



Florida Department of Transportation

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JARED W. PERDUE, P.E.
SECRETARY

September 10, 2026

Daniel Holt, PE, PTOE
Director, Project Delivery
Director, Technical Services
FHWA
400 West Washington Street, Suite 4200
Orlando, FL 32801

Re: State Specifications Office
Section: 415
Proposed Specification: **4150100 Reinforcement for Concrete**

Dear Mr. Holt:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Mateo Caravajal to move acceptance requirements for steel bars, wire reinforcement, and carbon steel welded wire reinforcement from Section 931 to Section 415.

Please review and transmit your comments, if any, within two weeks (10 business days). Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on File

Daniel Strickland, P.E.
State Specifications Engineer

DS/jb

Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

REINFORCING-REINFORCEMENT FOR CONCRETE

(REV 6-4-26)

SECITON 415 is deleted and the following substituted:

415-1 Description.

Furnish and ~~place~~ install ~~steel or fiber reinforced polymer (FRP)~~ reinforcement of the ~~quality~~, type, grade, size, and quantity designated in the Contract Documents. ~~Obtain all reinforcing from a producer on the Department's Production Facility Listing.~~

415-2 Materials.

Meet the following requirements:

Plastic Chairs and Bolsters*.....Section 415

Couplers and Splice Devices*Section 931

Metal Dowel Bar Assemblies*Section 931

Steel Reinforcement-Steel..... Section 931-1.1

Wire Reinforcement.....Section 931

Wire Reinforcement..... 931-1.2

FRP Bar Reinforcement..... Section 932-6

*Use products on the Department's Approved Products List (APL).

415-3 Protection of Material.

Store reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it from mechanical injury and surface deterioration. Ensure that the reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material prior to incorporation into the work. Protect FRP against UV exposure and extreme ambient storage temperatures as required by the FRP manufacturer. If the manufacturer does not provide any requirements, limit FRP sun exposure to 4 months and ~~maximum ambient~~ storage temperature to 120°F.

415-4 Bending, Splicing, and Cutting.

415-4.1 Steel Reinforcement: Fabricate reinforcing bars as prescribed in the CRSI Manual of Standard Practice. Shop bend the reinforcement cold to the shapes indicated in the Plans. ~~Do not bend the reinforcement to shape in the field.~~ Minor bending adjustments may be performed in the field with the approval of the ~~as directed by the~~ Engineer.

~~_____ Do not hot bend, or hot~~ straighten, weld, or thermal cut reinforcing steel.

415-4.2 Fiber Reinforced Polymer (FRP) Reinforcement: ~~No~~ Do not field fabricate ~~ion of~~ FRP reinforcing bars, ~~is permitted~~ except for tying and field cutting per ACI 440.5. Do not bend, ~~or~~ straighten, couple, thermal cut, or shear cut FRP reinforcing bars.

415-5 Placing and Fastening.

415-5.1 General: Unless otherwise specified in the Contract Documents, the tolerance for bar spacing is plus or minus 1 inch from the plan position and the tolerance for concrete cover is minus 1/4 inch or plus 1/2 inch from the plan dimensions. Construct all tie patterns referenced by this Section in accordance with the CRSI Manual of Standard Practice.

415-5.2 Concrete Blocks for Spacing: Use precast concrete blocks to space and support the reinforcing bars. Use concrete blocks with a concrete class equal to or greater than the concrete in which they are to be placed and have wires cast into them for fastening to the reinforcing bars. When the concrete mix design requires highly reactive pozzolans or minimum surface resistivity, use blocks from concrete of the same mix design. Moist-cure the blocks for at least three days.

Submit a certification verifying the class of concrete used to fabricate the concrete blocks, and identifying the batch and load of concrete from which the concrete blocks were cast.

415-5.3 Tying: Securely tie all reinforcement together without damage. Use ties of sufficient strength to maintain the reinforcement in its proper position. For stainless steel reinforcement, use stainless steel wire or non-metallic tying materials.

The tying materials should not damage the reinforcement during the construction.

415-5.4 Splices: Where splices are authorized, rigidly clamp the bars or tie them in a manner meeting the Engineer's approval. Use the lap splice length as shown on the Plans.

415-5.4.1 Steel Reinforcing: ~~Use mechanical couplers or splice devices for steel reinforcing that are listed on the Department's Approved Product List (APL).~~ Do not use welded splices for steel reinforcing except as specifically authorized by the Engineer and meeting the requirements of AWS D 1.4 Structural Welding Code - Reinforcing Steel.

~~Use mechanical couplers or splice devices for steel reinforcing that are listed on the Department's Approved Product List (APL).~~

415-5.4.2 Fiber Reinforced Polymer (FRP) Reinforcing: Do not use mechanical couplers for FRP reinforcing bars. Use lap splices only.

415-5.5 Footings:

415-5.5.1 Supports: Support footing mat reinforcing with approved bolsters or concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the reinforcing using the cast-in wires.

