

## SECTION 03211

# REINFORCING STEEL AND WELDED WIRE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Materials and procedures for placing reinforcing steel and steel welded wire fabric.
- B. Coating for reinforcing steel and steel welded wire fabric.

#### 1.2 REFERENCES

- A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. AASHTO M 284: Epoxy Coated Reinforcing Bars
- E. ASTM A 36: Carbon Structural Steel
- F. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- G. CRSI Manual of Standard Practice
- H. UDOT Minimum Sampling and Testing Guide
- I. UDOT Quality Management Plans

#### 1.3 SUBMITTALS

- A. Furnish Certificates of Compliance from the manufacturer stating that the materials meet this specification.

- B. Prequalify all coatings meeting AASHTO M 284 Annex A1: Prequalification of Organic Coatings for Steel Reinforcing Bars.
  - 1. Furnish a copy of the Prequalification Test Report to the Department's Construction and Materials Division.
  - 2. Provide an 8-ounce sample of the coating material from each batch in conformance AASHTO M 284 Annex A1.2.2, to the Department's Construction and Material Division.
  
- C. A copy of the purchase order or a detailed letter to the Engineer verifying the warehouses or fabricators of the steel reinforcing bars or welded wire reinforcement with required samples.
  
- D. Samples of the steel reinforcing bars or welded wire reinforcement from the fabricator's source, following UDOT's Minimum Sampling and Testing Guide.
  - 1. Provide 3 samples of each size cut to 2 ft length.
  - 2. Samples may be waived if the original contract amount is less than 4,000 lbs.
  - 3. Supply test bars at no additional cost to Department.
  
- E. Splice Shop Drawings: Submit five sets for approval showing the proposed number and locations of each mechanical butt splice splicing.
  - 1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.
  
- F. Submit two sample mechanical butt splices and test to destruction in the presence of the Engineer.
  
- G. Reinforcing Steel Shop drawings.
  - 1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.

#### **1.4 QUALITY ASSURANCE**

- A. The Department may witness coating processes for project work and obtains random samples by heat number and manufacturer to conduct verification testing.
  
- B. Prequalification:
  - 1. Epoxy Coating Suppliers: through UDOT's Quality Management Plan - Reinforcing Steel Epoxy Coating.
  - 2. Galvanized Coating Suppliers: through UDOT's Quality Management Plan - Reinforcing Steel Galvanized Coating.
  - 3. Reinforcing steel suppliers through UDOT's Quality Management Plan (QMP) for steel.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Do not damage the bars or the coating during handling and storage.
  - 1. Use systems with padded contact areas when handling epoxy coated bars.
  - 2. Pad all bundling bands for epoxy coated bars.
  - 3. Lift all bundles with strong-back, multiple supports, or a platform bridge.
  - 4. Do not drop or drag bars.
- B. Repair damaged bars or coating at no additional cost to the Department.

## **PART 2 PRODUCTS**

### **2.1 REINFORCING STEEL**

- A. Deformed billet-steel bars as specified. Meet AASHTO M 31, Grade 60

### **2.2 EPOXY AND GALVANIZED COATINGS**

- A. As specified. Meet AASHTO M 284 OR AASHTO M 111.
- B. Coat bars as shown on the plans.
  - 1. Maintain epoxy coating thickness between 8 and 12 mils.
  - 2. Maintain galvanized coating thickness as specified. ASTM A 767.
  - 3. Coat bars after bending, unless the fabricator can show that satisfactory results can be obtained by coating before bending.
  - 4. Reject any bent bars with visible cracks or damage in the coating.

### **2.3 WIRE AND WIRE REINFORCEMENT**

- A. Cold-Drawn Steel Wire: As specified. Meet AASHTO M 55.
- B. Welded Steel Wire Reinforcement: As specified. Meet AASHTO M 55.
- C. Tie Wire: 16 gauge before coating.
  - 1. Use coated wire.

### **2.4 BAR SUPPORTS**

- A. Epoxy-coated, galvanized, or plastic-coated, or plastic bar supports:
  - 1. Meet the requirements of the "Bar Support" chart following this Section.

