishing Equipment for Driving Piles shall include the cost of furnishing all labor, materials and equipment necessary for transporting, erecting, maintaining, making any ordered equipment replacement, dismantling and removing the entire pile driving.

ITEM 551.4101--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 406mm DIAMETER
ITEM 551.4102--29 - FIBERGLASS REINFORCED PLASTIC (FRP) PILES, 330mm DIAMETER
ITEM 551.4103--29 - FURNISHING EQUIPMENT FOR DRIVING FRP PILES

The work under this Section will be paid for under the following Pay Item:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
551.4101--29	Fiberglass Reinforced Plastic (FRP) Piles, 406mm Diameter	Meter
551.4102--29	Fiberglass Reinforced Plastic (FRP) Piles, 330mm Diameter	Meter
551.4103--29	Furnishing Equipment for Driving FRP Piles	Lump Sum

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER**DESCRIPTION**

Under this work, the Contractor shall furnish and install fiberglass reinforced plastic (FRP) Composite Lumber (CL) for the fender system as shown on the Contract Plans and as described herein. The installed composite lumber shall be fastened to the FRP Piles. This work shall include all equipment, materials, labor and all else necessary to install the FRP Composite Lumber as shown on the plans.

The Work shall also include maintaining the fender system and navigation as necessary during construction; and to furnish, install, and maintain necessary access walkways for the maintenance of navigation lights during construction.

Work shall be performed in conformance with all regulations and requirements of the U.S. Coast Guard. Navigation shall be maintained at all times, and shall not be restricted during construction except as permitted by the U.S. Coast Guard.

1. Submittals

Submittals shall include the following:

1. Names and addresses of all Suppliers/Fabricators to be utilized in the Work.
2. Six copies of the Contractor's Work Plan and Schedule of Operation to submitted at 30 days prior to commencing any work in or over the navigable waterway to the New York City Department of Transportation and U.S. Coast Guard for approval.
3. Shop Drawings/Catalog sheets.
4. Certified copies of mill reports covering the chemical and physical properties of all metal furnished under the Section.
5. Copies of the FRP Composite Lumber manufacturer's standard and most recent product brochure for the product covered by these Specifications.
6. Independent test lab report confirming FRP Composite Lumber meets the Plastic Material Properties found in Table 1.
7. Independent test lab report and calculations confirming the FRP Lumber meets the structural property requirements found in Table 3.
8. Written certification from the manufacturer that their FRP Composite Lumber satisfies the requirements of specification and has been in service for a minimum of five (5) years on a minimum of three (3) other bridge pier protection applications in the United States. This written certification shall include project owner information, project names, locations, contacts and phone numbers.
9. Record/As-Built Drawings.
10. A written warranty signed by an authorized representative of the manufacturer shall be submitted, warranting that the composite lumber is of good quality, free from defects, and in conformance with the specifications, and further promising to repair or replace defective materials during a ten year period following completion of that portion of the work, at no additional cost to the City. Defective is defined as, but not limited to:
 - a. Failure of the product through overstress during construction
 - b. Excessive deflection or creep
 - c. Deterioration, discoloration, or bleeding of color

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER

- d. Splintering
- e. Cracking

The FRP lumber shall be installed on the Fiberglass Reinforced Plastic Piles specified under Item 551.41XX--29, FIBERGLASS REINFORCED PLASTIC (FRP) PILES. Coordination and preparation to install the FRP lumber to the FRP Piles for fender system construction shall be included under this item.

MATERIALS**I. Fiberglass Reinforced Plastic Composite Lumber:**

- A. **COMPOSITE LUMBER (CL)** – The plastic for CL shall be a mixture of one or more of the following recycled post consumer or post industrial thermoplastics: high-density polyethylene, medium-density polyethylene, low-density polyethylene. The plastic shall be mixed with appropriate colorants, UV inhibitors and antioxidants so that the resulting product meets the material property requirements specified in Table 1. CL shall not absorb moisture, corrode, rot, warp, splinter or crack. The outer skin shall be smooth and black in color unless otherwise specified in the purchase documents. It shall contain hindered amine light stabilizers to provide sufficient resistance to ultraviolet light degradation as to meet the requirements in Table 1.
- B. CL shall be manufactured as one continuous piece and shall undergo a post production operation to ensure residual stresses are relieved. No joints or splices are permitted. CL shall consist of a dense outer skin surrounding a less dense core. Interior voids shall not exceed 19mm [0.75"] in diameter. CL shall be free of twist and curvature. Dimensions and tolerances shall be in accordance with Table 2.
- C. CL shall be reinforced by four (4) – 41mm [1.625 inch] fiberglass reinforcing rods spaced inside the four corners of the member. Reinforcing rods shall be continuous and offer a minimum flexural strength of 482.6MPa [70 ksi] when tested in accordance with ASTM D4476 and a minimum compressive strength of 275.8MPa [40 ksi] when tested in accordance with ASTM D695. CL shall meet the structural properties (plus or minus 15%) listed in Table 3.

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER**Table 1 - Plastic Material Properties**

Density ASTM D 792	Skin	881-1,009 kg/m ³ [55-63 pcf]
Density ASTM E12	Core	545-769 kg/m ³ [34-48 pcf]
Water Absorption ASTM D 570	Skin	2 hrs: < 1.0% weight. increase 24 hrs: < 3.0% weight. increase
Brittleness ASTM D 746	Skin	No break at -40°C[-40°F]
Impact Resistance ASTM D 746 Modified	Skin	Greater than 213.5 N.m/m [4 ft-lbs/inch]
Hardness ASTM D 2240	Skin	44-75 (Shore D)
Abrasion ASTM D 4060	Skin	Weight Loss: < 0.02 oz [0.5g] Wear Index: 2.5 to 3.0 Cycles = 10,000 Wheel = CS17 Load -1 kg [2.2 lb]
Chemical Resistance ASTM D 543	Skin Sea Water Gasoline No. 2 Diesel	< 1.5% weight increase < 7.5% weight increase < 6.0% weight increase
Tensile Properties ASTM D 638	Skin/Core	Minimum 3.447MPa [500 psi]at break
Compressive Modulus ASTM D 695	Skin/Core	Minimum 275.8MPa [40 ksi]
Coefficient of Friction ASTM F 489	Skin	Maximum 0.25, wet or dry
Nail Pull-Out ASTM D 1761	Skin/Core	Minimum 60 lb [267 N]