415-5.5.2 Tolerances: Place footing mat reinforcing bars within 1/2 inch vertically from the plan bottom clearance and within 1 inch from the plan side clearance.

415-5.5.3 Tying: Tie footing mat reinforcing bars with a double-strand single tie at all intersections on the periphery and at alternate intersections within the mat.

415-5.6 Dowel Bars for Columns and Walls:

415-5.6.1 Supports and Positioning: Position dowel bars projecting into columns and walls so as to allow splicing of the vertical bars to the dowels and to tie the dowel bars in their plan position. Support the dowel bars by a rigid template such that concrete placement does not disturb their position. Support the reinforcing bars prior to placement of the footing concrete and do not insert dowel bars into the plastic concrete.

415-5.6.2 Tolerances: Place the dowels bars within 1/2 inch of their plan position and with a side clearance tolerance not exceeding 1/4 inch.

415-5.7 Verticals and Hoops for Columns:

415-5.7.1 Spacing-off from Side Forms: Space column reinforcing bars from the side forms with concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the reinforcing reinforcement using the cast-in wires.

415-5.7.2 Tolerances and Clearance:

1. Column Verticals: Place column verticals within 1/2 inch of their plan position. Ensure that the side form clearance is within 1/4 inch of the specified clearance.

2. Column Hoops: Place every hoop within 1 inch of the plan position for the specific hoop, with no accumulation of such tolerance caused by the spacing between any two hoops. Ensure that side form clearance for any hoop is within 1/2 inch of its specified clearance.

415-5.7.3 Tying: Tie ~~the~~ column hoops to the column verticals at each intersection, by a cross tie or figure 8 tie.

415-5.8 Wall ~~Reinforcing~~ Reinforcement (Not Including Dowel Bars):

415-5.8.1 Supports: Space wall reinforcing bars from the side forms with concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the ~~reinforcing~~ reinforcement using the cast-in wires. Fix the spacing between wall mats by means satisfactory to the Engineer.

415-5.8.2 Tolerance: Except when necessary to clear a fixture, place reinforcing bars within 1 inch of plan position. Ensure that the number of bars in any affected unit is as ~~specified, and~~ specified and place the remainder of the bars (not thus affected) within 1 inch of plan location.

415-5.8.3 Tying: Tie retaining wall reinforcing bars with a cross tie or figure 8 tie at each intersection on the periphery and at every third intersection within the mat. If workers use the reinforcing as a ladder, provide additional ties as directed by the Engineer.

Tie noise and perimeter wall reinforcing bars with a single tie at each intersection on the periphery and at every third intersection within the mat.

415-5.9 Pier and Bent Caps:

415-5.9.1 Supports: Support bottom reinforcing ~~bars~~ with approved bolsters or concrete blocks. Begin the spacing of bolsters or concrete blocks at not more than 2 feet from the end of the caps and space the additionally required bolsters at not more than 4 feet. Space side reinforcing from the side forms by concrete blocks. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Use concrete blocks with cube dimensions equal to the Plan concrete cover, fastened to the reinforcing ~~bars~~ using the cast-in wires.

415-5.9.2 Tolerances: Place the main longitudinal reinforcing bars ~~so as to~~ provide a bottom and top clearance within 1/4 inch of the plan vertical dimensions for all layers. Space the bars from side forms within 1/2 inch of the specified spacing.

Place stirrups within 1 inch of the plan position for each individual stirrup and do not allow the tolerance to accumulate.

415-5.9.3 Tying: Tie all intersecting bars with a double-strand single tie.

415-5.10 Deck Slabs:

415-5.10.1 Supports:

1. Bottom Mats: Support the bottom mat of reinforcing bars using slab bolsters or concrete blocks. Use one row of slab bolsters placed 6 inches from the edge of the slab and two rows down each deck section between beams. Do not allow the spacing between rows to exceed 4 feet, measured center to center.

Use concrete blocks 2 inches by 2 inches by clearance dimensions. Space concrete blocks 4 feet on center as a maximum.

2. Top Mats: Support the top mats of reinforcing bars by either continuous or individual high chairs. Provide high chairs along both sides of each beam and approximately

6 inches back from the edge of the beam. Place the outside row of high chairs 6 inches from the edge of the slab. If using individual high chairs, do not allow the longitudinal spacing to be greater than 4 feet.

As an alternate to the above, on prestressed beam construction, the Contractor may support the top mat of reinforcing bars on the shear connectors bent to the proper elevation with one line of high chairs centered between the beams.

3. Truss Bars: Support truss bars at each end of the top bends by continuous high chairs or by individual high chairs spaced longitudinally at not more than 4 feet.

415-5.10.2 Tolerances: Ensure that top and bottom clearances are within 1/4 inch from those shown in the Plans.

Ensure that end and bottom clearances are within 1/4 inch from those shown in the Plans.

