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Revision date: 21-Jul-2024

SPEC NOTE: This master specification is written to include SPEC NOTES to assist designers in their decision-making process. SPEC NOTES precede the text to which they apply. This section should serve as a guideline only and should be edited by a knowledgeable person to meet the requirements of each specific Project.

Text indicated in bold and by square brackets is optional. Make appropriate decisions and delete the optional text as well as the brackets in the final copy of the specification. Delete or hide the SPEC NOTES in the final version of the document.

This Specification specifies Glass-Fibre Reinforced Concrete (GFRC / GFRC) as manufactured by Fiberton.

Fiberton does not practice architecture or engineering. Therefore, the design responsibility remains with the Consultant, engineer, or Consultant. We hope the information given here will be of assistance. It is based upon data considered to be true and accurate and is offered solely for the user's consideration, investigation, and verification. Nothing contained herein is representative of a warranty or guarantee for which Fiberton can be held legally responsible. Fiberton does not assume any responsibility for any misinterpretation or assumptions the reader may formulate.

This specification was developed with the assumption that it will be used with a CCDC standard Contract, as amended by any supplementary instructions. As a result, some words have been capitalized in keeping with CCDC standard definitions. Please change the defined terms and capitalization if this Specification will be used with another type of Contract.

This Section may also be specified under Masterformat® number 03 49 00.

1. GENERAL
   1. GENERAL INSTRUCTIONS
      1. Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
      2. Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only
   2. SUMMARY
      1. Provide labour, materials, Products, equipment and services to complete the Fibre-Reinforced Cementitious Panels work specified herein. This includes, but is not necessarily limited, to:
         1. Factory-fabricated glass fibre reinforced concrete (GFRC) panels for **[wall cladding]** **[curtain wall spandrels]** **[mullions]** **[column covers]** **[fascia units]** **[cornices]** **[soffits]** **[Insert additional application]** application.
         2. Auxiliary materials required for complete installation.

SPEC NOTE: Edit the list below to reflect the items affected by this Project. Only include in this Paragraph those sections and documents that directly affect the work of this section. If a reader could reasonably expect to find a product or component specified in this section, but it is specified elsewhere, then list the related section number(s) in the Paragraph below. Do not include Division 00 Documents or Division 01 Sections since it is assumed that technical sections are all related to Division 00 Documents and Division 01 Sections to some degree.

List below only products and construction that reader might expect to find in this Section but are specified in other Sections.

* + 1. Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole and may be directly applicable to this Section.
       1. Related requirements provided below are for convenience purposes only.
          1. Section 03 30 00, Cast-in-Place Concrete.
          2. Section 03 45 00, Architectural Precast Concrete.
          3. Section 05 12 00, Structural Steel Framing.
          4. Section 07 21 00, Thermal Insulation.
          5. Section 07 27 00, Air Barriers.
          6. Section 07 92 00, Joint Sealants.
  1. REFERENCES
     1. Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply.

SPEC NOTE: Pare down the paragraphs below to only include references which appear in the final version of the Specification.

