

SPECIFICATIONS FOR
SUPPLYING AND PLACING CONCRETE REINFORCEMENT

1.0 DESCRIPTION

The Work shall consist of:

- .1 Supplying, fabricating, delivery, handling, storing and placing of the specified type(s) of concrete reinforcement, including all bar supports and accessories; and
- .2 The quality control (QC) testing of all materials.

Concrete reinforcement shall be supplied in the lengths and shapes, and installed as indicated on the Drawings. No substitutions of bars or changes to bar details on the Drawings will be allowed without prior acceptance of the Engineer.

2.0 REFERENCES AND RELATED SPECIFICATIONS

All reference standards and related specifications shall be current issue or latest revision at the date of tender advertisement.

2.1 References

- CSA A23.1, Concrete Materials and Methods of Concrete Construction
- CAN/CSA G30.18, Billet-Steel Bars for Concrete Reinforcement
- ACI 117, Standard Tolerances for Concrete Construction and Materials
- ASTM A 615, Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- AASHTO M31, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement ASTM A 615/A 615M
- Reinforcing Steel Institute of Canada, (RSIC), Manual of Standard Practice
- MIT's Approved Products List
- ISIS Canada's Specifications for Product Certification of FRPs as Internal Reinforcement in Concrete Structures

2.2 Related Specifications

- Specifications for Reinforced Cast-in-Place Concrete
- Specifications for Superstructure Concrete

3.0 SUBMITTALS

The Contractor shall submit the following to the Engineer, in accordance with the Special Provisions:

- .1 Certification from the Manufacturer stating that the materials supplied meet the specified requirements.

4.0 MATERIALS**4.1 Reinforcing Steel**

Reinforcing steel shall conform to the requirements of CAN/CSA G30.18, Grade 400W and shall be deformed bar unless indicated otherwise on the Drawings.

Spiral reinforcement shall conform to Clause 6.6.3 of CSA 23.1.

4.2 Low Carbon Chromium Steel Bars (MMFX 2)

Deformed, low carbon chromium steel bars shall conform to the requirements of ASTM A 615, Grade 75 and ASTM A 1035. MMFX 2 (Microcomposite) is an approved product.

4.3 Fibre Reinforced Polymer (Glass or Carbon)

Fibre Reinforced Polymer Bars (GFRP and CFRP) shall conform to the requirements as specified on the Drawings and in accordance with ISIS Canada's Specifications for Product Certification of FRPs as Internal Reinforcement in Concrete Structures.

FRP reinforcement must be approved as identified in MIT's Approved Products List and shall be approved for use by the Engineer. Any FRP reinforcement that is not in MIT's Approved Products List will be subject to approval by the Engineer in accordance with ISIS Canada's Specifications for Product Certification of FRPs as Internal Reinforcement in Concrete Structures.

4.4 Bar Supports and Accessories

Bar supports and accessories shall conform to the requirements of CSA A23.1 and shall be approved for use by the Engineer. They shall be made from Type 316 stainless steel or hot-dipped galvanized steel, or in the case of chairs, from High Performance Concrete (HPC). An approved HPC rebar support is supplied by ConSys Inc. of Pinawa, Manitoba. They shall not stain, blemish or spall the concrete surface for the life of the concrete.

Tire wire shall be 16 gauge black annealed or coated wire as a minimum.

5.0 CONSTRUCTION METHODS

5.1 Supply and Fabrication

.1 General

Any reinforcement with flaws in manufacture or fabrication shall be replaced with acceptable reinforcement.

.2 Reinforcing Steel and MMFX 2

Hooks and bends shall conform to the requirements listed for CSA G30.18, Grade 400W bars in Clause 6.6.2 of CSA A23.1-04.

Reinforcing steel and MMFX 2 reinforcement shall be bent to the proper shape in a plant that has suitable devices for bending as recommended in the Reinforcing Steel Institute of Canada (RSIC) Manual of Standard Practice. Reinforcing bars shall conform accurately to the dimensions shown on the Drawings and within the fabricating tolerance as shown in the RSIC Manual of Standard Practice.

Billet steel reinforcement bars shall be bent at temperatures between 10°C and 100°C.

MMFX 2 bars shall be cold bent. Heating of the bars to facilitate bending will not be permitted. Bar cutting shall be done by shearing or with a water-cooled saw. Torch cutting will not be permitted.