Ensure that end and edge clearances are within 1/4 inch of the clearance specified.

Place curb bars within 1/4 inch in any direction of the plan position.

415-5.10.3 Tying: Tie all reinforcing bars in each layer with a double-strand single tie at every intersection on the periphery and at every third intersection in the interior area. Alternatively, at the Contractor's option, tie all reinforcing bars in each layer with a single-strand single tie at every intersection on the periphery and at every other intersection within the interior area. Alternatively, at the Contractor's option, if annealed soft-iron wire with uncoated diameter equivalent or greater than 16 gauge (0.062 in.) is used, tie all reinforcing bars in each layer with a single-strand single tie at every intersection on the periphery and at every third intersection in the interior area. If encountering difficulty in maintaining the reinforcing bars in position during the placing of concrete, tie additional intersections as necessary to hold the reinforcing bars secure.

415-5.11 Box Culverts:

415-5.11.1 Supports:

1. Bottom Slabs: In the bottom slabs of box culverts, provide supports for single-mat reinforcing bars and for bottom-mat reinforcing bars, including placement and spacing, as specified for footing mat steel in 415-5.5. In addition, where the Plans call for more than one mat of reinforcing bars in the bottom slab of the culvert, support the top mat away from the bottom mat, either by upper beam bolsters or by other means satisfactory to the Engineer.

2. Walls: Place, space and support the reinforcing bars in walls of box culverts in accordance with the requirements of 415-5.8.

3. Top Slabs: In the top slabs of box culverts, support the bottom mats of reinforcing bars by a row of slab bolsters 12 inches from the inside face of the walls and with additional rows of bolsters at spacings not exceeding 4 feet, center to center. As an exception, unless the Engineer deems the use of the slab bolsters as necessary to obtain proper support, the Contractor may use concrete blocks as the supporting device. Use blocks of dimensions not greater than 2 inches by 2 inches by the required clearance, with spacings not exceeding 4 feet in any direction. Fasten blocks to the reinforcing ~~steel~~ bars by the cast-in wires.

4. Truss Bars: Support truss bars as specified in 415-5.10.

415-5.11.2 Tolerances: Use tolerances in placing the reinforcing bars in box culvert slabs as specified for deck slabs in 415-5.10. Use tolerances for placing bars in walls as specified in 415-5.8.

415-5.11.3 Tying: Tie reinforcing bars in box culverts as specified for deck slabs in 415-5.10.

415-5.12 Cleaning: Before placing any concrete, clean all mortar from the reinforcement.

415-5.13 Bar Supports:

415-5.13.1 General: Provide reinforcing bar supports manufactured in accordance with all requirements of the CRSI Manual of Standard Practice. Use bar supports of adequate strength to withstand a 300 pound concentrated load without permanent deformation or breakage, with deflection less than 5% of the support height.

Ensure that no more than 5% of the reinforcing bar supports exhibit unsatisfactory performance, breakage, or permanent deformation during bar tying and/or concrete placement operations. If a bar support does not achieve this level of performance, reduce the average spacing between bar supports by 15%, or remove that product from use on the job.

Ensure that bar supports do not move during concrete placing operations. To prevent movement, tie supports to the reinforcing bars.

When using bar supports on corrugated metal stay-in-place forms, use supports specifically designed for the form being used.

For structural elements located in extremely aggressive environments, do not use metal bar supports in contact with removable forms or floor surfaces to support reinforcing bars.

415-5.13.2 Metal Bar Supports: For metal bar supports in contact with removable forms, provide supports constructed with molded plastic legs or plastic protected metal legs or bolster rails. Do not allow any portion of the bar support other than the molded plastic leg or plastic protected portion of the metal leg or bolster rail to be closer than 1/2 inch from the removable form surface for concrete to be cast.

Submit certification verifying that all metal bar supports meet the following requirements:

1. That they are manufactured from cold drawn steel wire in accordance with the wire sizes and geometrical dimensions shown in the CRSI Manual of Standard Practice, Chapter 3.

2. That the plastic used for protection of the steel legs or bolster rails has a thickness of 3/32 inch or greater at points of contact with the form work.

Provide plastic protection by a dipping operation, by adding pre-molded plastic tips to the legs of the support or by molding plastic to the top wire of the support. Ensure that the plastic material used for protection of steel legs does not chip, crack, deform, or peel during use.

Do not use metal bar supports to support FRP reinforcing bars.

415-5.13.3 Plastic Bar Supports and Spacers: Use plastic bar supports and spacers listed on the Department's APL. Manufacturers seeking evaluation of products for inclusion on the APL must submit an application in accordance with Section 6 and include a product photo, technical data sheet, and certified test reports from an independent laboratory showing that the plastic bar supports meet all the requirements specified herein.

