# SECTION 06 74 10

# PULTRUDED FRP ACCESS PLATFORMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:
   1. Pultruded FRP frames, supports and miscellaneous members for FRP access platforms.
   2. Pultruded FRP gratings for FRP access platforms.
   3. Pultruded FRP stairs for FRP access platforms.
   4. Pultruded FRP handrails and guardrails for FRP access platforms and stairs.

B. Information herein pertains to Add Alternate No. 2 as follows.
   1. Base Scope of Work shall 05 51 36 Metal Grate Platforms Stairs and Rails as specified herein for all access platforms stairs and railings.
   2. Alternate No. 2 shall include providing FRP access platforms stairs and railings as specified in Section 06 74 10 should Alternate No. 2 be accepted.

C. Exclusions & Variations: No exclusions or variations to the scope of this Section shall be entertained by the Architect without written approval by the Owner submitted to the Architect for review a minimum of 10 working days prior to submittals being received.

### 1.2 DEFINITIONS

A. FRP: Fiber reinforced polymer.

B. Pultruded FRP: Pultruded Glass Fiber Reinforced Polymer members assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.

### 1.3 ACTION SUBMITTALS

A. Exclusions: No exclusions to the scope of this Section shall be entertained by the Architect without written approval by the Owner submitted to the Architect for review a minimum of 10 working days prior to submittals being received.

B. Product Data: For each type of product indicated.

C. Shop Drawings:

1. Include Project and condition specific FRP Access Platform systems and components. Include plans, elevations, sections, details, and attachments to other work in compliance with all specified requirements reviewed and approved by FRP Manufacturer prior to submittal to Architect. Manufacturer's standard details as published are not acceptable and do not satisfy shop drawing requirements. Show the following items at minimum with project and condition specific detailing:
    a. Include details of assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each connection.
    b. Detail fabrication and assembly of FRP Components, anchors and accessories.
    c. Connection Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include rails and frames for equipment attachment and mounting where utilized.

D. Samples: For each exposed product and for each color and texture specified.
1. Provide minimum 12 inch long sections for FRP platform grating members minimum 2 main members with all cross members and rods. Sample shall be coated with post fabrication UV protectant and non-skid grit on the top surface as specified.
2. Provide minimum 12 inch long top rail section consisting of two 6 inch long sections secured with typical FRP Railing connector. Sample shall be coated with post fabrication UV protectant as specified.
3. Provide minimum 12 inch long stair stringer member to be utilized for stairs. Sample shall be coated with post fabrication UV protectant and as specified.
4. Provide minimum 12 inch long section for FRP stair grating members minimum 2 main members with all cross members. Sample shall be coated with post fabrication UV protectant and non-skid grit on the top surface as specified.
5. Provide two of each Type of Panel Hold Downs, Connectors and Clips utilized to anchor all grating members for anchorage and to prevent panel drift.

A. Delegated Design Submittal: Submit for FRP Access Platforms, Stairs and Rails indicated to comply with Performance Requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Submit structural calculations for members and connections, stairs and railings. The system shall lend itself to a rational structural analysis with section properties of framing members demonstrated by calculations.

## 1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For access platform components all vibration control items and accessories from manufacturer.

B. Coordination Drawings; Rooftop FRP Access Platforms Stairs and Rails: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which platform and / or the ladder framing system will be attached.
2. MEP items in the immediate vicinity.
3. Items penetrating the roofing system assembly and fully coordinated with the Work of Section 07 54 00.

C. Certificates and Reports:
1. Welding certificates.
2. Mill certificates.
3. Fabricator Certification from Manufacturer.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. The material covered by these specifications shall be furnished by an ISO-9001 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication and installation of FRP systems.

B. Fabricator Qualifications: Firm Certified in writing by the Manufacturer and 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.

C. Installer Qualifications: Fabricator of products.

D. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

E. Preinstallation Meeting: Minimum 21 days before starting access platform construction, conduct conference at site.
1. Meet with Owner, Architect, General Contractor, FRP Access Platform installer, testing and inspecting agency representative, FRP system manufacturer's representative, and installers whose work interfaces with or affects the Work of this Section.
2. Review status of submittals and confirm Architect approval. No Work of this Section may be performed prior to submittal approval.
a. If submittals are not approved, discuss measures of remedy and compliance.

