## SECTION 6.02
## REINFORCING STEEL

**6.02.01 - Description**: Work under this item shall consist of furnishing and placing reinforcing steel and splicing materials, of the type and size designated, as shown on the plans, as directed by the Engineer and in accordance with these specifications.

**6.02.02 - Materials**: The materials for this work shall conform to the requirements of Article M.06.01.

**6.02.03 - Construction Methods:**

**1 - Shop Drawings**: Prior to fabricating any materials, the Contractor shall submit shop drawings of the reinforcing steel and splicing materials, with material lists, material designations, placement diagrams, bending diagrams and manufacturer's literature for mechanical connections, for review and approval, in accordance with Article 1.05.02. Any expenses incidental to the revision of materials furnished in accordance with shop drawing and order lists to make them comply with the requirements of the plans, specifications or special provisions shall be borne by the Contractor.

**2 - Fabrication:**

**(a) Cutting and Bending:**

Bar reinforcement shall be cut and bent to the shapes shown on the plans. Fabrication tolerances shall be in accordance with the requirements of ACI 315. All bars shall be bent cold, unless otherwise permitted.

Coated bars shall not be field cut, unless permitted by the Engineer. Field cutting of coated bars should be performed using hydraulic-powered cutters or friction cutting tools to minimize coating damage and field touch-up. Flame cutting of coated bars will not be permitted. Field cut coated bars shall be repaired immediately.

Bars partially embedded in concrete shall not be field bent, except as shown on the plans or permitted by the Engineer.

**(b) Hooks and Bend Dimensions:**

The dimensions of hooks and the diameters of bends measured on the inside of the bar shall be as shown on the plans. When the dimensions of hooks or the diameter of bends are not shown, they shall be in accordance with the ACI 318, "Building Code Requirements for Reinforced Concrete" as amended by ASTM A767M for galvanized bars.

**(c) Identification:**

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the CRSI "Manual of Standard Practice".

**3 - Handling, Storing and Surface Condition of Reinforcement:** Steel reinforcement shall be stored above the surface of the ground on platforms, skids, or other supports and shall be protected as far as practical from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

Epoxy-coated and galvanized reinforcing steel shall be handled and stored by methods that will not damage the coating. All systems for handling coated reinforcement shall have adequately padded contact areas wherever possible. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports, or platform bridge so as to prevent bar-to-bar abrasion from sags in the bar bundle. Bars or bundles shall not be dropped or dragged. Coated reinforcing steel shall be transported and stored on wooden or padded supports. Epoxy-coated reinforcing steel, stored at the job site, shall be protected by covering with opaque polyethylene or other suitable protective material. Provisions shall be made for adequate ventilation to prevent condensation under the covering. Since the epoxy coating is flammable, the epoxy coated reinforcing shall not be exposed to any fire or flame.

Prior to placement of concrete, all reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, or other materials that would reduce bond. Reinforcement shall be free from injurious defects such as cracks and laminations. Bonded rust, surface seams, surface irregularities, or mill scale will not be cause for rejection, provided the

minimum dimensions, cross section area, and tensile properties of a hand wire brushed specimen meet the physical requirements for the size and grade of steel specified.

**4 - Placing and Fastening**

**(a) General:**

Steel reinforcement shall be accurately placed as shown on the plans and firmly held in position during the placing and setting of concrete. Bars shall be tied at all intersections except where the spacing is less than 300 mm in each direction when alternate intersections shall be tied. Bars shall be tied at all intersections around the perimeter of each mat.

Bundled bars shall be tied together at not more than 1800 mm centers. Lap splices shall have a minimum of two ties or be tied 300 mm apart for the length of the splice, whichever requires the greater number of ties. For epoxy-coated reinforcement, tie wires and metal clips shall be epoxy, plastic or nylon coated. For galvanized reinforcement, tie wires and metal clips shall be plastic coated or galvanized.

With the exception of tie down bars, welding (tack welding) will not be permitted for assembly of reinforcement, unless shown on the plans. Tie down bars shall be placed as shown on the plans and a top longitudinal reinforcing bar tied to these bars. When welding coated bars an appropriate protective mask must be worn, safety equipment used and suitable ventilation provided.

If wire fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

**(b) Support Systems:**

Reinforcing steel shall be supported in its proper position by use of precast mortar blocks, wire bar supports, supplementary bars (tie-down bars), side form spacers or other approved devices. Such devices shall be sufficiently strong and properly placed at frequent intervals so as to maintain the cover between the reinforcing and the surface of the concrete. The reinforcing steel cover shall be no less than that shown on the plans and no greater than that shown plus 6 mm.