2. Remove contaminants that affect the adhesion of the coating to the wire.
  3. Use an electrostatic-spray method, fluidized bed, or flocking to apply an epoxy coating.
  4. Apply plastic coating by spraying, dipping, or using as a powder.
  5. Maintain galvanized coating thickness as specified. AASHTO M 111.
  6. Maintain the thickness of epoxy or plastic coatings at a minimum of 5 mils with no maximum.
  7. Use patching material per the manufacturer's recommendation to repair damaged coating.
    - a. Use patching material that is compatible with the coating, and that is inert in concrete.
    - b. Hanger marks on the coated bar supports that result from the coating application process are acceptable and are not considered damaged coating.
- B. Precast concrete block bar supports:
1. Minimum 28-day compressive strength of 2,500 psi
  2. Three inch thick supports with sides ranging from 4 inches to 6 inches with a minimum soil contact area of 24 inch<sup>2</sup>.

## 2.5 MECHANICAL ANCHORAGE DEVICE

- A. Splice Coupler (**Same coating system as bar**)
1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 175 percent of the strength of the reinforcing bar without damage to the concrete.
  2. Steel Plate: Meet ASTM A 36.

## PART 3 EXECUTION

### 3.1 PLACEMENT

- A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.
- B. Bend all bars accurately.
- C. Place all reinforcement in designated position and securely hold in position while placing and compacting concrete.
- D. Wire bars together with ties at all intersections except when spacing is less than 9 inches in each direction, in which case, tie at alternate intersections.

- E. Maintain the specified distance from the forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices.
- F. Precast concrete block bar supports are only allowed when the concrete is placed in contact with the soil and then only as the support for the bottom mat of bars.
- G. Do not tack weld reinforcing bars in place.
- H. Overlap at least one panel of welded-wire fabric sheets to each other and fasten at the ends and edges.
- I. Support reinforcing steel for concrete “T” beams, pier caps, approach slabs, and deck slabs on metal chairs or slab bolsters following this Section, article 2.4, Bar Supports.
- J. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 4 ft on center of the bar in each direction.
- K. Tie deck steel to beams or forms at regular intervals of not more than 5 ft on center along the beams to prevent steel movement during concrete placement.
- L. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate, or use precast concrete block supports following this Section, article 2.4, Bar Supports.
- M. Engineer verifies placing and fastening of reinforcement in each section of work before any concrete is deposited.

### **3.2 FIELD CUTTING**

- A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.
- B. Repair the sawed or sheared end using the specified patching or repair material.

### **3.3 SPLICING**

- A. Furnish all reinforcing steel in the lengths specified.
- B. Do not splice bars, except where specified.
- C. Stagger splices as far as possible.

- D. Place and tie lapped splices in the bars. Maintain the minimum distance to the surface of the concrete shown.
- E. Do not lap splice No. 14 and No. 18 bars.
  - 1. Use mechanical butt splices when using No. 14 or No. 18 bars.
    - a. Decide the number and location of the splices with the following limitations:
      - 1) Extend bars a minimum of 10 ft above the top of footing.
      - 2) Stagger splices such that no particular bar designation is spliced more than 50 percent in 5 ft.
    - b. Use a standard, approved, exothermic process for mechanical butt splicing where the molten filler metal, contained by a high-strength steel sleeve of larger inside diameter than the bars, is introduced into the annular space between bars and the sleeve and between the ends of the bars.
    - c. After cooling and hardening of the filler metal, the splice must be capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other by the mechanical strength of the splice components.
    - d. The splice must not depend on fusion of the filler metal with the bars.
      - 1) Do not heat the bars to their melting point during the splicing process.
      - 2) Do not allow the degree of heat required to affect the splice to decrease the structural properties of the bars or affect their original hardness.
    - e. Splice according to the manufacturer's recommendations using the manufacturer's standard jigs, clamps, ignition devices, and other required accessories to make splices. Preheat bars where required by the manufacturer.
- F. Use one of the following mechanical butt splices for bars sizes No. 3 through No. 11 when designated on the plans. Follow the manufacturer's published recommendations for equipment and splicing procedures.
  - 1. A full mechanical connection that develops in tension or compression at least 175 percent of the specified yield strength of the bar.
  - 2. As described in this Section, article 3.3, Splicing, paragraph E.