Use non-stackable plastic bar supports and spacers. Bar supports shall be able to meet the concentrated load requirements of 415-5.13 within a working temperature range of 20 to 150°F. Spacers ~~shall~~ must be able to provide sufficient strength to support reinforcing

~~steel bar~~ in the required position without deformation and relaxation under job conditions. For drilled shafts, use wheel spacers with a smooth perimeter surface.

Submit protection from sunlight until placed in the form, and mold in a configuration which does not restrict concrete flow and consolidation.

All plastic bar supports and spacers shall have a maximum water absorption of 0.5% at 7 days as per ASTM D570. Plastic bar supports and spacers made of recycled plastic products must meet the additional requirements of Section 972.

~~Submit to the Engineer independent lab test data and certification verifying that the plastic spacers meet the requirements specified herein.~~

~~Use plastic bar supports listed on the Department's APL. Provide each individual bar support with an identification number unique to the particular model permanently marked on the surface as included in the APL. Manufacturers seeking evaluation of products for inclusion on the APL must submit an application in accordance with Section 6 and include certified test reports from an independent laboratory showing that the plastic bar supports meet all the requirements specified herein.~~

415-6 Welded Deformed Steel Wire Reinforcement.

415-6.1 General: Provide welded deformed steel wire reinforcement as shown in the Plans or as a substitute for deformed bar reinforcement when approved on the shop drawings. Propose substitutions of welded deformed steel wire reinforcement in a manner that provides a cross-sectional area per foot of welded deformed steel wire equal to that provided in the Plans for deformed bar reinforcement. Orient the deformed wires of welded deformed steel wire reinforcement in the same position as bar reinforcement detailed in the Plans. Cross wires of welded deformed steel wire reinforcement may be deformed or smooth and must have a cross-sectional area at least 35% greater than the area of the deformed wire.

415-6.2 Design: When welded deformed steel wire reinforcement is substituted for deformed bar reinforcement, ensure that the development length, splices, shear reinforcement, and distribution meet the requirements of the AASHTO LRFD Bridge Design Specifications.

415-7 Acceptance of Reinforcement.

415-7.1 Steel Reinforcement: Acceptance of reinforcing steel (all types), wire reinforcement, and welded wire reinforcement will be based on the manufacturer's certified mill test report, certifying that the test results meet the specification limits of the ASTM or AASHTO designation for the furnished product, including size, grade, and any additional Contract requirements. Certification must include compliance with AASHTO Product Evaluation & Audit Solutions work plan and the source of supply requirements specified in Section 6.

Submit the certified mill test report to the Engineer prior to use. The Department may sample and test reinforcing steel for independent verification.

415-7.2 Fiber Reinforced Polymer (FRP) Reinforcement: Acceptance of FRP reinforcing bars will be based on the producer currently on the Department's Production Facility Listing, samples taken by the Department, and manufacturer's certified mill test report.

Obtain FRP reinforcing bars from producers currently listed on the Department's Production Facility Listing. Submit the certified mill test report to obtain the Engineer's approval prior to use. The Engineer will select samples representing each LOT of FRP bar. Provide testing samples if the project includes more than 15,000-feet of straight, or 10,000-feet of bent, or 10,000-feet of spiral, or a combined length of more than 20,000-feet of FRP reinforcing bars. A

sample is defined as five FRP bars, 7-foot in length for straight bars and 2-foot in length for bent or spiral bars.

415-~~7~~8 Method of Measurement.

415-~~7~~8.1 Reinforcing Steel: The quantity to be paid for will be the plan quantity, in pounds, of reinforcing steel, stainless reinforcing steel, ~~or~~ low carbon chromium reinforcing steel, or stainless steel-clad bar incorporated into the completed work and accepted, subject to any changes approved by the Engineer. The quantity will not include the reinforcing steel (all types) in any item of work for which the basis of payment already includes the steel reinforcement. No additional payment will be made for substitutions of welded deformed wire reinforcement proposed by the Contractor. No separate payment will be made for reinforcing steel (all types) in pipe endwalls. No deduction will be made from reinforcing steel (all types) quantities for encroachment of inlets and pipes in box culverts. The lengths to be used in the calculation will be the detailed lengths of bars as shown in the Plans.

415-~~7~~8.2 Unit Weights of Steel Bars: The unit weights used will be CRSI Standard Reinforcing Steel Bar Weights.

415-~~7~~8.3 Welded Wire Reinforcement: Where welded wire reinforcement is to be paid for by weight, the quantity to be paid for will be the product of the area, in square feet, of the welded wire reinforcement incorporated into the completed work and accepted, multiplied by the manufacturer's standard weight per square foot.

When welded deformed steel wire reinforcement is substituted for deformed bar reinforcement, the quantity to be paid for will be the quantity which would be paid for if bar reinforcement as detailed in the Plans were utilized, based on plan quantity.