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER**Table 2 - Dimensions and Tolerances**

Fiber Reinforced Plastic Lumber	Dimension	Tolerance
Length	Per order	+6 inches / -0 inches
Width x Length	12" x 12" [300mm x 300mm]	± 0.250 in [± 6.4 mm]
Corner Radius	2.0 inches [50.8mm]	± 0.250 in [± 6.4 mm]
Outer Skin Thickness	0.1875 inches [4.7mm]	± 0.125 in [± 3.2 mm]
Distance from outer surface to fiberglass rebar elements	1.56 in [40mm]	± 0.625 in [± 15.8 mm]
Straightness (gap, bend or bulge inside while lying on a flat surface)		< 1.5 inches per 10 feet [<38.1 mm per 3.05 m length]

Table 3 - Structural Properties for 300mm x 300mm (nom.) [12" x 12"] O.D. FRP Lumber with (4) - 41mm [1.625"] Rebar

Member Size	300mm x 300mm [12" x 12"]
Modulus of Elasticity as derived below	3120MPa [452,439 psi]
Stiffness, EI in ²	2107 kN-m ² [7.34E+08 lb- in ²]
Yield Stress in Bending	33.9 MPa [4,914 psi]
Weight	63-77 kg/m [42-52 lb/ft]

- D. Modulus of Elasticity of a full size specimen shall be determine by conducting a three point bend test with a load applied in the center of a simply supported 4.27m [14-foot] span, at a deflection rate of 6mm [0.25"] per minute . The Modulus is to be taken at a strain of 0.01 mm per mm, where strain equals (6) x (depth of cross section) x (deflection) / (span length squared) and where Modulus of Elasticity equals (load) x (span length cubed) / [(48) x (deflection) x (moment of inertia)]. The results of the tests shall be submitted to the Engineer for review and approval.
- E. CL shall be reinforced with a continuous fiberglass reinforcing rods with a minimum flexural strength of 482.6MPa [70 ksi] when tested in accordance with ASTM D4476 and a minimum compressive strength of 275.8MPa [40 ksi] when tested in accordance with ASTM D695. Steel reinforcing rods shall not be permitted.
- F. Flame Retardant Co-extruded Skin - The co-extruded, outer skin of the CL shall include a flame-retardant additive. The additive used shall be either aluminum trihydrate or borax. The minimum amount of additive included in the co-extruded skin shall be 10% (by weight). Each shipment of CL delivered to the job site shall include a quality control report from the manufacturer certifying these minimum requirements are satisfied.
- G. The manufacturer shall be required to warranty all CL to be free from defects in material and workmanship for a period of ten years. The warranty shall cover all material costs

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER

related with repair or replacement of defective material. This warranty need not cover replacement or repair required as a result of normal wear & tear, misuse, failure to perform routine maintenance, non-recommended or improperly executed alterations by anyone other than the manufacturer, tampering or loading the product beyond its rated capacity, improper installation, or other use inconsistent with manufacturer's specifications. The warranty shall be issued directly to the City and shall commence from the date of acceptance of the work.

H. The following manufacturers are known to supply products that comply with these specification requirements:

i. SEAWARD
3470 Martinsburg Pike
Clearbrook, VA 22624-0098
Phone: (540) 667-5191

ii. Plastic Pilings, Inc.
1485 South Willow Avenue
Rialto, CA 92376
Phone: (919) 874-4080

iii. Engineer Approved Equal

2. Steel Plates And Hardware

- A. Structural steel shall conform to the requirements of ASTM A709 Grade 345.
- B. All structural steel shall be hot-dipped galvanized in accordance with ASTM A123 after fabrication.
- C. All bolts and nuts shall conform to ASTM A307 and ASTM A563, respectively and shall be hot dipped galvanized in accordance with ASTM A153.
- D. Dock or plate washer shall be a minimum 13 mm thick and hot dipped galvanized in accordance with ASTM A153.

CONSTRUCTION DETAILS**Preparation**

- A. Before fabricating any FRP CL material, the Contractor shall submit shop drawings to the Engineer for approval.
- B. Materials shall be protected at all times against exposure to extreme heat or impact. FRP CL shall be shipped in a manner that will minimize scratching or damage to the outer surfaces. FRP CL shall be stacked on dunnage above ground so that it may be easily inspected and stored in a

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER

manner that will avoid damage. CL shall be handled with nylon slings. Sharp instruments shall not be used in handling the product. FRP CL damaged in shipping or handling will be rejected.

- C. FRP CL shall be cut, beveled, drilled, countersunk, and otherwise fabricated in accordance with the approved shop drawings and 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 composite lumber to substrate by anchoring and fastening as shown on plans. All members where possible shall be installed in lengths as long as practicable, and unless otherwise shown, shall have the ends butted together and joined by means of bolted steel splice plates. Splice plates shall not be attached to the channel side of the fender system.

Installation

1. Install composite lumber per manufacturer's instructions.
2. All composite lumber walers shall be fastened to the piles with galvanized bolts at all intersections. Galvanized dock or plate washers shall be provided under all bolt heads and nuts.
3. Bolt heads shall be countersunk along navigable channel as indicated on the Contract drawings. Clear distance between the bolt head and waler face shall be a minimum 2" [51mm].
4. Recess all steel plates and hardware a minimum 2" [51mm] from the fender waler face of the channel side.
5. Provide composite lumber blocking and spacers as necessary.

Tolerances

1. Fender Construction: Variation from elevation and location shall not exceed 51mm [2"] from those on the Plans.

METHOD OF MEASUREMENT

The quantity to be paid for the Fiberglass Reinforced Plastic Composite Lumber will be measured per linear meter furnished and installed for the fender system as shown in the Contract Plans based on the 300mm x 300mm cross section of FRP composite lumber. No measurement will be made for waste. Composite lumber that are used to replace damaged lumber section that have been previously accepted by the Engineer, but are somehow damaged before completion of the Project, will not be measured for payment.

No separate measurement will be made for blocking, steel, bolts and hardware.

BASIS OF PAYMENT

The unit price bid per meter for Fiberglass Reinforced Plastic Composite Lumber complete and accepted in place shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as described herein. The unit price bid per meter for the FRP Composite Lumber is based on a 300mm x 300mm cross section with four 41mm diameter fiberglass reinforcement bars. The unit price shall also include furnishing, delivery, storage and handling all materials, equipment, and labor incidental thereto. The costs incidental to the disposal of cutoff and waste material will be included in the unit price bid of the FRP Composite Lumber.

