PART 1   GENERAL

1.1   SECTION INCLUDES
A. This section includes shop fabricated fiberglass reinforced plastic (FRP) pultruded fiberglass gratings, treads, ladder systems, and structural shapes where noted on the Drawings.

1.2   SCOPE OF WORK
A. The CONTRACTOR shall furnish and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.3   RELATED DOCUMENTS
A. Drawings, General Specifications, General Provisions, Special Project Conditions, and Division 1 Specification Sections, apply to this section.
C. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

1. ASTM D-635-Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
2. ASTM D-495-High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
3. ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics
4. ASTM E-84-Surface Burning Characteristics of Building Materials

1.4   CONTRACTOR SUBMITTALS
A. The CONTRACTOR shall furnish shop drawings of all fabricated systems and accessories in
accordance with the provisions of this Section.

B. The CONTRACTOR shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, ledge angles, embedded angles, member sizes, and connection details.

C. The CONTRACTOR shall submit the manufacturer's published literature including structural properties and design data, fiberglass load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the Contract Documents.

D. The CONTRACTOR may be requested to submit sample pieces of each item specified herein for acceptance by the ENGINEER as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

E. The CONTRACTOR shall provide calculations and drawings sealed by a Professional Engineer registered in the State of New York.

1.5 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous, separate, similar successful installations in the last five (5) years.

B. Substitution of any component or modification of system shall only be allowed when approved by the ENGINEER.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.6 PRODUCT DELIVERY AND STORAGE

A. All components shall be shop fabricated, piece match marked to assembly or erection drawings.

B. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

C. Storage of Products: All materials shall be carefully handled to prevent them from abrasion,
cracking, chipping, twisting, other deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 70 and 85 degrees F (21 to 29 degrees C) until they are required.

PART 2 PRODUCTS

2.1 GENERAL

A. The design criteria of the FRP products including connections shall be in accordance with governing building codes and generally accepted standards in the FRP industry.

B. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/360 of span for structural members. Connections shall be designed to transfer the loads.

C. All FRP items under this Section shall be composed of fiberglass reinforcements and resins in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

D. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mats and/or surfacing veils in sufficient quantities as needed by the application and/or physical properties required.

E. Resin shall be VINYLESTER (VEFR) for all systems. Fiberglass gratings shall only be MOLDED which shall be vinyl ester resin system, with chemical formulations as necessary to provide the corrosion resistance, strength, and other physical properties as required.

F. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids, and without dry spots, cracks, crazes, or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

G. All FRP items shall have a tested flame spread rating of 25 or less when tested in accordance with the ASTM E 84 Tunnel Test. Fiberglass items shall also have a tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTMD635. Manufacturer may be required to provide certification of ASTM E84 test on fiberglass components from an independent testing laboratory.

H. All clips and hardware incorporated into each fiberglass system shall be manufactured of Type 316 stainless steel.

I. After fabrication, all cut ends, holes and abrasions shall be sealed with a resin appropriate for application onto the base fiberglass material.
2.2 FIBERGLASS STRUCTURAL SHAPES

A. Material:

1. Structural shapes and plates shall be made from a premium grade polyester or vinyl ester resin with fire retardant additives to meet Class 1 flame rating of ASTM E-84 and meet all the self-extinguishing requirements of ASTM D-635. All structural shapes shall contain a UV inhibitor.

B. Process:

1. Manufactured by the pultrusion process.

2. Structural FRP members’ composition shall consist of a glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50 percent resin to glass ratio. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats shall be used internally for transverse strength.

2.3 MOLDED FIBERGLASS GRATING

A. Manufacturer:

1. Fibergrate; R.M. Headlee Co., Inc.

2. Strongwell;

3. Or approved equal.

B. Fabrication:

1. The grating shall be one piece construction with the tops of the bearing bars and cross bars in the same plane.

2. The fiberglass grating shall be as free from visual defects such as foreign inclusions, delaminations, blisters, resin burns, air bubbles, and pits. The surface shall have a smooth finish (except for grit top surfaces).

3. The mesh pattern and thickness shall be 1-1/2-inch square mesh, 1-1/2-inch thick.

4. The FRP molded grating and treads shall be manufactured by the open mold process.

5. Design live loads of the FRP gratings for walkway applications shall be 100 psf uniformly distributed load (or as required by the governing building code).

6. A maximum deflection of 3/8-inch or L/180 at the center of a simple span OR a concentrated load of 250 pounds with a maximum deflection of 1/4-inch at the center of a simple span.
C. Non slip surfacing: Fiberglass grating shall be provided with a quartz grit bonded to the top surface of the finished grating product.

D. Fire rating: Fiberglass grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Manufacturer may be required to provide certification of ASTM E84 test on fiberglass grating panels from an independent testing laboratory. Test data shall be from full scale testing of actual production fiberglass grating, of the same type and material supplied on the project.

E. Resin system: The resin system used in the manufacture of the fiberglass grating shall be VEFR. Manufacturer may be required to submit corrosion data from tests performed on actual fiberglass grating products in standard chemical environments.