415-~~7~~8.4 Fiber Reinforcing Polymer (FRP) Reinforcing: The quantity to be paid for will be the plan quantity, in linear feet, of bar incorporated into the completed work and accepted, subject to any changes approved by the Engineer. The quantity will not include the FRP bar in any item of work for which the basis of payment already includes the FRP bars. The lengths to be used in the calculation will be the detailed lengths of bars as shown in the Plans.

415-~~8~~9 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including all welding, all clips, spacers, ties, mechanical couplers, etc., and wire or other material used for fastening the reinforcement in place.

If spliced bars are used when full length bars might reasonably be required, the quantity paid for will be only that which would be obtained if full length bars were used, with no allowance for lap.

Payment will be made under:

Item No. 415- 1-	Reinforcing Steel - per pound.
Item No. 415- 2-	Stainless Reinforcing Steel - per pound.
Item No. 415- 3-	Low Carbon Chromium Reinforcing Steel - per pound.
<u>Item No. 415- X-</u>	<u>Stainless-Clad Reinforcing Steel - per pound.</u>
Item No. 415- 10-	Fiber Reinforced Polymer Reinforcing Bar - per linear foot.

REINFORCEMENT FOR CONCRETE

(REV 6-4-26)

SECITON 415 is deleted and the following substituted:

415-1 Description.

Furnish and install reinforcement of the type, grade, size, and quantity designated in the Contract Documents.

415-2 Materials.

Meet the following requirements:

Plastic Chairs and Bolsters*	Section 415
Couplers and Splice Devices*	Section 931
Metal Dowel Bar Assemblies*	Section 931
Steel Reinforcement	Section 931
Wire Reinforcement	Section 931
FRP Bar Reinforcement	Section 932

*Use products on the Department's Approved Products List (APL).

415-3 Protection of Material.

Store reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it from mechanical injury and surface deterioration. Ensure that the reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material prior to incorporation into the work. Protect FRP against UV exposure and extreme ambient storage temperatures as required by the FRP manufacturer. If the manufacturer does not provide any requirements, limit FRP sun exposure to 4 months and storage temperature to 120°F.

415-4 Bending, Splicing, and Cutting.

415-4.1 Steel Reinforcement: Fabricate reinforcing bars as prescribed in the CRSI Manual of Standard Practice. Shop bend the reinforcement cold to the shapes indicated in the Plans. Minor bending adjustments may be performed in the field as directed by the Engineer. Do not hot bend, hot straighten, weld, or thermal cut reinforcing steel.

415-4.2 Fiber Reinforced Polymer (FRP) Reinforcement: Do not field fabricate FRP reinforcing bars, except for tying and field cutting per ACI 440.5. Do not bend, straighten, couple, thermal cut, or shear cut FRP reinforcing bars.

415-5 Placing and Fastening.

415-5.1 General: Unless otherwise specified in the Contract Documents, the tolerance for bar spacing is plus or minus 1 inch from the plan position and the tolerance for concrete cover is minus 1/4 inch or plus 1/2 inch from the plan dimensions. Construct all tie patterns referenced by this Section in accordance with the CRSI Manual of Standard Practice.

415-5.2 Concrete Blocks for Spacing: Use precast concrete blocks to space and support the reinforcing bars. Use concrete blocks with a concrete class equal to or greater than the concrete in which they are to be placed and have wires cast into them for fastening to the reinforcing bars. When the concrete mix design requires highly reactive pozzolans or minimum surface resistivity, use blocks from concrete of the same mix design. Moist-cure the blocks for at least three days.

Submit a certification verifying the class of concrete used to fabricate the concrete blocks and identifying the batch and load of concrete from which the concrete blocks were cast.

415-5.3 Tying: Securely tie all reinforcement together without damage. Use ties of sufficient strength to maintain the reinforcement in its proper position. For stainless steel reinforcement, use stainless steel wire or non-metallic tying materials.

The tying materials should not damage the reinforcement during the construction.

415-5.4 Splices: Where splices are authorized, rigidly clamp the bars or tie them in a manner meeting the Engineer's approval. Use the lap splice length as shown on the Plans.

415-5.4.1 Steel Reinforcement: Use mechanical couplers or splice devices. Do not use welded splices for steel reinforcing except as specifically authorized by the Engineer and meeting the requirements of AWS D 1.4 Structural Welding Code - Reinforcing Steel.

415-5.4.2 Fiber Reinforced Polymer (FRP) Reinforcement: Do not use mechanical couplers for FRP reinforcing bars. Use lap splices only.

415-5.5 Footings:

415-5.5.1 Supports: Support footing mat reinforcing with approved bolsters or concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the reinforcing using the cast-in wires.

415-5.5.2 Tolerances: Place footing mat reinforcing bars within 1/2 inch vertically from the plan bottom clearance and within 1 inch from the plan side clearance.

415-5.5.3 Tying: Tie footing mat reinforcing bars with a double-strand single tie at all intersections on the periphery and at alternate intersections within the mat.