ITEM 551.4104--29 - FIBERGLASS REINFORCED PLASTIC (FRP) COMPOSITE LUMBER

No separate payment will be made for blocking, steel, bolts and hardware.

The work under this Section will be paid for under the following Pay Item:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
551.4104--29	Fiberglass Reinforced Plastic (FRP) Composite Lumber	Meter

ITEM 551.4105--29 - FENDER PANELS**DESCRIPTION**

Under this work, the Contractor shall furnish and install fender panel strips to the concrete cap of the fender system. The fender panel strips shall consist of 150mm wide by 100mm thick Ultra High Molecular Weight (UHMW) Polyethylene sections attached to the cast-in-place concrete cap of the fender system.

Work shall be performed in conformance with all regulations and requirements of the U.S. Coast Guard. Navigation channel shall be maintained at all times, and shall not be restricted during construction except as permitted by the U.S. Coast Guard.

Submittals

- A. Submittals shall include the following:
1. Names and addresses of all Suppliers/Fabricators to be utilized in the Work.
 2. Shop Drawings/Working Drawings/Catalog sheets.
 3. Certified copies of the chemical and physical properties of all products furnished under the Section.
 4. Record/As-Built Drawings.

MATERIALS

1. UHMW Polyethylene Panels shall meet the following requirements:

A. Properties

Density ASTM D792	0.930 - 0.960 g/cm³
Tensile Strength at Yield - 22.8 C [73 F] ASTM D638	17.92 - 23.4MPa {2600 -3400 psi}
Break @ 22.8 C [73 F]	24.8 - 35.9MPa {3600 - 5200 psi}
Hardness D2240 (Shore D)	61 - 70
IZOD Impact Strength	No Break
Water Absorption (%)	Nil
Coefficient of Friction @ 73 F	Static 0.15 - 0.20 Kinetic 0.10 - 0.15
Relative Volumetric Abrasion Loss*	95-120

* Industry Standard testing method using slurry of 60% aluminum oxide and 40% water at a rotation speed of 1,750 rpm for 2 hours. A lower number indicates better abrasion resistance.

- B. The color of the UHMW-PE fender panel shall be black. The UHMW material shall be UV stabilized.

ITEM 551.4105--29 - FENDER PANELS

- C. The following manufacturers are known to supply products that comply with these specification requirements:
- i. FENTEK AMERICAS
3302 Craggy Oak Court – Suite 102
Williamsburg, VA 23188
Phone: (757) 564-1780-
 - ii. ULTRA POLY
2926 South Steele Street
Tacoma, WA 98409
Phone: (253) 272-1217
 - iii. Engineer approved equal.

2. Fastener Hardware

- A. All bolts and nuts shall conform to ASTM A449 and ASTM A563, respectively and shall be hot dipped galvanized in accordance with ASTM A153. Dock or plate washer shall be a minimum 7 mm thick and hot dipped galvanized in accordance with ASTM A153.

CONSTRUCTION DETAILS**1. Preparation**

- A. Before fabricating any UHMW material, the Contractor shall submit shop drawings to the Engineer for approval. Submit working drawings for method of panel installation on the cast-in-place concrete cap for the fender system.
- B. Materials shall be protected from damage at all times. UHMW panels shall be shipped in a manner that will minimize scratching or damage to the outer surfaces. The panels shall be stacked on dunnage above ground so that it may be easily inspected and stored in a manner that will avoid damage. The panels shall be handled with nylon slings. Sharp instruments shall not be used in handling the product. Material damaged in shipping or handling will be rejected.
- C. UHMW panels shall be cut, beveled, drilled, countersunk, and otherwise fabricated in accordance with the approved shop drawings and 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 panels to substrate by anchoring and fastening as shown on plans.

2. Installation

- A. Install UHMW panels as indicated on the Contract Plans.
- B. Panels shall be fastened to the concrete substrate as shown on the Contract drawings.
- C. Bolt heads shall be countersunk as indicated on the Contract drawings. Clear distance between the bolt head and panel face shall be a minimum 1½" [38mm].

ITEM 551.4105--29 - FENDER PANELS**METHOD OF MEASUREMENT**

The quantity to be paid for the fender panels will be measured per square meter furnished and installed for the fender system as shown in the Contract Plans.

No separate measurement will be made for hardware, it is included in this pay item.

BASIS OF PAYMENT

The unit price bid per square meter for the fender panels complete and accepted in place shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as described herein. The unit price bid per square meter is based on a 100mm thick panel. The unit price shall also include furnishing, delivery, storage and handling all materials, equipment, and labor incidental thereto.

No separate payment will be made for furnishing and installing hardware, it is included in this item.

The work under this Section will be paid for under the following Pay Item:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
551.4105--29	Fender Panels	Square Meter

ITEM 551.4106--29 - FIBERGLASS HANDRAIL**DESCRIPTION**

Under this work, the Contractor shall furnish and install fiberglass handrail system along the top of concrete cap of the fender system. The fiberglass handrail system shall conform to 29CFR1910.23 (OSHA 1910.23) requirements with a minimum factor of safety rating of 2.0.

The railing shall consist of top rail, intermediate rail, kick plate and posts, and shall have a vertical height of 1.067m [42 inches] nominal from upper surface of top rail to concrete cap walkway. The top rail shall be smooth-surfaced throughout the length of the railing. The intermediate rail shall be approximately halfway between the top rail and the walkway. The ends of the rails shall not overhang the terminal posts except where such overhang does not constitute a projection hazard.

Work shall be performed in conformance with all regulations and requirements of the U.S. Coast Guard, the Army Corp of Engineers, the New York City Department of Transportation, the New York State Department of Environmental Conservation and other agencies for construction activities in the waterway. The navigation channel shall be maintained at all times, and shall not be restricted during construction except as permitted by the U.S. Coast Guard.

A. Submittals shall include the following:

1. Names and addresses of all Suppliers/Fabricators to be utilized in the Work.
2. Shop Drawings/Working Drawings/Catalog sheets.
3. Certified copies of the chemical and physical properties of all products furnished under the Section.
4. Record/As-Built Drawings.