3. Review methods and procedures related to access platform installation, including manufacturer's written instructions, approved shop drawings and all notations by Architect and engineered connections.
4. Where FRP access platforms on the rooftop are required, review interface with roofing system, building structure and all requirements for roof protection and preserving the roof system warranty.
5. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Review structural loading limitations of FRP access platforms, rails and stairs during and after roofing.

## 1.7 WARRANTY

A. Warrant Pultruded FRP composites products to be free from defects due to materials and workmanship for five years.

B. Special Warranty: Installer agrees to repair or replace components of Pultruded FRP Access Platform Assemblies that fail(s) in materials or workmanship within specified warranty period.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design Pultruded FRP Access Platforms, Stairs and Railings, including attachment to building construction and framing members. Provide comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Pultruded FRP Grate Platforms Stairs and Rails framing assembly: Framing assembly capable of withstanding structural loads complying with design criteria without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the faming assembly.

C. Structural Performance of platforms: Provide platform framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: Indicated on Drawings.
   2. Seismic Loads: Indicated on Drawings.
   3. Limit deflection to L/240 or 3/8 inch (9.6 mm) , whichever is less.
   4. Walkways and Platforms:
      a. Walkways and Elevated Platforms other than exits: Uniform load of 60 lbf/sq. ft..
      b. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..

D. Structural Performance of Stairs: Pultruded FRP Grating stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Uniform Load: Designed and constructed to carry a load of five times the normal live load anticipated but not less strength than to carry safely a moving concentrated load of 1,000 pounds (454 kg).
   2. Uniform and concentrated loads need not be assumed to act concurrently.
   3. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified.

E. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

F. Structural Performance of Guardrails: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Guardrails and Top Rails of Guards: Capable of withstanding, without failure, a force of at least 200 pounds (890 N) applied in a downward or outward direction within 2 inches (5 cm) of the top edge, at any point along the top rail.
      a. When a 200 pound (890 N) test load is applied in a downward direction, the top rail of the guardrail system shall not deflect to a height of less than 39 inches (99 cm) above the walking/working surface.
      b. Height: Not less than 42 inches (1070 mm) from leading edge of stair tread to top of surface of top rail.
         1) Top Edge Height: Permitted to exceed 45 inches (1140 mm) provided all criteria is met.
   2. Infill or Midrails of Guards:
      a. Midrails, intermediate vertical members, and intermediate members capable of withstanding, without failure, a force of at least 150 pounds (667 N) applied in any downward or outward direction at any point along the intermediate member.
      b. Height: Installed midway between top edge of guard rails and walking/working surface.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

H. Seismic Performance: All assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

I. Welding Qualifications: Where necessary qualify procedures and personnel according to AWS D1.1/D1.1M Structural Welding Code - Steel.

J. Coordinate building structural members, elevations, and roof layout for the design of catwalks. Support Pultruded FRP access platforms, stairs and railings from structural member connections and distributed accordingly.

K. Overall Assembly Safety Factor: Minimum of 2.

L. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

## 2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Strongwell with product lines as indicated throughout this Section. Subject to compliance with requirements and aesthetic equivalency as determined by the Architect, comparable products by one of the following may be acceptable:
1. Bedford Reinforced Plastics.
2. Fibergrate Composite Structures Inc.

B. Substitutions are not acceptable.

## 2.3 FABRICATOR

A. Pultruded FRP products shall be fabricated in the USA. and Fabricator shall provide a written Certificate of Compliance.

B. The Pultruded FRP Fabricator shall be certified by the Manufacturer in writing. Written Certification shall be provided for record with submittals.

## 2.4 MATERIALS GENERAL

A. Pultruded FRP products shall be manufactured in the USA. Manufacturer shall provide a written Certificate of Compliance. Written Certification shall be provided for record with submittals.

B. The materials covered by these specifications shall be furnished by an ISO-9001 certified manufacturer.

C. All materials for the Work of this Section shall be manufactured with the pultrusion process utilizing premium polyester resin, integrated UV inhibitors and comply with the following:

1. A flame retardant additive integral to the mix shall be provided prior to pultrusion.
2. A UV inhibitor shall be provided integral to the mix prior to pultrusion. UV inhibitors added to the pultrusion mix shall be sufficient to protect all members from UV radiation and degradation for the full duration of the warranty period.
3. A continuous synthetic surface veil fabric shall encase the glass reinforcement.

