Florida Department of Transportation

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SECRETARY

June 23, 2015

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Re: State Specifications Office
Section **415**
Proposed Specification: **4150000 Reinforcing Steel**

Dear Mr. Nguyen:

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

The changes are proposed by Dan Hurtado of the State Construction Office to address tying reinforcing for noise walls and perimeter walls. Rewritten for clarity and style.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.scheer@dot.state.fl.us.

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

Sincerely,

Signature on file

Daniel Scheer, P.E.
State Specifications Engineer

DS/ot
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

REINFORCING STEEL.
(REV ~~5-15~~*19*6-*22*-15)

SECTION 415 is deleted and the following substituted:

SECTION 415
REINFORCING STEEL

415-1 Description.

Furnish and place ~~in concrete masonry~~ reinforcing steel of the quality, type, size, and quantity designated.

415-2 Materials.

Meet the following requirements:

Bar Reinforcement 931-1.1
Welded Wire Reinforcement 931-1.2

415-3 Protection of Material.

Store steel reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it ~~as far as practicable~~ from mechanical injury and surface deterioration. ~~caused by exposure to conditions producing rust. When placing steel reinforcement in the work, e~~ *E*nsure that the steel reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material *prior to incorporation into the work*.

415-4 Bending, Splicing, and Cutting.

Fabricate reinforcing bars as prescribed in the CRSI Manual of Standard Practice. *Shop* ~~B~~*b*end the reinforcement cold to the shapes indicated in the Plans. ~~Perform bending in the shop before shipment, and~~ *Do* not *bend the reinforcement to shape* in the field ~~unless shown otherwise in the Contract Documents~~. *Minor bending adjustments may be performed in the field with the approval of the Engineer.*

Do not hot bend or straighten, weld, or thermal cut reinforcing steel ~~unless otherwise specified in the Contract Documents~~.

415-5 Placing and Fastening.

415-5.1 General: ~~When tolerances for reinforcing placement and concrete cover are not~~ *Unless* otherwise specified *in the Contract Documents*, the tolerance for bar spacing is plus or minus 1 inch ~~of~~*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 steel. Use concrete blocks with a strength equal to or greater than the concrete in which they are to be placed and have wires cast into them for fastening to the steel. Moist-cure the blocks for at least three days.

Provide a *certification*~~letter~~ ~~stating~~ *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 Wire for Tying: ~~For tying~~*Tie* reinforcing steel~~,~~ us*ing*~~e~~ ~~soft~~ pliable wire~~,~~ that readily bends and twists without breaking and that provides a tie of sufficient strength to hold the reinforcing steel in its proper position.

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 splice length as shown on the Plans.~~ The Contractor may submit additional splices the Specialty Engineer recommends for approval prior to use.~~

Do not use welded splices except as specifically authorized by the Engineer *and* ~~and, when authorized,~~ meet*ing* the requirements of AWS D 1.4 Structural Welding Code - Reinforcing Steel.

Use mechanical couplers or splice devices which develop at least 125% of the specified yield strength of the bar being spliced and are listed on the Departments Approved Product List (APL).

415-5.5 Footings:

415-5.5.1 Supports: ~~In general, s~~*S*upport ~~the~~ footing mat steel with concrete blocks having dimensions not greater than 4 by 4 inches by Plan clearance. Fasten concrete blocks to the steel using the cast-in wires.~~ The Engineer may approve other proposed means of support.~~

415-5.5.2 Tolerances: Place footing mat steel 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 steel 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 ~~column bars or~~ vertical ~~wall~~ bars to the dowels and to tie the dowel bars in their Plan position. Support the dowel bars by a rigid template ~~constructed across the top of the footing, and attach them to the template in~~ such ~~manner~~ that ~~placing the~~ concrete *placement* does not disturb their position. ~~Set the s~~*S*upport~~s~~ *the reinforcing* prior to *placement*~~the pouring~~ of the *footing* concrete~~ in the footings,~~ and do not *insert*~~push~~ dowel bars into the *plastic*~~wet~~ concrete~~ after placing the footing concrete~~.

415-5.6.2 Tolerances: Place the dowels 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~~ off~~ column steel from the side forms by concrete blocks of dimensions not exceeding 2 inches by 2 inches by clearance dimension. Securely fasten each block to the reinforcing.

415-5.7.2 Tolerances and Clearance:

~~(a)~~*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.

~~(b)~~*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 Steel (Not Including Dowel Bars):

415-5.8.1 Supports: Space~~ off~~ wall steel from the side forms by concrete blocks of dimensions not greater than 2 inches by 2 inches by clearance dimensions. Fix the spacing between wall mats by means satisfactory to the Engineer.