415-5.6 Dowel Bars for Columns and Walls:

415-5.6.1 Supports and Positioning: Position dowel bars projecting into columns and walls to allow splicing of the vertical bars to the dowels and to tie the dowel bars in their plan position. Support the dowel bars by a rigid template such that concrete placement does not disturb their position. Support the reinforcing bars prior to placement of the footing concrete and do not insert dowel bars into the plastic concrete.

415-5.6.2 Tolerances: Place the dowel bars within 1/2 inch of their plan position and with a side clearance tolerance not exceeding 1/4 inch.

415-5.7 Verticals and Hoops for Columns:

415-5.7.1 Spacing-off from Side Forms: Space column reinforcing bars from the side forms with concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the reinforcement using the cast-in wires.

415-5.7.2 Tolerances and Clearance:

1. Column Verticals: Place column verticals within 1/2 inch of their plan position. Ensure that the side form clearance is within 1/4 inch of the specified clearance.

2. Column Hoops: Place every hoop within 1 inch of the plan position for the specific hoop, with no accumulation of such tolerance caused by the spacing between any two hoops. Ensure that side form clearance for any hoop is within 1/2 inch of its specified clearance.

415-5.7.3 Tying: Tie column hoops to the column verticals at each intersection, by a cross tie or figure 8 tie.

415-5.8 Wall Reinforcement (Not Including Dowel Bars):

415-5.8.1 Supports: Space wall reinforcing bars from the side forms with concrete blocks having cube dimensions equal to the Plan concrete cover. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Fasten concrete blocks to the reinforcement using the cast-in wires. Fix the spacing between wall mats by means satisfactory to the Engineer.

415-5.8.2 Tolerance: Except when necessary to clear a fixture, place reinforcing bars within 1 inch of plan position. Ensure that the number of bars in any affected unit is as specified and place the remainder of the bars (not thus affected) within 1 inch of plan location.

415-5.8.3 Tying: Tie retaining wall reinforcing bars with a cross tie or figure 8 tie at each intersection on the periphery and at every third intersection within the mat. If workers use the reinforcing as a ladder, provide additional ties as directed by the Engineer.

Tie noise and perimeter wall reinforcing bars with a single tie at each intersection on the periphery and at every third intersection within the mat.

415-5.9 Pier and Bent Caps:

415-5.9.1 Supports: Support bottom reinforcing bars with approved bolsters or concrete blocks. Begin the spacing of bolsters or concrete blocks at not more than 2 feet from the end of the caps and space the additionally required bolsters at not more than 4 feet. Space side reinforcing from the side forms by concrete blocks. Stagger the location of blocks with an offset of 12 inches or greater and do not stack them. Use concrete blocks with cube dimensions equal to the Plan concrete cover, fastened to the reinforcing bars using the cast-in wires.

415-5.9.2 Tolerances: Place the main longitudinal reinforcing bars to provide a bottom and top clearance within 1/4 inch of the plan vertical dimensions for all layers. Space the bars from side forms within 1/2 inch of the specified spacing.

Place stirrups within 1 inch of the plan position for each individual stirrup and do not allow the tolerance to accumulate.

415-5.9.3 Tying: Tie all intersecting bars with a double-strand single tie.

415-5.10 Deck Slabs:

415-5.10.1 Supports:

1. Bottom Mats: Support the bottom mat of reinforcing bars using slab bolsters or concrete blocks. Use one row of slab bolsters placed 6 inches from the edge of the slab and two rows down each deck section between beams. Do not allow the spacing between rows to exceed 4 feet, measured center to center.

Use concrete blocks 2 inches by 2 inches by clearance dimensions. Space concrete blocks 4 feet on center as a maximum.

2. Top Mats: Support the top mats of reinforcing bars by either continuous or individual high chairs. Provide high chairs along both sides of each beam and approximately 6 inches back from the edge of the beam. Place the outside row of high chairs 6 inches from the edge of the slab. If using individual high chairs, do not allow the longitudinal spacing to be greater than 4 feet.

As an alternate to the above, on prestressed beam construction, the Contractor may support the top mat of reinforcing bars on the shear connectors bent to the proper elevation with one line of high chairs centered between the beams.

3. Truss Bars: Support truss bars at each end of the top bends by continuous high chairs or by individual high chairs spaced longitudinally at not more than 4 feet.

415-5.10.2 Tolerances: Ensure that top and bottom clearances are within 1/4 inch from those shown in the Plans.

Ensure that end and bottom clearances are within 1/4 inch from those shown in the Plans.

Ensure that end and edge clearances are within 1/4 inch of the clearance specified.

Place curb bars within 1/4 inch in any direction of the plan position.