* + - 1. ASTM International. (ASTM)
         1. ASTM A29: Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
         2. ASTM A36/A36: Standard Specification for Carbon Structural Steel
         3. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
         4. ASTM A123/A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
         5. ASTM A153/A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
         6. ASTM A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
         7. ASTM A513: Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
         8. ASTM A653/A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
         9. ASTM A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
         10. ASTM C33: Standard Specification for Concrete Aggregates
         11. ASTM C150: Standard Specification for Portland Cement
         12. ASTM C979: Standard Specification for Pigments for Integrally Colored Concrete
         13. ASTM C1666: Standard Specification for Alkali Resistant (AR) Glass Fiber for GFRC and Fiber-Reinforced Concrete and Cement
      2. CSA Group (CSA)
         1. CSA A23.1: Concrete Materials And Methods Of Concrete Construction/Test Methods And Standard Practices For Concrete
         2. CAN/CSA A3000: Cementitious materials compendium, Includes Update No. 1 and Errata
         3. CSA G40.20: General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
         4. CAN/CSA S16: Design And Construction Of Steel Structures
         5. CAN/CSA S136: North American Specification For The Design Of Cold-Formed Steel Structural Members
         6. CSA S136: North American Specification For The Design Of Cold-Formed Steel Structural Members
         7. CSA W47.1: Certification Of Companies For Fusion Welding Of Steel
         8. CSA W47.2: Certification Of Companies For Fusion Welding Of Aluminum
         9. CSA W59: Welded Steel Construction
         10. CSA W59.2: Welded Aluminum Construction
      3. GRCA International
         1. Specification for the Manufacture, Curing & Testing of Glassfibre Reinforced Concrete (GFRC) Products.
      4. International Organization for Standardization (ISO)
         1. ISO 9001: Quality management systems — Requirements
         2. ISO 14001: Environmental Management Systems — Requirements With Guidance For Use
      5. Underwriters Laboratories of Canada (ULC)
         1. CAN/ULC S114: Standard Method of Test for Determination of Non-Combustibility in Building Materials
    1. Definitions:
       1. GFRC: Glass Fiber Reinforced Concrete. A sprayed composite with anabsolute minimum of 4 percent by weight of total mix with minimum design thickness of 15 mm (1/2 in.) as defined in PCI MNL 128.
  1. PREINSTALLATION MEETINGS
     1. General Requirements and Procedures for Project Meetings: in accordance with **[Section 01 31 19, Project Meetings]**
     2. Pre-installation Meetings: Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
        1. Ensure attendance of Subcontractor performing work of this Section, as well as representatives from manufacturers and fabricators involved in or affected by installation. Notify Consultant and Owner of scheduled meeting dates in advance.
        2. Agenda:
           1. Review progress of related construction activities and preparations for particular activity under consideration.
           2. Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
           3. Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
           4. Review methods and procedures for GFRC panel installation, including manufacturer's instructions.
           5. Examine support, including alignment and attachment to structural members.
           6. Review flashing, details, penetrations, openings, and conditions of other elements that may affect GFRC panels.
           7. Discuss governing regulations, insurance, certificates, tests, and inspections as applicable.
           8. Review temporary protection requirements for GFRC panels before, during and after installation.
           9. Discuss procedures repair procedures for GFRC panels where permitted by Consultant.
        3. Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
        4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.
  2. SUBMITTALS
     1. General Requirements and Procedures for Submittals: in accordance with **[Section 01 33 00, Submittal Procedures.]**
     2. Product Data: Submit manufacturer’s product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for GFRC panels work specified in this Section.
     3. Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction.
        1. Illustrate fabrication and installation layouts of GFRC panels such as details of edge conditions, joints, panel profiles, corners, anchoring, attachment assembly, trims, flashings, closures, accessories and other special conditions.
        2. Include the following:
           1. Thickness of facing mix, GFRC backing, and bonding pads for typical panels.
           2. Panel frame details for typical panels, including sizes, spacings, thicknesses, and yield strengths of various members.
           3. Size, location, and details of flex, gravity, and seismic anchors for typical panels.
           4. Erection sequence for special conditions.
           5. Descriptions of loose, cast-in, and field hardware.
           6. Finishes
           7. Other items sprayed into panels.
     4. Delegated Design Submittals:
        1. Engineering design completion of GFRC panels work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
        2. Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of **[Insert Province]**.
        3. Submit copy of structural calculations upon request by Consultant.
     5. Verification Samples: Submit verification samples confirming colour and finish selections for each exposed element in minimum 300 by 300 mm (12 by 12 in.) size, and of actual thickness, representative of finishes, colour, and textures of exposed surfaces.
     6. Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.
  3. CLOSEOUT SUBMITTALS
     1. General Requirements and Procedures for Closeout Submittals: in accordance with Section 01 78 00, Closeout Submittals.
     2. Operating and Maintenance Data: Submit care and maintenance instructions for GFRC panels to be included in building's operation and maintenance manual.
     3. Warranty Documentation: Submit copy of extended warranties specified in this Section.
  4. QUALITY ASSURANCE
     1. Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years’ experience manufacturing such materials.
        1. Certification: Manufacturer must be ISO 9001 and ISO 14001 certified.
        2. Manufacturer must be member in good standing of Glass-fibre Reinforced Concrete Association (GRCA)
     2. Manufacturer's responsibility: must include fabricating **[and installing]** GFRC panels and providing professional engineering services needed to assume engineering responsibility for GFRC panels.
     3. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
        1. Steel: to CSA W47.1 and CSA W59
        2. Aluminum: to CSA W47.2 and CSA W59.2
        3. Stainless Steel: to CSA W47.1 (Annex K) and CSA W59
     4. Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
     5. Professional Engineer’s Qualifications: Employ Professional Engineer licensed to practice in Province of **[Insert Province]** who carries professional liability insurance and has sufficient experience providing engineering services of similar kind, scope, and complexity.
        1. Professional Engineer’s Responsibility:
           1. production and review of Shop Drawings and comprehensive engineering analysis, based on GFRC production test values,
           2. design and certification of GFRC panels, including attachments for building construction, in accordance with applicable codes and regulations,
           3. stamping and signing of each Shop Drawing and associated calculations.
     6. Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
     7. Mock-Ups: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects of GFRC panels, and to set quality standards for fabrication and installation.
        1. Location: Build mockup of typical wall area **[as shown on Drawings][as directed on site by Consultant.]**
        2. Mock-up types: **[in-situ]** **[separate from building]**.
        3. Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
        4. Reviewed mock-ups: **[may become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents][must be demolished]**
  5. DELIVERY, STORAGE AND HANDLING
     1. General Product Requirements: in accordance with Section **[01 61 00, Common Product Requirements.]** Deliver, store and handle GFRC panels in accordance with manufacturer’s written instructions.
        1. Handle and transport GFRC panels to avoid damage.
        2. Place non staining resilient spacers between panels.
        3. Support panels on non staining material during shipment.
        4. Protect panels from dirt and damage during handling and transport.
        5. Store GFRC panels to protect from contact with soil, staining, and physical damage.
        6. Store panels with non staining resilient supports in same positions as when transported.
        7. Store panels on firm, level, and smooth surfaces.
        8. Place stored panels so identification marks are clearly visible.
        9. Prevent contact with other materials to avoid staining, denting, or other damage to GFRC panels.
  6. site conditions
     1. Field Measurements: Verify actual dimensions of construction contiguous with GFRC panels by field measurements before fabrication.
     2. Coordinate GFRC panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, weather-tight, secure, and noncorrosive installation.
  7. WARRANTY
     1. Extended warranty: Submit for Owner’s review and acceptance, manufacturer’s extended warranty in which manufacturer commits to repair or replace components of GFRC panels that fail within specified warranty period. Manufacturer’s extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
        1. Warranty Period: 2 years from date of Substantial Performance of the Work.
        2. Warranty Scope: Materials only