4. All exposed surfaces shall be smooth and true to form, consistent with ASTM D4385.
5. All exposed traffic surfaces shall have an embedded abrasive finish applied prior to the finish resin coating.
6. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D635.
7. Pultruded profiles shall satisfy the visual requirements of ASTM D4385.
8. All FRP members shall meet or exceed the minimum published mechanical, physical, electrical, flammability, and corrosive properties published in the manufacturer's literature.

D. All cut ends and other terminations shall be coated with UV inhibitor. Do not permit sharp edges or ends on finished surfaces.

E. Molded FRP materials are not acceptable, provide Pultruded FRP members only.

F. Fiber Reinforcement:
1. Fiber Type: E-glass fiber.
2. Fiber Architecture:
   a. Oriented-strand glass fiber rovings; 65 to 70 percent glass minimum.
   b. Density: As recommended by the manufacturer to meet Performance Requirements.
3. Core: Oriented fibers surrounded by continuous filament mat.
4. Cover: Continuous synthetic surfacing veil.
   a. Veil: polyester non-woven fabric to encase glass reinforcement for protection and elimination of fiber bloom.

## 2.5 PULTRUDED FRP MEMBERS

A. Pultruded FRP Support Members: Structural shapes, angles and plate produced in multiple shapes and sizes to meet Drawings, Performance Requirements and the following.
1. Premium polyester resin.
2. Fiber reinforcement to meet structural properties of manufacturer's literature.
3. Integral flame retardant.
4. UV inhibitor integral to mix prior to pultrusion.
5. Additional UV inhibitor applied following pultrusion and curing of all members; 1 mil minimum cured thickness.
   a. Color of UV inhibitor: As selected by Architect from manufacturer's standard range**.**
6. Minimum Ultimate Properties:
   a. Tensile Stress, LW: 30,000 psi
   b. Tensile Stress, CW: 7,000 psi
   c. Compressive Stress, LW: 30,000 psi

d. Compressive Stress, CW; 15,000 psi
e. Flexural Stress, LW: 30,000 psi
f. Flexural Stress, CW: 10,000 psi
g. Short Beam Shear, LW: 4,500 psi
h. Ultimate Bearing Stress, LW: 30,000 psi

7. Basis of Design: Extren 525 Series Shapes by Strongwell with UV inhibitor applied following pultrusion and curing of all members.

B. Pultruded FRP Gratings for platforms.

1. Premium polyester resin.
2. Fiber reinforcement to meet structural properties of manufacturer's literature.
3. Integral flame retardant.
4. UV inhibitor integral to mix prior to pultrusion.
5. Additional UV inhibitor applied following pultrusion and curing of all members; 1 mil minimum cured thickness.
   a. Color of UV inhibitor: As selected by Architect from manufacturer's standard range**.**
6. T5800; 2 inch T bars spaced 2.4 inches on center with 58 percent open area minimum and as required to comply with structural performance requirements.
7. Cross-rods: Shall consist of a center core wedge and two spacer bars that are notched at each bearing bar so that each bearing bar is both mechanically locked and chemically bonded to the web of each bearing bar.
8. Spacer bars: Shall be continually bonded to the center core wedge. The cross-rods shall be spaced a maximum of 8 inches in from the panel edge.
9. All exposed traffic surfaces of the panels shall be covered with a bonded epoxy medium grit anti-skid surface.
10. Provide manufacturer's continuous Curb Angles for all grating panel edges throughout the Work of this Section.
11. Panel Hold Downs and Connectors: Provide weldable 316L stainless steel insert clips with through bolts for all panels with spacing to meet Performance Requirements.
12. Grating Basis of Design: Duradeck T-5800 Series by Strongwell.

C. Pultruded FRP Stairs:

1. Stair Support members and stringers: Provide members that meet all requirements of FRP Support Members as specified in this Section.
   a. Fabricate stringers of FRP Support Member tubes or channels as indicated and required to meet the Performance Requirements of this Section.
      1) Stringer Size: As indicated and required to comply with Performance Requirements of this Section. Treads shall not protrude beyond top edge of stringers.
      2) Provide closures for exposed ends of channel stringers.
   b. Fabricate tread and other supports from FRP Support Member tubes, angles or channels as indicated and required to meet the Performance Requirements.

1) Support Sizes: As indicated and required to meet the Performance Requirements of this Section.