415-5.8.2 Tolerance: Except whe*n*~~re it is~~ necessary ~~in order~~ to clear a fixture, place ~~each~~ bar*s* within 1 inch of ~~its specified~~*Plan* position. ~~In any case, e~~*E*nsure that the number of bars in any affected unit is as specified, and place the remainder of the bars (not thus affected) within ~~the specified~~ 1 inch *of Plan location*~~tolerance~~.

415-5.8.3 Tying: Tie *retaining* wall steel with a cross tie or figure 8 tie *at each intersection on the periphery and at every third intersection within the mat*. ~~On the periphery, tie the steel at each intersection. Within the mat, tie the steel at every third intersection, except that where the wall is of such size that it is necessary that~~*If* workmen use the reinforcing as a ladder, ~~the Engineer may require~~ *provide additional ties* ~~tying at every other intersection, or at every intersection,~~ as ~~he deems necessary~~*directed by the Engineer*.

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

415-5.9 Beams and Caps:

415-5.9.1 Supports: Maintain bottom clearances by approved heavy beam bolsters. Support additional layers of main longitudinal steel from the lower layers by heavy upper-beam bolsters, placed directly over low supports.

Begin the spacing of beam bolsters at not more than 2 feet from the end of the beams or caps and space the additionally required bolsters at not more than 4 feet.

Use concrete blocks, having dimensions not greater than 2 inches by 2 inches by specified clearance, fastened to the steel by the cast-in wires, for spacing the upper main longitudinal steel below the top bars. Maintain the side clearance by concrete blocks, having dimensions not greater than 2 inches by~~–~~ 2 inches by required clearance, fastened to the reinforcing steel by the cast-in wires.

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

~~Space and tie the~~ *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:

~~(a)~~*1.* Bottom Mats: ~~In general, s~~*S*upport the bottom mat~~s~~ of *reinforcing* steel *using slab bolsters or concrete blocks. Use*~~by~~ one row of slab bolsters placed 6 inches from the edge of the slab and ~~by~~ two rows down each *deck section*~~panel~~ between beams. ~~Bottom mat slab bolsters may not have rails in contact with removable forms, except when the environmental classification is slightly aggressive and the requirements of 415-5.13.2 are satisfied. Molded plastic rails may not be in contact with removable forms. Do not use metal chairs and bolsters on stay-in-place forms when the form bottom elevation is 12 feet or less above mean high water and the environmental classification is extremely aggressive.~~ Do not allow the spacing between rows to exceed 4 feet, measured center to center.

~~As an exception, when deemed satisfactory by the Engineer, the Contractor may use concrete blocks in lieu of slab bolsters.~~ Use *concrete* blocks 2 inches by 2 inches by clearance dimensions. Space concrete blocks 4 feet on center as a

maximum. ~~If at any time, however, the Engineer judges that the concrete blocks do not provide the proper support, he may require using slab bolsters.~~

~~(b)~~*2.* Top Mats: Support the top mats of steel by either continuous ~~high chairs~~ or individual high chairs. ~~Support~~ *Provide* ~~continuous~~ 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, ~~space them transversely, as specified for the continuous high chair, and~~ do not allow the longitudinal spacing to be greater than 4 feet.

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

~~(c)~~*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 steel in each layer with a double-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 steel in position during the placing of concrete, tie additional intersections as necessary to hold the reinforcing steel secure.

415-5.11 Box Culverts:

415-5.11.1 Supports:

~~(a)~~*1.* Bottom Slabs: In the bottom slabs of box culverts, provide supports for single-mat steel and for bottom-mat steel, 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 steel 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.

~~(b)~~*2.* Walls: Place, space and support the steel in walls of box culverts in accordance with the requirements of 415-5.8.

~~(c)~~*3.* Top Slabs: In the top slabs of box culverts, support the bottom mats of steel 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 by the cast-in wires.

~~(d)~~*4.* Truss Bars: Support truss bars as specified in 415-5.10.1(~~c~~*3*).

415-5.11.2 Tolerances: Use tolerances in placing the steel in box culvert slabs as specified for deck slabs in 415-5.10.2. Use tolerances for placing steel in walls as specified in 415-5.8.2.

415-5.11.3 Tying: Tie steel in box culverts as specified for deck slabs in 415-5.10.3.

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 steel 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 ~~the deformation~~*deflection* ~~being~~ less than 5% of the support height.

Ensure that no more than 5% of the reinforcing steel bar supports exhibit unsatisfactory performance, breakage, or permanent deformation during rebar 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 steel.

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 steel.

415-5.13.2 Metal Bar Supports: For metal bar supports in contact with removable forms ~~for concrete to be cast~~, 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.