1. PRODUCTS
   1. MANUFACTURERS
      1. Basis-of-Design: Materials specified in this Section are based on GFRC Panels as manufactured by Fiberton and distributed by Corearch Inc., 43 Millwick Dr., North York, ON, M9L 1Y4; https://www.corearch.ca Substitution Limitations: No further substitutions are acceptable.
   2. DESIGN CRITERIA
      1. GRCA Specifications: Comply with “Specification for the Manufacture, Curing & Testing of Glassfibre Reinforced Concrete (GFRC) Products”.
      2. CSA Specifications: Design cold-formed metal framing used for the work of this Section to CAN/CSA S136.
      3. CISC Specifications: Design structural steel framing used for the work of this Section to CAN/CSA S16.
      4. Intended aesthetics: Drawings and Specifications provide requirements regarding system’s aesthetic and performance criteria. Unless indicated otherwise, preserve intended aesthetic effects. For any proposed deviations, provide detailed explanation to Consultant for evaluation. Acceptance or rejection of proposed deviations rests solely with Consultant.
   3. PERFORMANCE REQUIREMENTS
      1. GFRC panel system must be designed to withstand project-specific design loads and their effects within constraints specified in this Section and **[Insert Building Code]** without defects, damage, or failure, including but not limited to the following:
         1. Dead Loads: Including those transferred from structural elements.
         2. Environmental Loads: Such as wind, snow, rain, hydrostatic, seismic and earth pressures as applicable.
         3. Live Loads: Including those arising from use and occupancy.
         4. Loads from Temperature and Moisture Loads: Including expansion, contraction, deflection, deformation, creep, shrinkage, settlement, and differential movement.
      2. Structural Performance: GFRC panels, including panel frames, anchors, and connections, shall withstand the following design loads, as well as the effects of thermal- and moisture- induced volume changes, according to load factors and combinations established in PCI MNL 128, "Recommended Practice for Glass Fibre Reinforced Concrete Panel."
         1. Design Loads: Refer to Structural Drawings.