MATERIALS

1. **Fiberglass Handrail**

- A. The fiberglass railing shall be yellow in color. The fiberglass railing material shall be UV stabilized. All exposed and finished surfaces of the fiberglass railing shall be smooth, resin rich, free of voids and without dry spots, cracks or un-reinforced areas. All glass fibers shall be well covered with resin to protect against exposure to weathering or wear.

B. Properties

Tensile Strength ASTM D638	206Mpa [30,000 psi]
Tensile Modulus ASTM D638	17.2MPa [2.5 x 10 ⁶ psi]
Compressive Stress ASTM D695	206 MPa [30,000 psi]
Compressive Modulus ASTM D695	17.2MPa [2.5 x 10 ⁶ psi]
Flexural Stress ASTM D790	206MPa [30,000 psi]
Flexural Modulus ASTM D790	17.2MPa [2.5 x 10 ⁶ psi]
Shear Stress ASTM D2344	31MPa [4,500 psi]
Density ASTM D792	1,660.8 – 1937.6 kg/ m ³ 0.060 – 0.070 lbs/in ³

ITEM 551.4106--29 - FIBERGLASS HANDRAIL

24 Hr. Water Absorption (%) ASTM D570	0.6% max.
Coefficient of Thermal Expansion ASTM D696	1.4 x 10 ⁻⁶ cm./cm./ C (min.) {8.0 x 10 ⁻⁶ in./in./ F (min.)}

C. The following manufacturers are known to supply products that comply with these specification requirements:

- i. **STRONGWELL**
400 Commonwealth Avenue
Bristol, VA 24203
Phone: (276) 645-8000
- ii. **ENDRO FIBERGLASS SYSTEMS, INC.**
871 Marriottsville Road
Marriottsville, MD 21104
Phone: (410) 442-1118
- iii. Engineer approved equal

2. **Fastener Hardware**

- A. Stainless Steel Hexagonal Headed Bolts and Nuts, ASTM A593 and ASTM A594, Group 2. Washers shall be stainless steel, Type 316.

CONSTRUCTION DETAILS

1. **Preparation**

- A. Before fabricating any fiberglass material, the Contractor shall submit shop drawings to the Engineer for approval. Submit working drawings for method of installation of the riling posts on the cast-in-place concrete cap for the fender system.
- B. Materials shall be protected from damage at all times. Handrails and posts shall be shipped in a manner that will minimize scratching or damage to the outer surfaces. The material shall be stacked on dunnage above ground so that it may be easily inspected and stored in a manner that will avoid damage. The fiberglass material shall be handled with nylon slings. Sharp instruments shall not be used in handling the product. Material damaged in shipping or handling will be rejected.

2. **Installation**

- A. Install handrails and posts per manufacturer's instructions.
- B. The fabricated handrail system shall be furnished complete with fittings by the FRP manufacturer.
- C. Posts shall be fastened to the concrete substrate as shown on the Contract drawings. Posts shall be mounted vertical. Mounting bolting shall be minimum 64mm [2½"] embedment into the concrete cap. The anchoring of posts and framing of members for railings shall

ITEM 551.4106--29 - FIBERGLASS HANDRAIL

be of such construction that the completed structure shall be capable of withstanding a load of at least 891 N [200 pounds] applied in any direction at any point on the top rail or uniform load of 730.5 N/meter [50 lbs/feet].

- D. The kick plate or toe board shall be 100mm [4 inches] nominal in vertical height from its top edge to the level of the walkway. It shall be securely fastened in place and shall not be more than 6mm [0.25 inches] clearance above walkway.

METHOD OF MEASUREMENT

The quantity to be paid for the Fiberglass Handrail will be measured per meter furnished and installed as shown in the Contract Plans. Measurement will be taken along the centerline of the top of railing, end to end of railing between the limits indicated on the Contract drawings. Handrails used to replace damaged railing section that have been previously accepted by the Engineer, but are somehow damaged before completion of the Project, will not be measured for payment.

No separate measurement will be made for hardware, it is included in this item.

BASIS OF PAYMENT

The unit price bid per meter for Fiberglass Handrail complete and accepted in place shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as described herein. The unit price bid per meter shall also include furnishing, delivery, storage and handling all materials, equipment, and labor incidental thereto.

No separate payment will be made for furnishing and installing hardware, it is included in this item.

The work under this Section will be paid for under the following Pay Item:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
551.4106--29	Fiberglass Handrail	Meter

ITEM 555.9991--29 - CONCRETE PIER BOX (TYPE 1 - PIER 4)
ITEM 555.9992--29 - CONCRETE PIER BOX (TYPE 2 - PIER 5)
ITEM 555.9993--29 - CONCRETE PIER BOX (TYPE 3 - PIER 6)
ITEM 555.9994--29 - CONCRETE PIER BOX (TYPE 4 - PIER 7)

DESCRIPTION

Under these items, the Contractor shall furnish and install pier boxes of the size and shape shown on the plans. The pier box units shall be used as stay-in-place forms for the construction of the pier substructures. This work shall include the fabrication of the concrete pier box units and the installation of the pier box units at their respective locations. The work under these items shall also include, but not limited to, materials, casting, coating, transporting, positioning, supporting and sealing the bottom of the boxes plus removal and disposal of the supports for the fabrication, construction, erection and installation of each concrete pier box unit.

All work shall be performed in conformance with all regulations and requirements of the U.S. Coast Guard. Navigation shall be maintained at all times and shall not be restricted during construction except as permitted by the U.S. Coast Guard. The Contractor shall submit request for restrictions to the navigation channel to the Engineer for approval by the U.S. Coast Guard, in accordance with the Special Provisions.

The stone masonry work including anchors shall be performed and paid for in accordance with the stone masonry item.

MATERIALS

Concrete

All material requirements for the concrete shall conform to the requirements of Section 555 of the NYSDOT Standard Specifications and as amended herein.

Concrete shall be Class HP with a compressive strength of 31MPa (28 days). The mix design shall be developed and submitted to the Engineer for approval.

Reinforcement steel shall be stainless steel conforming to the requirements of ATSM A955M, Grade 420, Type 316LN. Reinforcement supports and chairs shall be stainless steel.

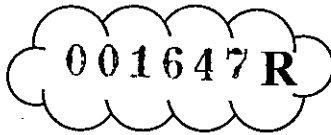
Concrete Admixtures

Concrete admixtures shall conform to the requirements of Section 711-08 of the NYSDOT Standard Specifications.