2. Pultruded FRP Gratings for Stair Treads and Platforms:
   a. Provide grating members that meet all requirements of Gratings for platforms as specified in this Section.
   b. Attach a 2 inch deep continuous nosing to the leading edge of all treads and landings covered with a bonded epoxy medium grit anti-skid surface.
   c. Provide continuous tread support angles and through bolted stainless steel saddle hold down clips minimum 4 per tread. Support angles shall be anchored to stringers to meet Performance Requirements.
   d. Basis of Design: Duradeck by Strongwell with T-5000 2 inch nosing.

D. Pultruded FRP Handrails and Guardrails.
   1. Premium polyester resin.
   2. Fiber reinforcement to meet structural properties of manufacturer's literature.
   3. Integral flame retardant.
   4. UV inhibitor integral to mix prior to pultrusion.
   5. Additional UV inhibitor applied following pultrusion and curing of all members; 1 mil minimum cured thickness.
      a. Color of UV inhibitor: As selected by Architect from manufacturer's standard range**.**
   6. Provide handrails and railings that comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
   7. Rails and Posts: Provide 1.9 inch diameter or 1.75 inch minimum square tube rails and posts, Pultruded FRP with the following minimum properties:
      a. Provide materials with a Class 1 rating of 25 or less per ASTM E-84 and meeting the self-extinguishing requirements of ASTM D-635.
      b. Resin shall be UV inhibited and the composite shall include a veil on all exposed surfaces.
      c. Visual quality of the pultruded shapes shall conform to ASTM D-4385.
      d. Ultimate Flexural Stess (Full Section): 60,000 psi minimum.
      e. Density: 0.065 - 0.075 lbs per cubic inch per ASTM D792.
   8. Kickplate: Provide continuous kickplate at the perimeter of all platforms minimum 4 inch high, corrugated extrusion.
   9. Connections:
      a. Railings: Provide manufacturer's FRP connectors secured with epoxy adhesive to meet the Performance requirements for rail splices, post to rail connections and railing returns. Provide all wall brackets and other components as recommended by the manufacturer to meet the Project conditions.
      b. Post to platform and stringer connections: Provide mechanically anchored connections to platform structure and to stair stringers utilizing additional

plates, shapes, channels and spacers to develop connections meeting all performance requirements.

10. Basis of Design: Safrail Industrial Railing System by Strongwell.

## 2.6 ACCESSORIES

A. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).

B. High Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy hex carbon steel nuts; and ASTM F436/F436M, Type 1, hardened carbon steel washers. Hot dipped galvanized according to ASTM A123/A123M or ASTM A153/A153M.

C. Post Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material for Interior Locations: Carbon steel components are zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations:
      a. Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
      b. High Strength Bolts, Nuts, and Washers Hot dipped galvanized.

## 2.7 FABRICATION

A. Fabricator: Subject to compliance with requirements, provide products fabricated by one of the following:
   1. Advantic LLC
   2. Fabricator certified in writing by the manufacturer meeting all requirements of this Section including but not limited to the requirements indicated in Quality Assurance.

B. General:
   1. Shop Assembly: Fabricate and assemble all components in the shop to the greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
   2. Fabricate in accordance with approved shop drawings.
   3. Seams and mold lines shall be filled where necessary, ground smooth, and finished to match surrounding surfaces.
   4. Identification:

a. Identify each part with a permanent serial number in an inconspicuous location not exposed to view in the finished assembly.
b. Number parts to coordinate with shop drawings.

5. Apply additional coat of UV protection.
6. Cure and clean components prior to shipment, and remove material that may be incompatible with adjacent building materials.

C. Pultruded FRP Support Members:

1. Fabricate members to support access platform assemblies in accordance with the sealed shop drawings and calculations. Any variations in the shop or field shall be reviewed and endorsed by the delegated design engineer and all submittals updated.
2. Fabricate support members in accordance with manufacturer's fabrication requirements, free of sharp edges, burs or uncoated FRP fibers.
3. Provide predrilled or punched holes for all mechanical connections, with appropriate UV protection at all locations.
4. Channels, angles, additional support members and anchors: Provide additional members of sufficient length and strength to support the access platform system and all components including but not limited to brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other Work.
   a. Furnish inserts and anchorage devices for connecting to concrete or masonry work.
5. Fillers: Provide fillers made from stainless steel plate, or other suitably crush resistant material, where required to transfer loads to structural supports.
   a. Size fillers to suit conditions and to produce adequate bearing area to prevent rotation and overstressing of members and assembly.

