SECTION 03200

CONCRETE REINFORCEMENT

3200.01 GENERAL

A. Description

Concrete reinforcement shall include, but not necessarily be limited to, furnishing and placing various types and/or sizes of steel reinforcing for embedment in Portland cement concrete as specified in the Contract Documents.

B. Related Work Included Elsewhere

Not applicable.

C. Quality Assurance

1. Inspection and Testing

   The Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. When specific tests of materials are called for in the referenced standards and specifications, the Engineer has the option of requiring that any or all of these tests be performed for materials furnished for a specific project. When testing is required, it will be specified herein or in the “Special Provisions”.

2. Tolerances

   Reinforcing bars shall be cut and bent within the following tolerances:

   a. Sheared Length: Plus, or minus 1 inch for #3 to #11 bars inclusive and 2 inches + for #14 and #18 bars.

   b. Depth of Truss Bars: Plus 0, minus 1/2 inch.

   c. Stirrups, Ties, and Spirals: Plus, or minus 1/2 inch.

   d. All Other Bends: Plus, or minus 1 inch.

D. Submittals

1. Shop Drawings

   Shop drawings shall be submitted as specified in the "General Provisions" for all reinforcing bars and shall contain the following data, lists, and information; bar lists, placement plans, and bending diagrams showing individual weight of each bar, total weight of each bar size, total weight of bars on the list, description, details, dimensions, and locations of each item; detail reinforcing in accordance with the

requirements of ACI 315-99 Details and Detailing of Concrete Reinforcement. Base the calculated weights on the theoretical unit weights shown in Table 1, ASTM A615.

2. Certificates of Compliance

   a. Certificates of compliance shall be submitted in accordance with the "General Provisions" for all concrete reinforcement stating that the material furnished meets the requirements specified in Section 03200.02.

   b. Submit certificates of compliance for all reinforcing materials.

3. Certified Test Results

   c. Certified test results shall be submitted for all epoxy coatings for deformed steel reinforcing bars showing that they meet the requirements specified in Section 03200.02.

   d. Perform testing in accordance with ASTM A615 as modified by ACI 318 building code requirements for reinforced concrete.

   e. A certified copy of mill tests shall be submitted on each heat of reinforcing steel delivered, showing physical and chemical analysis.

3200.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for concrete reinforcement.

B. Contractor's Options

Substitution of smaller size bars will be permitted only upon specific authorization by the Engineer. Substituted bars shall provide a steel area equal to or larger than that called for by the design provided the spacing is not reduced to a point where the clear distance between the bars is less than one and one-half times the nominal diameter of the bars, nor one and one-half times the maximum size of the coarse aggregate, nor 1 1/2 inches, and further provided that the planned cover is maintained. No additional compensation will be allowed because of the substitution of larger areas of steel.

C. Detailed Material Requirements

1. General

   Reinforcing steel shall conform to the requirements of ACI 318.

2. Bar Reinforcement

   Bar reinforcement shall consist of deformed bars meeting the requirements of ASTM A615, Grade 60, modified in accordance with ACI 350.

3. Tie or Dowel Bars

   Tie or dowel bars shall be round steel bars meeting the requirements of AASHTO M 31, Grade 60.

   Sleeve for dowel bars shall be of sheet metal capable of sliding over 2 ± 1/4 inch of the dowel and shall have a closed end with a stop to hold the end of the sleeve at a minimum distance of 1 inch from the end of the dowel bar.

4. Welded Steel Wire Fabric

   Welded steel wire fabric shall meet the requirements of ASTM A185. Fabric used in pavement construction shall be furnished in flat sheets. When galvanizing is specified, the fabric shall be galvanized after fabrication.

5. Welded Deformed Steel Wire Fabric

   Welded deformed steel wire fabric shall meet the requirements of AASHTO M 221.

6. Fabricated Steel Bar Mats

   Fabricated steel bar mats shall consist of steel meeting the requirements of AASHTO M 31 fabricated to meet the requirements of AASHTO M 54.