### **3.4 BENDING**

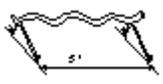
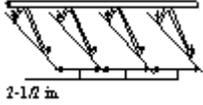
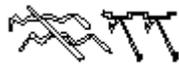
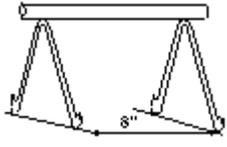
- A. Bend reinforcement to the shapes specified. Refer to CRSI Manual of Standard Practice.
- B. Do not heat the bars during the bending operations.

- C. Cut and bend as specified.
- D. Complete all bending before coating except as specified for bent bars.

### **3.5 FIELD QUALITY CONTROL**

- A. Have the coated bars inspected for damage to the coating after the bars are in place and immediately before concrete placement.
- B. Repair all visible defects using the specified method recommended by the coating manufacturer.

### Bar Supports

Types and Sizes				Minimum Wire Sizes <sup>2</sup> and Geometry			
Symbol	Bar Support Illustration	Type of Support	Standard Sizes	Nominal Height	Carbon Steel		Geometry
					Top	Legs	
SB <sup>1</sup>		Slab Bolster	3/4, 1, 1-1/2, and 2 inch heights in 5 ft and 10 ft lengths	All	4 ga. Corrugated	6 ga.	Legs Spaced 5 inches on Center, Vertical Corrugations Spaced 1 inch on Center (See Note 3)
BB <sup>1</sup>		Beam Bolster	1, 1-1/2, and 2 inch; over 2 inch to 5 inch heights in increments of 1/4 inch lengths of 5 ft.	Up to 1-1/2 inch incl.	7 ga.	7 ga.	Legs Spaced 2-1/2 inches on Center (See Note 3)
				Over 1-1/2 inch to 2 inches incl.	7 ga.	7 ga.	
				Over 2 inches to 3-1/2 inches incl.	4 ga.	4 ga.	
				Over 3-1/2 inch	4 ga.	4 ga.	
BC		Individual Bar Chair	3/4, 1, 1-1/2, and 1-3/4 inch heights	All	-----	7 ga.	(See Note 3)
JC		Joist Chair	4, 5, and 6 inch widths and 3/4, 1, and 1-1/2 inch heights	All	-----	6 ga.	(See Note 3)
HC or HPC*		Individual High Chair	2 inch to 15 inch heights in increments of 1/4 inch.	2 inches to 3-1/2 inches incl.	-----	4 ga.	Legs at 20 degree or less with vertical. When height exceeds 12 inches, legs are reinforced with welded crosswires or encircling wires (See Note 4)
				Over 3-1/2 inches to 5 inches incl.	-----	4 ga.	
				Over 5 inches to 9 inches incl.	-----	2 ga.	
				Over 9 inches to 15 inches incl.	-----	0 ga.	
CHC		Continuous High Chair	Same as HC in 5 ft and 10 ft lengths	2 inches to 3-1/2 inches incl.	2 ga.	4 ga.	Legs at 20 degree or less with vertical. All legs 8-1/4 inches on center maximum, with leg within 4 inches of end of chair, and spread between legs not less than 50 percent of nominal height. (See Note 5)
				Over 3-1/2 inches to 5 inches incl.	2 ga.	4 ga.	
				Over 5 inches to 9 inches incl.	2 ga.	2 ga.	
				Over 9 inches to 15 inches incl.	2 ga.	0 ga.	

Notes and Bar Supports Table, see next page.

Notes:

1. Top wire on continuous supports, not otherwise designated as corrugated, may be straight or corrugated at the option of the manufacturer.
2. Minimum wire sizes are American steel and wire gauges.
3. To provide adequate stability against overturning, the leg spread measured between points of support on the minor axis of the support shall not be less than 70 percent of the nominal height.
4. To provide adequate stability against overturning, the leg spread measured between points of support on the minor axis of the support shall not be less than 55 percent of the nominal height.
5. To provide adequate stability against overturning and to provide adequate load capacity, the leg spread measured between points of support on the minor axis of the support shall not exceed the minimum and maximum percentages of the nominal height, as shown.

<b>Nominal Height (inches)</b>	<b>Distance Between Supports as a Percent of Nominal Height</b>	
	<b>Minimum</b>	<b>Maximum</b>
Under 4	70	No Limit
4	70	95
6	65	90
8	60	85
10	55	80
12	50	75
Over12	50	75

END OF SECTION