D. Pultruded FRP Gratings for platforms.

1. Fabricate gratings in panel sections of typical sizes and configuration to accommodate the engineered assembly to bear on all supports and be mechanically anchored in place.
2. Fabricate support members in accordance with manufacturer's fabrication requirements, free of sharp edges, burs or uncoated FRP fibers.
3. Provide predrilled or punched holes for all mechanical connections, with appropriate UV protection at all locations.
4. Provide additional components as necessary for a complete system meeting all Performance Requirements.
5. Coat all cut edges with appropriate veil fabric and additional UV protection at all locations.
6. Provide continuous curb angles at all grating panel edges; do not leave cut gratings exposed to view.

E. Pultruded FRP Stairs:

1. Stair Framing:
   a. Fabricate stringers of FRP tubes or channels.

1) Stringer Size: As indicated on Drawings and as required to comply with performance requirements.
2) Provide closures for exposed ends of channel stringers.

2. Fabricate platforms and tread supports of FRP channel headers and miscellaneous framing members required to comply with performance requirements.
   a. Provide closures for exposed ends of channel framing.

3. Secure stringers to headers; bolt framing members to stringers and headers.

4. Where masonry walls support stairs, provide temporary supporting struts designed for erecting stair components before installing masonry.

F. Pultruded FRP Handrails and Guardrails.

1. FRP fiberglass railing system shall be fabricated into finished sections by fabricating and joining together pultruded round tube using glass-reinforced thermoset components; epoxy bonded and connected as shown in the fabrication details. Railing sections shall be fabricated to the size shown on the approved fabrication drawings and shall be piece marked with a waterproof tag in inconspicuous locations.
2. All railing corners and intersecting elements shall be continuously connected.
3. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
4. Avoid the use of adjustable connectors wherever possible.
5. Clean and prepare all materials prior to applying adhesive.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Observe field conditions to confirm that building lines, grades, and elevations will allow proper installation of Pultruded FRP products.

B. Verify that support framing has been constructed to allow accurate placement and alignment of anchor bolts, plates, dowels, or other connections to structure.

C. Prior to installation, verify all field dimensions. Report discrepancies that could affect installation. Do not proceed with installation until discrepancies are corrected.

D. The beginning of installation shall be construed as acceptance of existing conditions.

### 3.2 PREPARATION

A. For rooftop access platforms, provide sufficient roof protection boards in the area of construction to ensure protection of the roofing system and any installed portion of the

system including but not limited to the vapor retarder. Comply with Section 07 54 00 Polyvinyl Chloride (PVC) Roofing System for all roof system protection.

## 3.3 ERECTION

A. Install components in accordance with manufacturer's instructions and approved shop drawings.

B. Lifting and Positioning: Lift FRP composites with suitable lifting devices at points indicated on approved shop drawings.

C. Set components level, plumb, square, and true within the allowable tolerances.

D. Temporarily support and brace panels as required to maintain position, stability, and alignment until permanent connection.

E. Do not allow components to be cut, trimmed, or otherwise changed without express written permission or direction from the manufacturer. Provide revised calculations and shop drawings in the event a revision is required.

F. Anchoring:

1. Anchor FRP composites members as shown on approved shop drawings.
2. Perform arc or gas welding in accordance with FRP-composites manufacturer's instructions and approved shop drawings, using materials compatible with the base material.

G. Tolerances:

1. Warpage: Maximum permissible warpage of one corner out of the plane of the other three shall be 1/8 inch per foot, or 3/8 inch total after installation.
2. Bowing: Less than L/200 with a maximum of 1 where L is the panel length in the direction of the bow. Differential bowing between adjacent members of the same design shall be no more than 1/4 inch.
3. Width of Joint: 1/4 to 1/2 inch, depending upon engineering criteria.
4. Maximum Offset from True Alignment: 1/4 inch in 20 feet.
5. Maximum Variation from True Position: 1/2 inch in 20 feet.
6. Gap Tolerances between Joints for panel dimensions of:
   a. Less than 10 feet: plus or minus 3/16 inch.
   b. 10 feet to 20 feet: plus or minus 1/4 inch.
   c. Greater than 20 feet: plus or minus 5/16 inch.

## 3.4 CLEANING

A. Clean installed products using cleaning methods and materials approved by FRP-composites manufacturer.

3.5 PROTECTION

A. Comply with FRP-composites manufacturer's recommendations and instructions for protecting installed products during construction activities.

B. Provide field touch up of any coatings damaged during construction operations. Replace any damaged components that are beyond repair as determined by the Architect.

END OF SECTION