.3 FRP Reinforcement

FRP reinforcement shall be bent to the proper shape during fabrication. Absolutely no field bending of

the bars is permitted. Should modifications to the FRP reinforcement be required, the Contractor shall notify the Engineer immediately.

5.2 Handling and Storage

.1 General

The Contractor shall handle and store the concrete reinforcement in a manner that ensures it is not damaged or contaminated with dirt or other materials.

The concrete reinforcement shall not be placed directly on the ground. Timber pallets, platforms, skids or other supports shall be placed under the reinforcement to keep it free from dirt and mud and to provide easy handling.

Prior to concrete placement, the Contractor and Engineer shall inspect the concrete reinforcement for surface damage.

.2 Reinforcing Steel and MMFX 2

All reinforcing steel and MMFX 2 reinforcement shall be clean and free from paint, oil, mill scale and other injurious defects.

Rust, surface seams or surface irregularities will not be cause for rejection, provided that the minimum dimensions, height of deformations, cross-sectional area and tensile properties of a hand-wire-brushed specimen are not less than the applicable specification requirements.

.3 FRP Reinforcement

The Contractor shall load, haul, store, and handle the FRP bars in accordance with the Manufacturer/Supplier's instruction to prevent damage. FRP bars are susceptible to surface damage; therefore, special care is required in the loading, hauling, storage and handling of these bars. Bundling bands shall be padded or suitable banding shall be used to prevent damage to the reinforcement.

If the FRP bars are to be stored on-site for more than 3 months, the FRP bars shall be covered with an opaque material to avoid UV radiation and exposure to chemical substances.

FRP bars are very light and flexible; therefore, hoisting bundles of FRP shall be performed with a strongback spreader bar or multiple supports to avoid excessively bending of the bars. The FRP reinforcement shall not be dropped or dragged.

5.3 Placing and Fastening

.1 General

The Contractor shall supply and place all necessary support accessories to ensure proper placement of concrete reinforcement. All concrete reinforcement shall be accurately placed in the positions shown on the Drawings, and firmly tied and chaired before placing the concrete.

Distances from the forms shall be maintained by means of stays, spacers, or other approved supports. Reinforcing cover shall not be less than the minimum specified on the Drawings. Reinforcement includes ties, stirrups, and main reinforcement. For textured architectural surfaces, the concrete cover shall be measured from the deepest point of the textured surface. Spacers and supports for holding reinforcement at the required location and ensuring the specified concrete cover over the reinforcement shall be made from precast concrete or non-rusting metal. Precast concrete supports of approved shape and dimensions, with compressive strengths equal to or exceeding the placed concrete, are

acceptable. Any non-rusting metal chairs protruding through the surface of the hardened concrete shall be cut back at least 25 mm, and the holes filled. Non-rusting metal chairs shall not be used to support reinforcement on surfaces that are to be exposed. Where possible, this reinforcement is to be supported entirely from above. The use of pebbles, pieces of broken stone or brick, plastic, metal pipe, and wooden blocks, will not be permitted.

Immediately before placing, concrete reinforcement shall be free of all material that would reduce the bond to concrete, including but not necessarily limited to: dirt, detrimental rust, loose scale, and form oil.

.2 Placing Steel Reinforcement and MMFX 2

Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction, when alternate intersections shall be tied. Welding or tack welding of reinforcing steel and MMFX 2 will not be allowed. Unless otherwise shown on the Drawings, the minimum distance between bars shall be 40 mm.

Field bending of reinforcing steel and MMFX 2 bars will not be allowed unless approved by the Engineer.

.3 Placing FRP Reinforcement

The Contractor shall place the FRP reinforcement in accordance with the Manufacturer/Supplier's instructions.

All FRP reinforcement shall be secured to and supported within formwork as required to prevent displacement by concrete placement or workers. All FRP reinforcement shall be accurately supported using concrete or non-corrosive chairs before concrete placement is started. The Contractor shall use chairs that incorporate a positive locking mechanism to restrain FRP reinforcement from floating during concrete placement.

The Contractor will be allowed to cut the FRP reinforcement with a high speed grinding cutter, fine blade saw, diamond blade or masonry blade with the prior approval of the Engineer.

Shearing FRP reinforcement will not be allowed.

The Contractor shall place the FRP reinforcement within the tolerances as specified in ACI 117.

The Contractor shall remove form oil from FRP bars using a method approved by the Manufacturer before placing concrete.