Revise deflection limit in subparagraph below to suit Project.

* + 1. Deflection Limitation: Design panel frames to withstand design loads without lateral deflections greater than **[L/240]** of wall span or 25 mm, whichever is less.
    2. Thermal Movements: fabricate and install GFRC panel systems to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
       1. Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12-hour period.
       2. Account for thermal stresses, drilling impacts, or other causes before or during cementitious cladding installation. Implement handling and storage methods for GFRC panels to reduce such stresses.
    3. System Fire Characteristics:
       1. Combustibility: Non-combustible to CAN/ULC S114.
    4. Moisture Control and Weathertightness:
       1. Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Face sealed assemblies are not permitted.
       2. Continuity: Maintain integrity and continuity of building enclosure’s thermal, air, and vapour control layers at all times by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.
       3. System must discharge water in manner that avoids staining of architectural finishes, formation of puddles or formation of icicles.
  1. GFRC PANELS

SPEC NOTE: Edit the tag below to reflect the project’s requirements.

* + 1. Material Tag: This item is noted as **[“GFRC”]** on Drawings and Schedules.
    2. Description: Manufacturer’s standard panel products are manufactured using cement / aggregate slurry and reinforced with alkali-resistant fibers.
    3. Panel Thickness: **[15 mm (19/32 in).]** **[20 mm (25/32 in).]** **[As noted on Drawings]**

SPEC NOTE: Grades of GFRC explained.

General Purpose Cast Premix GFRC: Grades 8 and 8P

* Grade 8: Standard general-purpose GFRC used in casting applications.
* Grade 8P: Similar to Grade 8 but includes an aqueous acrylic thermoplastic co-polymer dispersion, enhancing certain properties of the mix.

Sprayed Premix or High Quality Cast Premix GFRC: Grades 10 and 10P

* Grade 10: Suitable for both sprayed applications and high-quality casting. This grade is typically used where a higher quality finish or specific performance characteristics are required.
* Grade 10P: Similar to Grade 10 but includes an aqueous acrylic thermoplastic co-polymer dispersion, further improving the mix's properties.

Normally Sprayed GFRC: Grades 18 and 18P

* Grade 18: Designed for direct spraying applications. This grade is commonly used for large panels and complex shapes where spraying is the preferred method of application.
* Grade 18P: Similar to Grade 18 but includes an aqueous acrylic thermoplastic co-polymer dispersion, which enhances the mix design's performance.

The 'P' designation in these grades (8P, 10P, and 18P) indicates the inclusion of an aqueous acrylic thermoplastic co-polymer dispersion in the GFRC mix. This additive helps to improve the overall properties of the GFRC, such as durability, flexibility, and resistance to cracking.