A corrosion inhibitor admixture shall be provided for the concrete box units. The corrosion inhibitor admixture shall consist of a calcium nitrate solution as approved by the NYSDOT Material Bureau. The corrosion inhibitor shall be compatible with other concrete admixtures furnished for this item.

Marine Epoxy Coating

The marine epoxy coating for the exterior of the precast boxes shall be a two component, high-solids, solvent-free, epoxy resin, high-build protective coating specifically intended for splash zone applications. The coating shall be Sikagard 62 or approved equal.



- ITEM 555.9991--29 - CONCRETE PIER BOX (TYPE 1 - PIER 4)**
- ITEM 555.9992--29 - CONCRETE PIER BOX (TYPE 2 - PIER 5)**
- ITEM 555.9993--29 - CONCRETE PIER BOX (TYPE 3 - PIER 6)**
- ITEM 555.9994--29 - CONCRETE PIER BOX (TYPE 4 - PIER 7)**

Structural Steel

Structural steel angles and bent plates shall be stainless steel conforming to ASTM A276, Type 316LN. Welding shall conform to AASHTO/AWS D1.5M

CONSTRUCTION DETAILS

Stone Masonry

Stone masonry shall conform to Item 560.01 but no separate payment will be made.

Coordination of Work

The Contractor shall coordinate the fabrication of the concrete pier box units with other integral items included in this Contract.

The Contractor shall be responsible to coordinate the installation of the concrete pier boxes with other Contract work and including the U.S. Coast Guard and users of the waterway.

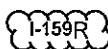
The concrete pier box units shall be utilized as the template for the installation of the foundation piles and shafts. The position and placement of the precast box units shall be accurately set and surveyed prior to the installation of the drilled shafts. The temporary supports for the box units shall be positioned to ensure they do not obstruct the installation operations of the drilled shafts. The Contractor shall survey the locations of the completed units and incorporate the as-built survey information into the as-built records.

Submittals

Submittals shall include the following:

1. The Contractor's Work Plan and Schedule of Operation shall be submitted to the Engineer and U.S. Coast Guard for approval prior to commencing any work in or over the waterway.
2. Design and erection calculations for the transport, positioning and installation of the pier box units shall be submitted for review and approval. Calculations and erection plans shall be prepared, signed and sealed by a Professional Engineer licensed in the State of New York
3. Shop Drawings/Fabrication Drawings/Working Drawings/Erection Drawings/Catalog Sheets.
4. Concrete Mix Design.
5. Certified copies of mill reports covering the chemical and physical properties of all materials furnished under the Section.
6. Names and addresses of all Suppliers/Fabricators to be utilized in the Work.
7. Record/As-Built Drawings.

The drawing and catalog sheet submittals shall conform to the requirements of NYSDOT Reinforcement requirements in the Standard Specifications.



ITEM 555.9991--29 - CONCRETE PIER BOX (TYPE 1 - PIER 4)
ITEM 555.9992--29 - CONCRETE PIER BOX (TYPE 2 - PIER 5)
ITEM 555.9993--29 - CONCRETE PIER BOX (TYPE 3 - PIER 6)
ITEM 555.9994--29 - CONCRETE PIER BOX (TYPE 4 - PIER 7)

The Contractor shall submit fabrication and working drawings in accordance with the Standard Specifications to the Engineer for approval. The working drawings shall include method of erecting and positioning the concrete pier box units for the placement of the substructure unit. The reinforcement bar lists and placement drawings shall meet the requirements of the current edition of the Concrete Reinforcing Steel Institute publication for reinforcement bar detailing.

The Contractor shall prepare erection calculations, installation procedures and erection drawings for the concrete pier box units for review and approval. The procedures and plans shall include, but is not limited to, the method of transport for the units to the site; the details and arrangement for transporting/floating precast units; the lifting and marine equipment for positioning precast units; the temporary supports for the positioning and erection of the precast box units; and details of collars and other support devices for the precast units. The temporary support and other devices shall be capable of carrying the full dead load of the completed precast box unit including the masonry stone, tremie concrete mass, and the substructure concrete. Calculations and erection plans shall be prepared, signed and sealed by a Professional Engineer licensed in the State of New York.

Survey shall be performed to locate and position the temporary supports for the box units. The placement of the temporary supports shall be such that the supports do not interfere with the erection of the precast box units and the installation of the drill shafts. The survey data shall be included in the fabrication and erection drawings for the installation of each pier box.

Fabrication

The fabrication and construction details of the concrete pier box units shall conform to the requirements of Section 555 of the NYSDOT Standard Specifications and as amended herein.

The concrete pier box units shall be constructed to be able withstand the construction loading during the transportation, erection and installation of the precast box units. The Contractor shall provide additional reinforcement and inserts as necessary for the Contractor's method for transportation, erection and installation of the box units. The Contractor shall incorporate these additional details into the shop drawings.

The box units incorporate other permanent elements into concrete substructure units. The incorporation of these permanent elements shall be carefully coordinated to ensure that all required elements are placed prior to concrete placement. The permanent elements shall be securely fixed within the formwork of the box units as necessary.

Concrete knockouts for the drilled shafts and other openings shall be provided as necessary.

The exposed vertical exterior concrete surfaces of the box shall be coated with the marine epoxy coating prior to exposing the concrete to salt or brackish water. The marine epoxy coating on the exterior vertical surface of the precast box units shall be applied according to the manufacturer's recommendations and as follows:

1. Surface Preparation - Clean and prepare surface and allow a 24 hour neutralization period before applying the coating.

ITEM 555.9991--29 - CONCRETE PIER BOX (TYPE 1 - PIER 4)
ITEM 555.9992--29 - CONCRETE PIER BOX (TYPE 2 - PIER 5)
ITEM 555.9993--29 - CONCRETE PIER BOX (TYPE 3 - PIER 6)
ITEM 555.9994--29 - CONCRETE PIER BOX (TYPE 4 - PIER 7)

2. Mixing - Pre-mix each component. Proportion equal parts, by volume of Component "A" and Component "B", in a clean container. Mix with low-speed drill and paddle as recommended by the manufacturer. Mix only that quantity that can be used within its pot life.
3. Application - Two coats shall be applied before installing the boxes. The substrate temperature shall be a minimum of 10°C (50°F) at application. The coating shall not be thinned. Apply the coating using high-quality rollers or brushes. Saturate all the rollers or brushes with the coating before immersion. Apply the coating with the least amount of agitation possible. Always apply the second coat as soon as possible to reduce potential surface contamination. Any damaged coating shall be touched up.