5.4 Tying Reinforcement

.1 Reinforcing Steel and MMFX 2

For lapping steel reinforcing bars at the joints and intersection, an ample supply of annealed wire at least 1.5 mm in diameter shall be provided. Proper cutting pliers shall be used and the bending and tying of the wires done as neatly as possible. Twisted ends of the tie wire shall be bent away from forms and surfaces so that they do not project into the concrete cover over the reinforcement.

.2 FRP Reinforcement

For lapping FRP reinforcement at joints and intersections, the Contractor shall tie all intersections using plastic coated or nylon zip ties, or non-rusting material approved by the Engineer.

5.5 Splicing

.1 General

Splices shall only be provided as shown on the Drawings. Splices other than as shown on the Drawings will not be permitted without the written approval of the Engineer. Splices, where possible, shall be staggered.

.2 Reinforcing Steel and MFX 2

For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete. In general, suitable lap lengths shall be supplied as detailed on the Drawings. If this information is not detailed on the Drawings, a minimum of 35 bar diameters lap length shall be provided.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

.3 FRP Reinforcement

Lap slices shall be used wherever detailed or specified on the Drawings and where continuity is required in the reinforcement. The use of mechanical connection or welded splices is not permitted.

5.6 Bar Accessories in Bridge Deck Slabs

The Contractor shall supply and place a longitudinal row of high chairs as close as possible to each side of every girder in order to rigidly support the top transverse reinforcement in the deck slab.

All bar accessories in bridge deck slabs shall be a type approved by the Engineer and shall be non-rusting. They shall be made from precast concrete or in the case of steel, Type 316 stainless steel or hot-dip galvanized steel.

All FRP reinforcement shall be tied and supported, as necessary, to prevent displacement by concrete placement operations and workers.

6.0 QUALITY MANAGEMENT

6.1 Quality Control for FRP Reinforcement

The Contractor shall be responsible for all quality control testing of FRP reinforcement in accordance with *ISIS Canada's Specification for Product Certification of FRPs as Internal Reinforcement in Concrete Structures*.

6.2 Quality Assurance

After all concrete reinforcement has been placed, a final inspection by the Engineer will be made prior to the placement of concrete to locate any damage or deficiencies. All visible damage or any deficiencies shall be repaired by the Contractor to the satisfaction of the Engineer before concrete is placed. The Contractor shall allow the Engineer unhindered access to the concrete reinforcement and shall assist the Engineer in carrying out the inspection.

7.0 METHOD OF MEASUREMENT**7.1 Reinforcing Steel**

Supplying and placing of all reinforcing steel will be measured on a weight basis. The total weight to be paid for will be based on the actual length of reinforcing steel placed and the mass per unit of length as stated in CAN/CSA G30.18. The Contractor shall verify the total weight of placed reinforcing steel.

7.2 MMFX 2 (Microcomposite)

Supplying and placing of all MMFX 2 reinforcement will be measured on a weight basis. The total weight to be paid for will be based on the actual length of the MMFX 2 reinforcing placed and the mass per unit of length. The Contractor shall verify the total weight of placed MMFX 2 reinforcement.

7.3 FRP Reinforcement

Supplying and placing of all FRP reinforcement will be measured on a lineal length basis. The total length to be paid for will be determined based on the actual length of the FRP reinforcement placed. The Contractor shall verify the total length of placed FRP reinforcement.

7.4 Bar Supports and Accessories

Supplying and placing all bar supports and accessories will be considered incidental to the concrete reinforcement and no separate measurement will be made of this work.

8.0 BASIS OF PAYMENT**8.1 Reinforcing Steel**

Supplying reinforcing steel will be paid for at the Contract Unit Price per kilogram for "Supply Reinforcing Steel (Black)", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

Placing reinforcing steel will be paid for at the Contract Unit Price per kilogram for "Placing Reinforcing Steel", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.2 MMFX 2 (Microcomposite)

Supplying MMFX 2 reinforcement will be paid for at the Contract Unit Price per kilogram for "Supply Reinforcing Steel (MMFX 2)", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

Placing MMFX 2 reinforcement will be paid for at the Contract Unit Price per kilogram for "Placing Reinforcing Steel", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.3 FRP Reinforcement

Supplying FRP reinforcement will be paid for at the Contract Unit Price per lineal metre for "Supplying FRP Reinforcement", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

Placing FRP reinforcement will be paid for at the Contract Unit Price per lineal metre for "Placing FRP Reinforcement", measured as specified herein, and will be payment in full for performing all operations herein described and all other items incidental to the Work.