* + 1. Mix Design: **[Grade 8]** **[Grade 8P][Grade 10][ Grade 10P]** **[Grade 18]** **[Grade 18P]** GFRC panels with following characteristics as described in GRCA “Specification for the Manufacture, Curing & Testing of Glassfibre Reinforced Concrete (GFRC) Products”:

SPEC NOTE: Delete the mix that doesn’t apply to your project or insert your own mix here.

* + - 1. Premix Grade: Grade 8
         1. Description: General purpose premix
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.40
         4. AR Glassfibre content (by weight of total mix): 2.0 - 3.0%
         5. Polymer solids content (by weight of cement): Nil
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
         9. Minimum bulk wet density: 2000 kg/m³
      2. Premix Grade: Grade 8P
         1. Description: General purpose premix
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.40
         4. AR Glassfibre content (by weight of total mix): 2.0 - 3.0%
         5. Polymer solids content (by weight of cement): 4 - 7%
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
         9. Minimum bulk wet density: 2000 kg/m³
      3. Premix Grade: Grade 10
         1. Description: Sprayed premix or High-quality cast premix
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.38
         4. AR Glassfibre content (by weight of total mix): 2.0 - 3.5%
         5. Polymer solids content (by weight of cement): Nil
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
         9. Minimum bulk wet density: 2000 kg/m³
      4. Premix Grade: Grade 10P
         1. Description: Sprayed premix or High-quality cast premix
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.38
         4. AR Glassfibre content (by weight of total mix): 2.0 - 3.5%
         5. Polymer solids content (by weight of cement): 4 - 7%
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
         9. Minimum bulk wet density: 2000 kg/m³
      5. Spray Grade: Grade 18
         1. Description: Direct sprayed GFRC
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.38
         4. AR Glassfibre content (by weight of total mix): 4.0 - 5.5%
         5. Polymer solids content (by weight of cement): Nil
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
         9. Minimum bulk wet density: 2000 kg/m³
      6. Spray Grade: Grade 18P
         1. Description: Direct sprayed GFRC
         2. Aggregate/cement ratio: 0.5 - 1.50
         3. Water/cement ratio: 0.30 - 0.38
         4. AR Glassfibre content (by weight of total mix): 4.0 - 5.5%
         5. Polymer solids content (by weight of cement): 4 - 7%
         6. Extreme dimensional variations: 0.6 – 1.2 mm/m
         7. Water Absorption: 5 – 11%
         8. Minimum bulk dry density: 1800 kg/m³
    1. Finish: exposed-face surfaces of GFRC must match confirmed mockups. Ensure panel faces are free of joint marks, grain, or other obvious defects.
  1. GFRC materials
     1. Portland Cement: to CAN/CSA A3000 or equivalent to ASTM C150; free from lumps and impurities.
     2. Glass fibres: Alkali resistant (AR), specifically produced for use in GFRC, and complying with ASTM C1666/C 1666M.
     3. Acrylic Polymer: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130 and GRCA Specifications.
     4. Fine Aggregates: CSA A23.1 or equivalent to ASTM C33, clean, dry, and ready-for-use silica sand with required granulometry containing more than 96% silica.
     5. Water: Potable; free from deleterious material that may affect colour stability, setting, or strength of GFRC.
     6. Admixtures: comply with PCI MNL 130.
     7. Pigments: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.
  2. anchors, connectors AND FRAMING
     1. Carbon-Steel Shapes and Plates: to CSA G40.20/G40.21 or ASTM A36/A36M with hot-dip galvanized finish to CAN/CSA-G164 or ASTM A123/A123M after fabrication, or ASTM A153/A153M, as applicable.
     2. Anchors and Inserts: to ASTM A29 or ASTM A108
        1. Minimum Diameter: 6 mm (1/4 inch).
        2. Yield Strength: Must conform to design minimum and maximum steel yield strength.
        3. Compatibility: Inserts must be compatible with or isolated from other materials to avoid electrolysis.
        4. Finish: hot-dip galvanized finish to CAN/CSA-G164 or ASTM A123/A123M after fabrication, or ASTM A153/A153M, as applicable.
     3. Cold-Formed Steel Framing: Manufacturer's standard C-shaped steel studs, complying with CSA S136 with following characteristics:
        1. Minimum Uncoated Steel Thickness: 1.37 mm (0.0538 inch) with stiffened flanges, U-shaped steel track.
        2. Finish: Z275 (G90) zinc-coating to ASTM A653/A653M.
     4. Hollow Structural Sections: Steel tubing to ASTM A500, Grade B, or ASTM A513.
     5. Steel Channels and Angles: to CSA G40.20/G40.21 or ASTM A36/A36M.
  3. FABRICATION
     1. Panel Frame: Fabricate panel frames and accessories plumb, square, and true to line, ensuring components are securely fastened in accordance with Shop Drawings and requirements of this Section.
        1. Use jigs or templates for fabricating panel frames.
        2. Cut cold-formed metal framing members by sawing or shearing; do not use a torch for cutting.
        3. Fasten cold-formed metal framing members and hollow structural sections, steel channels, or steel angles by welding. Comply with CSA W47.1 and CSA W59 for welding requirements.
        4. Reinforce, stiffen, and brace framing assemblies as required to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to avoid damage or significant distortion.
        5. Repair galvanized surfaces that are damaged in accordance with ASTM A780.
     2. Moulds: Construct molds that will result in finished GFRC panels that meet indicated profiles, dimensions, and tolerances without damaging GFRC during stripping. Ensure molds are built to prevent water leakage and loss of cement paste.
     3. GFRC Fabrication: Comply with PCI MNL 130 procedures.
        1. Mark each GFRC panel to correspond with identification mark on Shop Drawings. Include casting date on each panel.
     4. Fabrication Tolerances: Comply with PCI MNL 130.
  4. AUXILIARY MATERIALS
     1. Accessories: Provide components required for a complete, watertight panel assembly including, but not limited to, trims, copings, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar elements. Match material and finish to cementitious cladding system unless otherwise indicated.
     2. Air Barrier/Vapour Retarder: As specified in 07 27 00, Air Barriers
     3. Insulation: As specified in 07 21 00 - Thermal Insulation.
     4. Fasteners: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