Transportation

Prior to transport, the method of transport of the box unit to the project site shall be submitted to the Engineer for approval. The Contractor shall also submit the request for restrictions to the navigation channel and coordinate the closure with the U.S. Coast Guard.

Erection

Prior to erection of the box units, the Contractor shall submit an erection procedure to the Engineer for review and approval. The erection procedure shall include detailed information concerning the proposed method of construction and the construction equipment required.

Method of supporting the box units shall be submitted prior to the installation of the supports. The temporary supports shall be capable of carrying the full dead load of the completed box unit including the stone masonry, tremie concrete mass, and the substructure concrete. The temporary supports shall also be able to withstand loadings from the drilled shaft operations subsequent to the installation of the pier box units. Temporary supports at the proposed pier location for the box unit shall be installed sufficiently prior to the erection of the box units to allow for field verification of the temporary supports and the proposed location of the precast box units by the Engineer. The Contractor shall provide control points to verify the proposed location of the box units.

The position and placement of the box units shall be carefully controlled to ensure the proper structure alignment of the bridge.

METHOD OF MEASUREMENT

The work will be measured as the number of Concrete Pier Boxes (Type 1, 2, 3 or 4) furnished, installed and accepted in place as shown on the Plans.

BASIS OF PAYMENT

The unit price bid for each of the Concrete Pier Boxes (Type 1, 2, 3 or 4) furnished, installed and accepted in place shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as described herein and shown on the Plans.

- ITEM 555.9991--29 - CONCRETE PIER BOX (TYPE 1 - PIER 4)
- ITEM 555.9992--29 - CONCRETE PIER BOX (TYPE 2 - PIER 5)
- ITEM 555.9993--29 - CONCRETE PIER BOX (TYPE 3 - PIER 6)
- ITEM 555.9994--29 - CONCRETE PIER BOX (TYPE 4 - PIER 7)

No separate payment will be made for the survey, temporary supports, reinforcement, stone masonry, structural steel, and other incidentals.

The tremie concrete for the Concrete Pier Boxes shall be paid for under appropriate pay items.

Payment will be made under:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
Item 555.9991--29	Concrete Pier Box (Type 1 - Pier 4)	Each
Item 555.9992--29	Concrete Pier Box (Type 2 - Pier 5)	Each
Item 555.9993--29	Concrete Pier Box (Type 3 - Pier 6)	Each
Item 555.9994--29	Concrete Pier Box (Type 4 - Pier 7)	Each

ITEM 10557.34 M - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE**DESCRIPTION**

This work shall consist of furnishing and placing portland cement lightweight concrete fill and overfill on the bascule span steel grid deck, as indicated in the plans and as specified herein.

MATERIAL REQUIREMENTS

Use materials meeting §557-2. Perform additional work as follows:

Manufacture lightweight high-performance according to §501, with the following modifications:

1. Design a lightweight high-performance concrete mixture, proportioned according to the American Concrete Institute Manual of Concrete Practice, ACI 211.2, and Standard Practice for Selecting Proportions for Structural Lightweight Concrete. Produce a homogeneous mixture of cement, fly ash, microsilica, fine aggregate, lightweight coarse aggregate, air entraining agent, normal range set-retarding water-reducing admixture, and water as designed.
2. Use Type 2 cement with a minimum cement content of 400 kg/m. Use 15-20% Fly Ash (or GGBFS) and 6-10% microsilica.
3. Use lightweight coarse aggregate conforming to §703-10, with a gradation in the 10 mm to 2.36 mm size designation in Table 1, ASTM C330.
4. Construct lightweight aggregate stockpile(s) so as to maintain uniform moisture throughout the pile. Continuously and uniformly sprinkle the stockpile(s) with water for a minimum of 24 hours using a sprinkler system approved by the Materials Engineer. If a steady rain of comparable intensity occurs, turn off the sprinkler system at the direction of the Materials Engineer, until the rain ceases. At the end of the wetting period, or after the rain ceases, allow stockpiles to drain for 12 to 15 hours immediately prior to use, unless otherwise directed by the Materials Engineer.
5. After the materials have been accepted for this work, determine the proportions for concrete and equivalent batch masses based on trials made with materials to be used in the work.
 - a. Determine the cement content for each trial batch by means of a yield test according to ASTM C138.
 - b. At least 1 week prior to concrete placement, provide the Materials Engineer with a copy of the trial mix design with the following data.
 - i. Fine and coarse aggregate (saturated surface dry condition) content in kg/m³.
 - ii. Cement content in kg/m³.
 - iii. Water content in kg/m³.
 - iv. Dry unit mass in accordance with ASTM C567.
 - v. 28 day compressive strengths.
 - vi. Batch masses.

The Materials Engineer will approve the batch weights prior to use. Use these values to manufacture all lightweight concrete for this project, and periodically correct the batch masses to account for changes in the fine aggregate fineness modulus and aggregate moisture contents.

ITEM 10557.34 M - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE

- 6. Achieve an average compression strength of 25.00 MPa, or greater, with no individual cylinder compressive strength less than 21.00 MPa.
- 7. Produce concrete with an average dry unit mass ranging from 1750 to 1850 kg/m³ when tested in accordance with ASTM C567.

CONSTRUCTION DETAILS

Apply the provisions of §557-3 and the following modifications:

- 1. Add the following to §557-3.01, Concrete Manufacturing and Transporting:
 - a. Use slump and air tests as a control measure to maintain a suitable consistency. Perform slump and air tests according to NYSDOT Materials Method 9.2. Determine air content by the volumetric method described in ASTM C173. Air content and slump placement limits are:

	<u>Minimum</u>	<u>Desired</u>	<u>Maximum</u>
Air Content (Roll-A Meter)	5.0%	6.5%	8.0%
Slump (mm)	----	65-90	100

- b. If the lightweight coarse aggregate moisture content at the time of batching is less than saturated surface dry (SSD), introduce lightweight coarse aggregate, along with approximately 2/3 of the total mixing water, into the mixer and mix for a minimum of 10 minutes. Otherwise, batch the coarse aggregate routinely with the fine aggregate, admixtures, cement, fly ash, microsilica, and remaining mixing water and mix completely.
- c. Have the lightweight aggregate manufacturer supply a service representative at the site for the first two days of lightweight concrete placement operations to assist in the control of lightweight concrete mixing and placement operations.