7. Wire Fabric for Pneumatically Applied Mortar

   Wire fabric for pneumatically applied mortar and concrete encasement shall meet the requirements of AASHTO M 55. It shall be fabricated from size W1.4 wire on 3-inch centers in each direction. It shall have a minimum galvanized coating of 0.8 ounces per square foot when tested in accordance with AASHTO T 65.

8. Cold Drawn Steel Wire

   Cold drawn steel wire for concrete reinforcement shall meet the requirements of AASHTO M 32.

9. Tie Devices

   Tie devices for use in securing contiguous traffic lanes of Portland cement concrete pavement or a traffic lane and concrete curb or combination curb and gutter shall be of malleable iron or steel. The tie devices shall meet the dimensions specified and produce a frictional force of at least 160 pounds per foot of spacing when tested in accordance with MSMT 512.

10. Galvanizing

    Galvanizing for deformed steel bars shall be in accordance with ASTM A 153.

11. Epoxy Coatings for Deformed Steel Reinforcing Bars

Epoxy coatings for deformed steel reinforcing bars shall be epoxy powders which are electrostatically spray applied to sandblasted near white steel (fusion bonded epoxy resin). Ties, supports, and inserts used in conjunction with epoxy coated steel reinforcing bars shall be similarly coated.

a. Prequalification

Prequalification of epoxy coating will be based on MSMT 613 with the following limits:

Property	Requirement
Thickness, mils	5 to 11 after curing
Holidays/foot	2 max.
Bend Test	No cracks in coating
Hardness, KHN	16 min.
Pullout Strength Ratio Coated/Uncoated	0.80 min.
Impact Resistance, Area of Damage Square Inches	0.15 max.
Abrasion Resistance, mg loss	100 mg/1000 cycles max.
Chemical Resistance	The coating shall not blister, soften, disbond or develop holidays.
Chloride Penetration	1×10^{-4} Molar max.
Resistance to Applied Voltage	No evolution of hydrogen gas at the cathode or rusting at the anode within one hour. No holidays developed at the end of 30 days of testing.

b. Control and Acceptance

Control and acceptance of epoxy coating will be based on MSMT 613 with the following limits:

Property	Specification
Thickness, mils	5 to 11 after curing
Holidays/foot	2 max.
Bend Test (No. 5 Deformed Steel Reinforcing Bars)	No cracks in coating
Hardness, KHN	16 min.

NOTE: Condition of cure shall be checked by the applicator's method deemed most effective to determine that the coating is fully cured.

c. Patching Materials

Patching or repair material shall be available through the epoxy powder manufacturer. The material shall be compatible with epoxy coating and inert in concrete. The material shall be capable of allowing concrete to be placed within 1 hour after application at an ambient temperature of 35°F.

12. Metal Accessories: As recommended by CRSI Manual of Standard Practice. Where concrete surfaces will be exposed to public view in the finish structure, use supports with plastic protected or stainless steel legs.

3200.03 EXECUTION

A. Fabrication

1. General

After bar lists and bending diagrams have been approved, fabricate each unit of reinforcement to the type, shape, size, grade, and dimensions shown on the approved shop drawings.

2. Cutting and Bending

Perform cutting and bending of reinforcing bars before shipment to the site. Bend all bars cold in a manner that will not injure the material and in accordance with the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.

3. Bar Support and Spacers

Support bars by means of bolsters or chairs with no less than the minimum required by ACI 315-99, Details and Detailing of Concrete Reinforcement.

Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks.

Hold reinforcing steel in position in walls, columns, piers, and abutments by means of mortar blocks, bar supports, or spacers wired to reinforcing steel.

Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

Do not place bars or fabricated mats on layers of fresh concrete as the work progresses.

B. Shipping, Handling, and Protection of Material

Reinforcing steel bars shall be shipped in standard bundles and tagged and marked in accordance with the provisions of the Code of Standard Practice of the Concrete Reinforcing Steel Institute. Bundles shall be kept intact and material undamaged and properly identified until ready for use.

Tag each bundle at the mill with a waterproof tag showing the name of the mill and heat number, the grade and size of the bars, and identifying number.

Reinforcing steel bars shall be stored on blocking, racks, or platforms so as not to be in contact with the ground.