1. EXECUTION
   1. EXAMINATION
      1. Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
      2. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. preparation
      1. Install subframing, furring, and other miscellaneous panel support members and anchorages according to GFRC panel manufacturer's written recommendations.
      2. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.
   3. INSTALLATION
      1. Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
      2. Install clips, hangers, and other accessories required for connecting GFRC panels to supporting members and backup materials.
      3. Install panels perpendicular to supports unless otherwise indicated. Anchor GFRC panels and other components of the Work securely in place, with provisions for thermal and structural movement.
      4. Connect GFRC panels in position by bolting or welding, or both, as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.
      5. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by GFRC panel manufacturer.
      6. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   4. assembly tolerances
      1. Measured deviations in joints between panels must not exceed tolerances indicated below.
         1. Panel size ≤ 3 m /deviation of joints ± 2 mm
         2. Panel size 3 m to 6 m / deviation of joints ± 4 mm
         3. Panel size ≥6 m / deviation of joints ± 6 mm
         4. Turning on the panel surface 300 mm from one side to other three sides / less than, 1.5 mm
   5. PROTECTION
      1. Protect GFRC panels from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
      2. Protect GFRC panels from damage by field welding or cutting operations, and provide noncombustible shields as required.
      3. Perform cleaning procedures, if necessary, according to GFRC manufacturer's written instructions. Clean soiled GFRC surfaces with detergent and water, using soft fibre brushes and sponges, and rinse with clean water. Prevent damage to GFRC surfaces and staining of adjacent materials.
      4. Promptly replace GFRC panels work damaged during construction that cannot be satisfactorily repaired.
   6. CLEANING AND WASTE MANAGEMENT
      1. Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
      2. Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

END OF SECTION