Handle and place concrete according to §557-3.06, Handling and Placing, except that pumping is not permitted. No waivers will be granted. Insert concrete vibrators deeper at full depth areas.

During concrete placement, wash off any mortar that leaks through the steel grid panels and drips onto any structural steel.

- 2. Test the concrete according to written Department procedural directives. Fabricate and cure cylinders for compressive strength testing according to NYSDOT Materials Method 9.2 procedures. The Engineer will cast cylinders, in sets of 2 individual cylinders, at a frequency of 1 set for each 50 m³, or fraction thereof actually placed. A minimum of 1 set will represent each day's concrete placement.
- 3. Cure concrete according to §557-3.12, Curing, except that only continuous wetting is allowed.
- 4. Make any repairs as per the provisions of §557-3.13, Damaged or Defective Concrete. In addition, the Engineer will reject any concrete represented by a cylinder set with an average compressive strength less than 25.00 MPa, or an individual cylinder with a compressive strength less than 21.00 MPA. Proposed repairs require Deputy Chief Engineer, Structures approval.

ITEM 10557.34 M - LIGHTWEIGHT HIGH-PERFORMANCE CONCRETE

5. The loading limitations §557-3.14 of apply, except that concrete Cylinder sets designated for early loading must attain an average compression strength of 25.00 MPA, or greater, with no individual cylinder less than 21.00 MPa.

METHOD OF MEASUREMENT

Payment will be made at the unit price bid per square meter for the number of square meters of swing span deck stated in the Estimate of Quantities shown on the contract plans.

BASIS OF PAYMENT

The unit price bid per square meter shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as shown on the plans or called for in the specification.

SECTION 564 - STRUCTURAL STEEL

564-1 DESCRIPTION. Under this work, the Contractor shall fabricate, furnish and erect structural steel and other metal parts as shown on the plans and in accordance with the provisions of the contract documents. The Contractor's attention is directed to §106-01, Source of Supply and Quality Requirements, with regard to advising Departmental Representatives of the sources of proposed materials. 5

564-2 MATERIALS. Materials for this work shall meet the requirements of the New York State Steel Construction Manual and the following subsections of §700 - Materials:

Paint as Specified	708	
Structural Steel	715-01	10
High Strength Bolts, Nuts and Washers	715-14	
Pins and Rollers	715-15	
Vertical Load Transmitting Devices	728	
Painting Procedures	740	

Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of §715-01, Structural Steel. 15

564-2.01 Structural Steel Replacement - Stock Steel Option. Stock steel may be furnished for this work. If furnished, the stock steel shall comply with the provisions of §715-01, Structural Steel. Positive heat identification will be required for all stock steel. Certified copies of the results of chemical analysis and physical tests shall be furnished to the Department. Shop inspection will be provided unless otherwise noted on the contract plans, or waived by the D.C.E.S. The provisions of this subsection shall apply only to pay items entitled "Structural Steel Replacement (kg.)" or "Structural Steel Replacement (Each)." 20

564-3 CONSTRUCTION DETAILS. All structural steel work, including, but not limited to fabrication inspection, transportation, and erection shall be done in accordance with the provisions of the SCM. 25

Shop drawings prepared for pay items titled Structural Steel Replacement (Kg.) and Structural Steel Replacement (Each) shall be prepared, approved and distributed in accordance with the provisions of the SCM, except that the term "D.C.E.S." shall be interpreted as "the Engineer."

564-4 METHOD OF MEASUREMENT. Measurement will be made by one, or combinations of the following methods as indicated in the contract documents. 30

- Kilogram
- Each
- Lump Sum

564-4.01 Kilogram. Measurement will be made on a kilogram basis. The mass of each shipping unit shall be clearly shown on the approved shop drawings. For the purpose of measurement, such items as castings, anchor bolts, forgings, fasteners, cable and other metal parts used in the construction shall, unless otherwise provided, be considered to be structural steel even if made of other materials. 35

A. Payment Mass. Payment will be based on the computed mass of metal as shown on the approved shop drawings, and shall include permanent bolts and welds in the structure as erected. The mass of all erection materials including but not limited to bolts, pilot and driving nuts, temporary protective coatings, and all boxes, crates or other containers used for packing, together with sills, struts, and rods used for supporting members during transportation, shall be excluded. 40

The mass of all required bolt heads, nuts and washers will be estimated, making no allowance for waste, and included in the mass for which payment will be made. 45

The mass of all required welds will be estimated and included in the mass for which payment will be made.

B. Computed Mass. The mass of steel shall be assumed as 7850 kg/m³. The mass of cast iron shall be assumed as 7210 kg/m³.

The masses of rolled shapes and of plates of all dimensions shall be computed on the basis of their nominal masses as required by the dimensions shown on the approved shop drawings. If the Contractor, however, elects to use for his convenience, steel members with masses that are greater than the nominal masses specified on the approved drawings, the computations shall be based on the nominal mass values on the drawings. Deductions shall be made for copes, cuts and all holes except those holes required for high-strength bolts.

The mass of fillet welds shall be computed from the following:

TABLE 564-1 MASS OF DEPOSITED METAL PER METER OF FILLET WELD							
Size of Fillet (mm)	5	6	8	10	12	16	20
Deposited Metal (kg/m)	0.139	0.200	0.365	0.516	0.705	1.088	1.747

The masses of castings shall be computed from the dimensions shown on the approved shop drawings, with an addition of 10% for fillets and overrun.

The mass of high-strength bolts, nuts and washers, exclusive of grip, shall be computed from the following:

TABLE 564-2 MASSES OF HIGH-STRENGTH BOLTS								
Bolt Diameter (mm)	13	16	20	22	24	27	30	36
Mass of 100 Bolts with Nut and 2 Washers (kg) ¹	10.8	16.3	28.7	38.8	51.4	71.6	91.7	143.0

NOTE 1. Measured mass will be exclusive of grips.

564-4.02 Each Unit. Measurement will be made for each unit of structural steel as indicated on the contract plans. The provisions of §564-4.01, concerning castings, anchor bolts, forgings, fasteners, cable, and other metal parts, shall apply.