Platforms for the support of workers and equipment during concrete placement shall be supported directly on the forms and not on the reinforcing steel.

**(c) Precast Mortar Blocks:**

Precast mortar blocks shall have a compressive strength not less than that of the concrete in which they are to be embedded. The face of the blocks in contact with forms for exposed surfaces shall not exceed 50 mm x 50 mm in size and shall have a color and texture that will match the concrete surface. Precast mortar blocks shall not be used on exposed surfaces of precast concrete members. When used on vertical or sloping surfaces, such blocks shall have an embedded wire for securing the block to the reinforcing. When used in slabs, either such a tie wire or, when the weight of the reinforcing is sufficient to firmly hold the blocks in place, a groove in the top of the block may be used. For epoxy-coated bars, such tie wires shall be epoxy, plastic or nylon coated. For galvanized bars, such tie wires shall be plastic coated or galvanized.

**(d) Wire Supports:**

Wire bar supports, such as ferrous metal chairs and bolsters, shall conform to industry practice as described in the CRSI "Manual of Standard Practice of the Concrete Reinforcing Steel Institute." All bolsters or chairs which bear against the forms for exposed surfaces shall be equipped with snug fitting, high density, polyethylene tips which provide 12 mm minimum clearance between the metal and any exposed surface. For epoxy-coated reinforcement, all wire bar supports and bar clips shall be epoxy or plastic coated. For galvanized reinforcement, chair and bar supports shall be hot-dip galvanized, after fabrication, in accordance with ASTM A123.

The maximum spacing of slab bolster rows and high chair rows for concrete deck slabs shall be 1200 mm unless otherwise directed by the Engineer.

**(e) Repair of Coated Reinforcing Steel:**

**Epoxy-coated Reinforcing Steel -** In addition to the requirements of ASTM D3963M, all damage (i.e., scratches, nicks, cracks) to the epoxy coating of the bar reinforcement, visible to the unaided eye with corrective vision, caused during shipment, storage or placement shall be repaired by the Contractor at the job site with approved patching material. Ends of bars that have been sheared, saw cut or cut by other means shall be coated with approved patching material. The areas on the bars and tie down bars damaged by welding shall be repaired with approved patching material.

Patching of damaged areas shall be performed in accordance with the patching material manufacturer's recommendations. Any singular damaged surface area (prior to repair with approved patching material), shall not exceed 2% of the total surface area of the bar. The total bar surface area covered by patching material shall not exceed 5% of the total surface area of the bar. Should either of these limits be exceeded the bar shall be removed from the work and replaced with an acceptable bar. All patching material shall be fully cured prior to placing concrete.

The patching material shall be compatible with the epoxy coating, inert in concrete, and suitable for repairs in the field. The patching material shall be prequalified, as required for the coating material, and shall be either identified on the container as meeting the requirements of Annex A1 of ASTM D3963M or shall be accompanied by a Materials Certificate certifying that the material meets the requirements of said Annex A1.

**Galvanized Reinforcing Steel -** All damage (i.e. scratches, nicks, cracks) to the galvanized coating on bar reinforcement, visible to the unaided eye with corrective vision, caused during shipment, storage or placement shall be repaired by the Contractor at the job site in accordance with ASTM A780, Annex A2 - "Repair using Zinc-Rich Paints". Ends of bars that have beensheared, saw cut or cut by other means shall be coated with zinc-rich paint. The area on the bars and tie down bars damaged by welding shall be repaired with zinc-rich paint.

Field coating of damaged areas shall be performed in accordance with the zinc-rich paint manufacturer's recommendations. The zinc-rich paint shall conform to FS TT-P-641, Type 1 and shall be brush applied to achieve a dry film thickness from 75 - 150 mm. All touchup paint shall be fully cured prior to placing concrete.

**5 - Splicing of Bars:**

**(a) General:**

All reinforcement shall be furnished in the full lengths indicated on the plans unless otherwise permitted. Except for splices shown on the plans, splicing of bars will not be permitted without written approval of the Engineer. Splices shall be staggered as far as possible.

**(b) Lapped Splices:**

Lapped splices shall be of the lengths shown on the plans.

In contact lap splices, the bars shall be placed in contact and tied together in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans.

In non-contact lap splices, the bars shall be placed as shown on the plans and tied to adjacent bars in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans.

**(c) Welded Splices:**

Welded splices shall be used at the locations shown on the plans. Welding shall conform to AWS publication "Structural Welding Code, Reinforcing Steel, AWS D1.4" and applicable special provisions.