415-5.10.3 Tying: Tie all reinforcing bars in each layer with a double-strand single tie at every intersection on the periphery and at every third intersection in the interior area. Alternatively, at the Contractor's option, tie all reinforcing bars in each layer with a single-strand single tie at every intersection on the periphery and at every other intersection within the interior area. Alternatively, at the Contractor's option, if annealed soft-iron wire with uncoated diameter equivalent or greater than 16 gauge (0.062 in.) is used, tie all reinforcing bars in each layer with a single-strand single tie at every intersection on the periphery and at every third intersection in the interior area. If encountering difficulty in maintaining the reinforcing bars in position during the placing of concrete, tie additional intersections as necessary to hold the reinforcing bars secure.

415-5.11 Box Culverts:

415-5.11.1 Supports:

1. Bottom Slabs: In the bottom slabs of box culverts, provide supports for single-mat reinforcing bars and for bottom-mat reinforcing bars, including placement and spacing, as specified for footing mat steel in 415-5.5. In addition, where the Plans call for more than one mat of reinforcing bars in the bottom slab of the culvert, support the top mat away from the bottom mat, either by upper beam bolsters or by other means satisfactory to the Engineer.

2. Walls: Place, space and support the reinforcing bars in walls of box culverts in accordance with the requirements of 415-5.8.

3. Top Slabs: In the top slabs of box culverts, support the bottom mats of reinforcing bars by a row of slab bolsters 12 inches from the inside face of the walls and with additional rows of bolsters at spacings not exceeding 4 feet, center to center. As an exception, unless the Engineer deems the use of the slab bolsters as necessary to obtain proper support, the Contractor may use concrete blocks as the supporting device. Use blocks of dimensions not greater than 2 inches by 2 inches by the required clearance, with spacings not exceeding 4 feet in any direction. Fasten blocks to the reinforcing bars by the cast-in wires.

4. Truss Bars: Support truss bars as specified in 415-5.10.

415-5.11.2 Tolerances: Use tolerances in placing the reinforcing bars in box culvert slabs as specified for deck slabs in 415-5.10. Use tolerances for placing bars in walls as specified in 415-5.8.

415-5.11.3 Tying: Tie reinforcing bars in box culverts as specified for deck slabs in 415-5.10.

415-5.12 Cleaning: Before placing any concrete, clean all mortar from the reinforcement.

415-5.13 Bar Supports:

415-5.13.1 General: Provide reinforcing bar supports manufactured in accordance with all requirements of the CRSI Manual of Standard Practice. Use bar supports of adequate strength to withstand a 300 pound concentrated load without permanent deformation or breakage, with deflection less than 5% of the support height.

Ensure that no more than 5% of the reinforcing bar supports exhibit unsatisfactory performance, breakage, or permanent deformation during bar tying and/or

concrete placement operations. If a bar support does not achieve this level of performance, reduce the average spacing between bar supports by 15%, or remove that product from use on the job.

Ensure that bar supports do not move during concrete placing operations. To prevent movement, tie supports to the reinforcing bars.

When using bar supports on corrugated metal stay-in-place forms, use supports specifically designed for the form being used.

For structural elements located in extremely aggressive environments, do not use metal bar supports in contact with removable forms or floor surfaces to support reinforcing bars.

415-5.13.2 Metal Bar Supports: For metal bar supports in contact with removable forms, provide supports constructed with molded plastic legs or plastic protected metal legs or bolster rails. Do not allow any portion of the bar support other than the molded plastic leg or plastic protected portion of the metal leg or bolster rail to be closer than 1/2 inch from the removable form surface for concrete to be cast.

Submit certification verifying that all metal bar supports meet the following requirements:

1. That they are manufactured from cold drawn steel wire in accordance with the wire sizes and geometrical dimensions shown in the CRSI Manual of Standard Practice, Chapter 3.
2. That the plastic used for protection of the steel legs or bolster rails has a thickness of 3/32 inch or greater at points of contact with the form work.

Provide plastic protection by a dipping operation, by adding pre-molded plastic tips to the legs of the support or by molding plastic to the top wire of the support. Ensure that the plastic material used for protection of steel legs does not chip, crack, deform, or peel during use.

Do not use metal bar supports to support FRP reinforcing bars.

415-5.13.3 Plastic Bar Supports and Spacers: Use plastic bar supports and spacers listed on the Department's APL. Manufacturers seeking evaluation of products for inclusion on the APL must submit an application in accordance with Section 6 and include a product photo, technical data sheet, and certified test reports from an independent laboratory showing that the plastic bar supports meet all the requirements specified herein.

Use non-stackable plastic bar supports and spacers. Bar supports shall be able to meet the concentrated load requirements of 415-5.13 within a working temperature range of 20 to 150°F. Spacers must be able to provide sufficient strength to support reinforcing bar in the required position without deformation and relaxation under job conditions. For drilled shafts, use wheel spacers with a smooth perimeter surface.

Submit protection from sunlight until placed in the form. and mold in a configuration which does not restrict concrete flow and consolidation.