564.4.03 Lump Sum. No measurement will be taken. The provisions of §564-4.01 concerning castings, anchor bolts, forgings, fasteners, cable and other metal parts, shall apply.

564-5 BASIS OF PAYMENT

564-5.01 General. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. For the purpose of payment, castings, forgings, fasteners, anchor bolts for other than bridge bearing installation, cables and other metal parts used in the construction, will be considered to be structural steel, even if made of other materials.

Partial payment will be made for structural steel in accordance with §109-04 PARTIAL PAYMENTS.

564-5.02 Additional Work. Items that are included in the price bid and are the Contractor's responsibility are as follows:

A. Shop Drawings, including Paper Prints and Reproducible Prints. The cost of all

shop drawings, prints and reproducible prints required by the specifications shall be included in the unit price bid for the payment item requiring the drawings.

Any prints and reproducible prints required beyond the number specified shall be furnished by the Contractor at cost.

B. Laminar Defects at the Boundary of Tension Groove Welds. The cost of all work and materials required for the correction or elimination of laminar defects at the boundary of tension groove welds shall be included in the price bid for structural steel. 5

The cost of all ultrasonic testing and repairs and the cost of replacement of defective portions of plates where partial replacement is approved shall be borne by the Contractor and included in the price bid for structural steel. 10

C. Inspection of Bolted Connections. All labor and equipment necessary for the performance of inspection of bolt tightness during structural steel fabrication and erection shall be provided by the Contractor and included in the price bid for structural steel. The State shall witness the bolt testing, but will not provide equipment or labor.

D. Qualification Test for Welders, Welding Procedures and Electrode and Flux Combinations. The cost of tests required to qualify welders, welding procedures and electrode and flux combinations shall be included in the unit price bid for the steel with the exception that the State will witness tests and perform Charpy V-Notch Impact Tests without cost to the Contractor. 15

E. Radiographic Inspection. The cost of radiographic inspection and of preparation for radiography, together with the cost of providing access and of furnishing adequate facilities for the review of radiographs in the shop or field, shall be included in the price bid for structural steel. 20

F. Ultrasonic Inspection. Ultrasonic inspection, when required, will be performed by the State or its representatives unless otherwise provided for in the contract documents. The cost of any required preparation and of furnishing access to the joints shall be included in the price bid for structural steel. 25

G. Magnetic Particle Inspection. The cost of magnetic particle inspection when specified or required by the inspector to verify limits of defects discovered during visual inspection shall be included in the unit price bid for structural steel.

H. Repair of Defects in Welds and Base Metal. The cost of repairing defects found by visual inspection or nondestructive tests shall be included in the unit price bid for structural steel. 30

I. Field Inspection of Rejected Material or Material Not Offered for Shop Inspection even though Required to be Shop Inspected by the Contract Documents. When the Department, at its discretion, permits inspection of the subject materials to be performed at the project site, all costs of this inspection shall be borne by the Contractor as a condition of the Department's approval of inspection of this material. All costs associated with the inspection of rejected material, which has been shipped to the field without approval, shall be borne by the Contractor. 35

J. Straightening Bent Material and Correcting Camber Deficiencies. All corrective work required to straighten bent material and correct camber deficiencies, when permitted, shall be performed at no additional cost to the State. 40

K. Field Repair, Reaming and Drifting of Holes. All work permitted for the correction of unacceptable holes shall be provided at the Contractor's expense.

L. Metal Scuppers. Metal scuppers shall be paid for as structural steel unless otherwise noted on the plans.

M. Adjustment and Alignment of Bearings. All labor, materials and equipment required for adjustment and alignment of bearings shall be included in the unit price bid for structural steel.

N. Field Splices. When the specific location for a bolted or welded field splice in stringers and girders is not shown on the plans, the Contractor will be permitted to introduce splices at locations of his choice. The splices shall be made in accordance with the provisions of the SCM. No payment will be made for labor, material, and equipment required to make a splice if the splice is not shown on the contract plans. Also, payment will not be made for increases in the thickness of webs or flanges made necessary by the requested splice. 5

O. Photographs. Photographs requested by the D.C.E.S. in accordance with the provisions of the SCM, shall be furnished at no additional cost. 10

P. Testing of Stock Steel. All labor, materials and equipment necessary to perform chemical and physical tests on stock steel when such tests are required shall be furnished by the Contractor and included in the price bid for structural steel.

Q. Heat-Curving and Cambering. All costs of nondestructive testing, repairs or replacement of material damaged due to over stressing or destructive heating during heat-curving or cambering shall be borne by the Contractor. 15

564-5.03 Progress Payments - Lump Sum. These shall be calculated by multiplying the lump sum price bid by the ratio which represents the structural steel members erected during the payment period in question. (Refer to §109-03). The ratio will be computed by dividing the shipping mass of the erected steel (obtained from the Report of Shipment of Structural Material, Form B & GC-4b) by the Total Mass for Progress Payments for the appropriate item. "The Total Mass for Progress Payments" will be indicated on the plans for use in determining Partial Payments and Progress Payments. Under no circumstances will the "Total Mass for Progress Payments" be used for final payment purposes. The Contractor is advised not to use the "Total Mass for Progress Payments" as a bidding tool. Discrepancies which may occur between the total mass shipped and the "Total Mass for Progress Payments", as indicated on the plans, will not be a basis for additional compensation. 20 25

564-5.04 Other Work. Work not included in the unit price bid for the structural steel item is as follows:

A. Setting Anchor Bolts for Bridge Bearings. The pipe sleeves, anchor bolts and work required to furnish, set and grout the anchor bolts, shall be included in the price bid for the respective bearing item. 30

B. Vertical Load Transmitting Devices. The furnishing and installing of vertical load transmitting devices, such as; rubber impregnated random fiber pad, and plain rubber pad, shall be included in the price bid for the respective item.

Payment will be made under: 35

Item No.	Item	Pay Unit
564.05XX M	Structural Steel (Type 1-16)	Lump Sum
564.10nn M	Structural Steel Replacement	Kilogram
564.51nn M	Structural Steel	Kilogram
564.70nn M	Structural Steel Replacement	Each 40

NOTE: nn denotes serialized pay item, see §101-02 Definitions of Terms under "Specifications".