Welded splices shall not be used on epoxy-coated or galvanized bars. No welding shall be performed close enough to epoxy-coated or galvanized bars to cause any heating of the coating.

**(d) Splices made with Dowel Bar Mechanical Connections:**

Splices made with dowel bar mechanical connections shall be used at the locations shown on the plans. The minimum size of the bars and the length of the lap splices for the dowel bar mechanical connections shall be as shown on the plans.

The mechanical connections shall be installed in accordance with the manufacturers recommendations. All tools and equipment required to install and field inspect the connections shall be provided by the Contractor. The Contractor shall take all measures necessary to prevent concrete from adhering to the threaded portions of the mechanical connections.

After installing the coated mechanical connectors, all damaged areas on the coated connectors shall be repaired in accordance with 6.02.03-4(e).

**6 - Splicing of Welded Wire Fabric:** Welded wire fabric reinforcement shall be lap spliced as shown on the plans.

**7 - Substitutions**: Substitution of different size bars will be permitted only when authorized by the Engineer. The substituted bars shall have an area equivalent to or larger than the area shown on the plans.

**8 - Inspection**: Reinforcement in any member or component shall be placed, inspected and approved by the Engineer before placing of concrete begins. Concrete placed prior to approval of the reinforcement may be rejected and its removal required.

**6.02.04 - Method of Measurement:**

**1 - General**: No measurement will be made for payment for any clips, wire, separators, wire chairs, precast mortar blocks and other material used for fastening and supporting the reinforcement in the correct position.

**2 - Bar Reinforcement**: Uncoated, epoxy coated, galvanized and weldable bar reinforcement shall be classified as "Deformed Steel Bars", "Deformed Steel Bars - Epoxy Coated", "Deformed Steel Bars - Galvanized" and "Deformed Steel Bars - Weldable" respectively.

This work will be measured for payment by the number of kilograms of bar reinforcement installed and accepted.

The mass of reinforcing steel shall be computed using the values tabulated in Subarticle M.06.01.02. No allowance shall be made for the mass of the epoxy or galvanized coatings.

Tie down bars will not be measured for payment.

In case short bars are used when full length bars might reasonably be required, only the amount which would be obtained if full length bars were used will be measured for payment. No allowance will be made for lap splices not contemplated by the plans unless approved by the Engineer.

If bars are substituted upon the Contractor's request and as a result more reinforcing steel is used than specified, only the amount specified will be included.

**3 - Welded Wire Fabric**: This work will be measured for payment by the number of kilograms of welded wire fabric installed and accepted.

The mass of welded wire fabric will be computed from the values published in the CRSI "Manual of Standard Practice".

**4 - Dowel Bar Mechanical Connections**: Uncoated, epoxy coated and galvanized dowel bar mechanical connections shall be classified as "Dowel Bar Splicer System", "Dowel Bar Splicer System - Epoxy Coated" and "Dowel Bar Splicer System - Galvanized" respectively.

This work will be measured for payment by the number of dowel bar mechanical connections installed and accepted.

**6.02.05 - Basis of Payment**: Payment for this work will be made as follows:

**1 - Bar Reinforcement**: This work will be paid for at the contract unit price per kilogram for "Deformed Steel Bars", "Deformed Steel Bars - Epoxy Coated" or "Deformed Steel Bars - Galvanized" and "Deformed Steel Bars -

Weldable" complete in place and accepted, including shop drawings, furnishing, fabricating and placing reinforcing steel, welding splices and all materials, equipment, tools, labor and work incidental thereto.

**2 - Welded Wire Fabric**: This work will be paid for at the contract unit price per kilogram for "Welded Wire Fabric", complete in place and accepted, including shop drawings, furnishing, fabricating and placing welded wire fabric and all materials, equipment, tools, labor and work incidental thereto.

**3 - Dowel Bar Mechanical Connections**: This work will be paid for at the contract unit price each for "Dowel Bar Splicer System", "Dowel Bar Splicer System - Epoxy Coated" and "Dowel Bar Splicer System - Galvanized" complete in place and accepted, including shop drawings, furnishing, fabricating and placing dowel bar mechanical connections and all materials, equipment, tools, labor and work incidental thereto.

| Pay Item | Pay Unit |
|---|---|
| Deformed Steel Bars - Epoxy Coated | kg |
| Deformed Steel Bars - Galvanized | kg |
| Deformed Steel Bars - Weldable | kg |
| Welded Wire Fabric | kg |
| Dowel Bar Splicer System | EA. |
| Dowel Bar Splicer System - Epoxy Coated | EA. |
| Dowel Bar Splicer System - Galvanized | EA. |