All plastic bar supports and spacers shall have a maximum water absorption of 0.5% at 7 days as per ASTM D570. Plastic bar supports and spacers made of recycled plastic products must meet the additional requirements of Section 972.

415-6 Welded Deformed Steel Wire Reinforcement.

415-6.1 General: Provide welded deformed steel wire reinforcement as shown in the Plans or as a substitute for deformed bar reinforcement when approved on the shop drawings.

Propose substitutions of welded deformed steel wire reinforcement in a manner that provides a cross-sectional area per foot of welded deformed steel wire equal to that provided in the Plans for deformed bar reinforcement. Orient the deformed wires of welded deformed steel wire reinforcement in the same position as bar reinforcement detailed in the Plans. Cross wires of welded deformed steel wire reinforcement may be deformed or smooth and must have a cross-sectional area at least 35% greater than the area of the deformed wire.

415-6.2 Design: When welded deformed steel wire reinforcement is substituted for deformed bar reinforcement, ensure that the development length, splices, shear reinforcement, and distribution meet the requirements of the AASHTO LRFD Bridge Design Specifications.

415-7 Acceptance of Reinforcement.

415-7.1 Steel Reinforcement: Acceptance of reinforcing steel (all types), wire reinforcement, and welded wire reinforcement will be based on the manufacturer's certified mill test report, certifying that the test results meet the specification limits of the ASTM or AASHTO designation for the furnished product, including size, grade, and any additional Contract requirements. Certification must include compliance with AASHTO Product Evaluation & Audit Solutions work plan and the source of supply requirements specified in Section 6.

Submit the certified mill test report to the Engineer prior to use. The Department may sample and test reinforcing steel for independent verification.

415-7.2 Fiber Reinforced Polymer (FRP) Reinforcement: Acceptance of FRP reinforcing bars will be based on the producer currently on the Department's Production Facility Listing, samples taken by the Department, and manufacturer's certified mill test report.

Obtain FRP reinforcing bars from producers currently listed on the Department's Production Facility Listing. Submit the certified mill test report to obtain the Engineer's approval prior to use. The Engineer will select samples representing each LOT of FRP bar. Provide testing samples if the project includes more than 15,000-feet of straight, or 10,000-feet of bent, or 10,000-feet of spiral, or a combined length of more than 20,000-feet of FRP reinforcing bars. A sample is defined as five FRP bars, 7-foot in length for straight bars and 2-foot in length for bent or spiral bars.

415-8 Method of Measurement.

415-8.1 Reinforcing Steel: The quantity to be paid for will be the plan quantity, in pounds, of reinforcing steel, stainless reinforcing steel, low carbon chromium reinforcing steel, or stainless steel-clad bar incorporated into the completed work and accepted, subject to any changes approved by the Engineer. The quantity will not include the reinforcing steel (all types) in any item of work for which the basis of payment already includes the steel reinforcement. No additional payment will be made for substitutions of welded deformed wire reinforcement proposed by the Contractor. No separate payment will be made for reinforcing steel (all types) in pipe endwalls. No deduction will be made from reinforcing steel (all types) quantities for encroachment of inlets and pipes in box culverts. The lengths to be used in the calculation will be the detailed lengths of bars as shown in the Plans.

415-8.2 Unit Weights of Steel Bars: The unit weights used will be CRSI Standard Reinforcing Steel Bar Weights.

415-8.3 Welded Wire Reinforcement: Where welded wire reinforcement is to be paid for by weight, the quantity to be paid for will be the product of the area, in square feet, of the welded wire reinforcement incorporated into the completed work and accepted, multiplied by the manufacturer's standard weight per square foot.

When welded deformed steel wire reinforcement is substituted for deformed bar reinforcement, the quantity to be paid for will be the quantity which would be paid for if bar reinforcement as detailed in the Plans were utilized, based on plan quantity.

415-8.4 Fiber Reinforcing Polymer (FRP) Reinforcing: The quantity to be paid for will be the plan quantity, in linear feet, of bar incorporated into the completed work and accepted, subject to any changes approved by the Engineer. The quantity will not include the FRP bar in any item of work for which the basis of payment already includes the FRP bars. The lengths to be used in the calculation will be the detailed lengths of bars as shown in the Plans.

415-9 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including all welding, all clips, spacers, ties, mechanical couplers, etc., and wire or other material used for fastening the reinforcement in place.

If spliced bars are used when full length bars might reasonably be required, the quantity paid for will be only that which would be obtained if full length bars were used, with no allowance for lap.

Payment will be made under:

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| Item No. 415- 1- | Reinforcing Steel - per pound. |
| Item No. 415- 2- | Stainless Reinforcing Steel - per pound. |
| Item No. 415- 3- | Low Carbon Chromium Reinforcing Steel - per pound. |
| Item No. 415- X- | Stainless-Clad Reinforcing Steel - per pound. |
| Item No. 415- 10- | Fiber Reinforced Polymer Reinforcing Bar - per linear foot. |