F. Color: Yellow.

G. 1-1/2-inch thick molded stair treads in a 1-1/2-inch by 6-inch rectangular mesh pattern. The resin system shall be the same as the molded grating. The stair tread shall come complete with anti-slip nosing.

H. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the ENGINEER for approval.

2.4 STAIR TREADS

A. Stair treads shall be fabricated as described in paragraph 2.3, above.

B. Non slip surfacing: Stair treads shall be manufactured with a grit surface for slip resistance. For additional safety, and to meet OSHA requirements, stair treads shall be manufactured with a 1 1/2-inch wide nosing of contrasting color. Nosing shall be gritted with angular quartz grit.

C. Stair treads shall be designed for a uniform live load of 100 psf on the simple span of the tread OR a 300 pound line load at the center of the tread; the greater of the two criteria shall govern.

2.5 FRP SAFETY LADDER

A. The Scum Dry Well FRP safety ladder shall include a safety cage.

B. FRP safety ladder and cage components shall be:

1. Dynarail, as manufactured by Fibergrate Composite Structures Inc.

2. Or approved equal.

C. Ladder system shall satisfy OSHA load and dimensional regulations listed in Code of Federal Regulations, Title 29.
D. All ladder side rails, rungs, ladder mounting brackets and cage straps are to be FRP structural shapes manufactured by the pultrusion process.

E. Cage hoops and brackets shall be produced by the open molded hand lay-up method. All structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

F. All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.

G. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field.

H. The hoop brackets shall be shop attached to the ladder with bolts. The hoops shall be field attached to the hoop brackets.

I. All cut or machined edges, holes and notches shall be sealed to provide maximum corrosion resistance. All field fabricated cuts shall be coated similarly by the CONTRACTOR in accordance with the manufacturer’s instructions.

J. The ladder side rail shall be 1-3/4-inch square tube with a wall thickness of 1/4-inch or greater. The rungs shall be 1-1/4-inch diameter pultruded structural shapes, continuously fluted to provide a non-slip surface. Rungs that are gritted as a secondary operation shall not be permitted. Ladder wall and floor mount shall be fabricated from pultruded angles, 3/8-inch minimum thickness.

K. The ladder cage vertical bars shall be 1.5-inch wide by 5/8-inch pultruded I-beam shapes to offer protection to workers from exposed hardware. Cage hoops and cage brackets shall be manufactured by the open mold hand lay-up process. All cage hoops shall be 3-inch wide by 1/4-inch thick minimum.

L. Type 316 stainless steel bolts shall be provided for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, and wall brackets to the ladder.

M. All rungs shall be both mechanically attached to the ladder with stainless steel rivets and chemically bonded with epoxy.

N. All ladder and cage components are to be integrally pigmented yellow. All wall and floor mount brackets shall be light gray.

O. All fasteners used in the ladder system are to be Type 316 stainless steel. Rivets will be 18-8 stainless steel.

P. Pultruded structural shapes used in the ladder system are to have the minimum longitudinal mechanical properties listed below:
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<tr>
<th>Property</th>
<th>ASTM Method</th>
<th>Value</th>
<th>Units</th>
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<tr>
<td>Tensile Strength</td>
<td>D-638</td>
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<td>psi</td>
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<tr>
<td>Tensile Modulus</td>
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<td>Flexural Strength</td>
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<td>Flame Spread</td>
<td>E-84</td>
<td>25 or less</td>
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PART 3 EXECUTION

3.1 GENERAL

A. Measurements: FRP systems supplied shall meet the dimensional requirements and tolerances as shown or specified. The CONTRACTOR shall provide and/or verify measurements in the field for work fabricated to fit field conditions as required by manufacturer to complete the Work. When field dimensions are not required, CONTRACTOR shall determine correct size and locations of required holes or cutouts from field dimensions before fabrication.

B. Sealing: All shop-fabricated cuts, drilled holes, etc. shall be coated with resin to provide maximum corrosion resistance. All field fabricated cuts, drilled holes, etc. shall be coated similarly by the CONTRACTOR in accordance with the manufacturer's instructions.

C. Fiberglass Grating Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of 4 feet apart with a minimum of four per piece of fiberglass grating, or as recommended by the manufacturer.

D. Fiberglass Grating Layout: Each fiberglass grating section shall be readily removable, except where indicated on Drawings. Manufacturer to provide openings and holes where located on the Contract Drawings. Fiberglass grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
3.2 INSTALLATION

A. CONTRACTOR shall install FRP fiberglass systems in accordance with manufacturer’s assembly drawings.

B. Lock fiberglass items securely in place with hardware and fasteners, per manufacturer’s recommendations and as specified herein.

C. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drill surfaces in accordance with manufacturer’s instructions. Follow manufacturer’s instructions when cutting or drilling fiberglass products or using resin products. The CONTRACTOR shall provide adequate ventilation, as required, during the cutting, drilling, and resin application work.

END OF SECTION