Bars shall be kept free from dirt, paint, oil, grease, loose or thick rust, detrimental mill scale, other foreign substances and rust causing conditions. However, when steel has on its surface detrimental rust, mill scale, dust, or dirt, it shall be cleaned by a method approved by the Engineer.

C. Placing and Fastening

The placing of bars shall conform to the recommended practices in "Placing Reinforcing Bars" as published by the Concrete Reinforcing Steel Institute.

Reinforcing steel shall be accurately placed in the position shown on the plans and firmly held during the depositing and setting of the concrete. Cover, or the distance between the external face of the bar and the face of the finished concrete, shall be as indicated on the Plans. Reinforcing steel bars embedded in concrete shall not be bent after they are in place. Bars shall be tied at all intersections with 16 1/2 gage black annealed wire except that where spacing is less than 1 foot each direction alternate intersections need not be tied. All intersections shall be tied in the top mat of reinforcement placed on the top slabs of box culverts. Abrupt bends shall be avoided except where one steel bar is bent around the other. Stirrups and ties shall always pass around the outside of main bars and be securely attached thereto. All reinforcing steel shall be securely held at the proper distance from the forms by means of plastic coated steel chairs. Blocks for holding reinforcement away from contact with earth shall be precast concrete blocks of approved shape, mix, and dimensions and shall have tie wires embedded in them. Layers of bars shall be separated by approved plastic coated metal chairs or bolsters.

Any broken or damaged concrete spacer blocks shall be removed before concrete is placed. The use of pebbles, pieces of broken stone or brick, metal pipe, or wooden blocks as spacers will not be permitted. Reinforcing steel when placed in the work shall be free from flake rust, dirt, and foreign material before any concrete is placed. Any mortar which may be adhering to the reinforcing steel shall be removed. No concrete shall be deposited until the Engineer has inspected the placing of the reinforcing steel and given permission to place the concrete. The Contractor shall allow the Engineer 4 hours of normal working time after the reinforcement and forms are in place to conduct the inspection. Any bars of incorrect size, length, or shape shall be removed and replaced with correct bars. Any bars located or spaced incorrectly shall be relocated or spaced correctly before permission is given to place concrete, and such replacements and corrections shall be at the Contractor's expense. All concrete placed in violation of these provisions shall be rejected and removed.

When the ambient air temperature is below 40°F, the temperature of the air in contact with the reinforcement shall be raised to 40°F prior to placing concrete. When the ambient air temperature is above 70°F and the reinforcement is exposed to the direct rays of the sun, the reinforcement shall be cooled by means of a water spray or by shading prior to placing concrete.

Placing Reinforcing Steel

i. Variation of protective coating 2-inch cover	1/4 inch
ii. Variation of protective coating 3-inch cover	1/2 inch
iii. Variation from indicating space	1 inch

D. Splicing

Reinforcement shall be furnished in full lengths as indicated on the Plans. Splicing, except where shown on the Plans, will not be permitted without written approval from the Engineer; and if additional splices are used, the additional weight occasioned by such splices shall be at the Contractor's expense.

All splices shall conform to Class "B" in ACI 318 or as shown on the Plans. Splices shall be well distributed where conditions permit. Except where otherwise shown on the Plans, lap splices shall be made with the bars placed in contact and wired together. Lapped splices for reinforcement shall not be used for bar sizes larger than No. 11.

No welding of reinforcing steel or attachments thereto will be permitted without written authorization by the Engineer, unless so indicated on the Plans. Welding, if permitted, shall be in accordance with AWS D1.4.

E. Inspection

Deposit concrete only when the placement of the reinforcement has been checked and approved by the Engineer. The Contractor shall provide notice to the Engineer at least 24 hours in advance of any contemplated concrete pour.

F. Embedment

Place reinforcement so that there will be a clear distance of at least 2 inches between the reinforcement and any anchor bolts or other embedded metal work.

G. Concrete Protection for Reinforcement

Reinforcement shall be protected by the thickness of concrete indicated in the Contract Drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

1. Where concrete is deposited against the ground without the use of forms - not less than 3 inches.

2. Where concrete is exposed to weather, ground, sewage, or sewage gases, but placed in forms - not less than 2 inches for bars larger than No. 5 and 1-1/2-inches for No. 5 bars or smaller.

3. In slabs and walls not exposed to ground, weather, sewage or sewage gases - not less than 3/4 inch.

4. In beams, girders, and columns not exposed to ground, weather, sewage, or sewage gases - not less than 1-1/2 inches.

3200.04 METHOD OF MEASUREMENT

Measurement for concrete reinforcement consisting of plain round bars, deformed bars, or wire mesh will not be made, but shall be included in the unit or lump sum price bid for other items unless the Proposal indicates that measurement by one of the following methods is applicable.

A. Unit Price

1. Reinforcing Bars

Measurement for reinforcing bars will be made based on the total weight of all reinforcement accepted and installed according to the Contract Documents.

For plain or Deformed Bars, computed theoretical weights will be used with no allowances for over or underruns unless actual certified shipping weights are available, in which case these weights will be used as the basis of measurement; and allowances may be made for overruns not in excess of 3.5% on any one shipment. Under no circumstances will any allowances for overruns be made unless actual certified shipping weights indicate that such overruns actually existed. No allowances will be made for extra weight resulting from the use of substituted items or from the inclusion of extra laps and splices, even though approval has been granted for the use of substituted items or materials or lengths and sizes other than those originally required. Measurement of this item will not include the weight of any clips, chairs, spacers, tie wires, welds, or other accessory devices used in placing and securing the reinforcement.

The theoretical computed weights for Plain and Deformed Bars will be based upon the original approved and accepted overall lengths of bars computed on the basis of the following unit weights per linear foot.

Bar Number	Weight Pounds Per Linear Foot
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313

14S	7.650
18S	13.600

2. Welded Steel Wire Fabric

   Measurement for welded steel wire fabric will be made based on the area of the fabric as installed complete in place. No allowances will be made for overlap.

B. Lump Sum

Measurement for concrete reinforcement will be made on the basis of a lump sum for all reinforcement in the Project or a lump sum for all reinforcement in each structure or structural unit.

3200.05 BASIS OF PAYMENT

A. General

1. Payment for concrete reinforcement consisting of plain round bars, deformed bars, or wire mesh will not be made as such, but the cost thereof shall be included in the unit or lump sum price bid for other items unless the Proposal indicates that payment is applicable.

2. When applicable, payments will be made at the unit or lump sum prices bid. These prices shall include furnishing all labor, tools, equipment, and materials necessary to satisfactorily complete the work as shown and specified in strict accordance with the Contract Documents, and accepted by the Engineer.

B. Unit Price

1. General

   No payment will be made for the following:

   a. Clips, ties, bar supports, spacers, chairs, or other devices for holding reinforced steel in place.

   b. Additional reinforcing steel for splices permitted by the Engineer for Contractor's convenience.

   c. Overrun of scale weights of reinforcing steel.

   d. Reinforcing steel and accessories required for lump sum items.

2. Reinforcing Bars

   Payment for reinforcing bars will be made at the price bid per pound.

3. Welded Steel Wire Fabric

   Payment for welded steel wire fabric will be made at the price bid per square foot.

C. Lump Sum

1. Payment for concrete reinforcement will be made at the lump sum price bid for all reinforcement and appurtenances in the Project, or for all reinforcement and appurtenances in each structure or structural unit.

2. To provide for unforeseen changes in planned dimensions affecting reinforcing steel bid on a lump sum basis, the Proposal will include an item for contingent reinforcing steel. This item shall be used only upon written direction of the Engineer. If necessary changes in planned dimensions result in an increase in the quantity, then the pertinent lump sum price shall be increased by an amount obtained from the product of the additional poundage times the unit price bid per pound for contingent reinforcing steel. Should, however, the necessary changes in planned dimensions result in a smaller quantity than planned, then the pertinent lump sum price shall be reduced by an amount obtained from the product of the decrease in poundage times the unit price bid per pound for contingent reinforcing steel. The item shall include cost of furnishing, coating, fabricating, placing, and tying of the reinforcing steel and work required to complete the revisions to the reinforcing steel.

END OF SECTION