Provide certification verifying ~~Certify~~ 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, Table II.

~~(~~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 premolded 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 ~~under ordinary job conditions~~*during use*. ~~Provide molded plastic legs that have sufficient strength to carry the weight of the supported reinforcing steel in its required position without deformation and relaxation under job conditions.~~

415-5.13.3 Plastic Bar Supports and Spacers: Use non-stackable *plastic* bar supports and spacers ~~comprised of either reinforced or non-reinforced virgin or recycled plastic~~. Bar supports shall be able to meet the concentrated load requirements of 415-5.13.1 within a working temperature range of 20 to 150°F. Spacers shall be able to provide sufficient strength to support reinforcing steel in the required position without deformation and relaxation under job conditions. For drilled shafts, use wheel spacers with a smooth perimeter surface.

Provide protection from sunlight until placed in the form and mold in a configuration which does not restrict concrete flow and consolidation. ~~Do not use bolster rails in direct contact with *vertical* concrete surfaces.~~

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.

Provide ~~to~~ the Engineer *with* 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* ~~The Contractor may~~ *as a* substitute ~~welded deformed steel wire reinforcement~~ 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. ~~The Contractor may use smooth or deformed c~~*C*ross wires of welded deformed steel wire reinforcement *may be deformed or smooth and must have a cross-sectional area*~~. Use a cross wire size that is a minimum of~~ *at least* 35% ~~or more~~ *greater* ~~of~~*than* the area of the deformed wire.

~~Provide welded steel wire reinforcement as shown in the Plans.~~

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 Method of Measurement.

415-7.1 General: The quantity to be paid for will be the *plan quantity*~~computed weight~~, in pounds, of reinforcing steel ~~entering~~ *incorporated* into the completed ~~structure or item of~~ work and accepted*, subject to any changes approved by the Engineer*. The quantity will not include the reinforcing steel in any item of work for which the basis of payment 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 in pipe endwalls. No deduction will be made from reinforcing steel 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.~~ The quantity to be paid for will be the original plan quantity, determined as provided above.~~

415-7.2 Unit Weights of Bars: The unit weights used will be CRSI Standard Reinforcing Steel Bar Weights.

415-7.3 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 ~~actually~~ incorporated in*to* the *completed* ~~structure~~ *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 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.

I*f*~~n case~~ *spliced*~~short~~ bars are ~~permitted for~~ use*d* when full length bars might reasonably be required, the weight 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.

REINFORCING STEEL.
(REV 6-22-15)

SECTION 415 is deleted and the following substituted:

SECTION 415
REINFORCING STEEL

415-1 Description.
Furnish and place reinforcing steel of the quality, type, size, and quantity designated.

415-2 Materials.
Meet the following requirements:
Bar Reinforcement 931-1.1
Welded Wire Reinforcement 931-1.2

415-3 Protection of Material.
Store steel 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 steel reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material prior to incorporation into the work.

415-4 Bending, Splicing, and Cutting.
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 Engineer.
Do not hot bend or straighten, weld, or thermal cut reinforcing steel.

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 steel. Use concrete blocks with a strength equal to or greater than the concrete in which they are to be placed and have wires cast into them for fastening to the steel. Moist-cure the blocks for at least three days.
Provide 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 Wire for Tying: Tie reinforcing steel using pliable wire that readily bends and twists without breaking and that provides a tie of sufficient strength to hold the reinforcing steel in its proper position.
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 splice length as shown on the Plans.

Do not use welded splices 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 which develop at least 125% of the specified yield strength of the bar being spliced and are listed on the Departments Approved Product List (APL).

415-5.5 Footings:

415-5.5.1 Supports: Support footing mat steel with concrete blocks having dimensions not greater than 4 by 4 inches by Plan clearance. Fasten concrete blocks to the steel using the cast-in wires.

415-5.5.2 Tolerances: Place footing mat steel 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 steel 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 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 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 steel from the side forms by concrete blocks of dimensions not exceeding 2 inches by 2 inches by clearance dimension. Securely fasten each block to the reinforcing.

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 Steel (Not Including Dowel Bars):

415-5.8.1 Supports: Space wall steel from the side forms by concrete blocks of dimensions not greater than 2 inches by 2 inches by clearance dimensions. 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 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 steel with a cross tie or figure 8 tie at each intersection on the periphery and at every third intersection within the mat. If workmen use the reinforcing as a ladder, provide additional ties as directed by the Engineer.

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

415-5.9 Beams and Caps:

415-5.9.1 Supports: Maintain bottom clearances by approved heavy beam bolsters. Support additional layers of main longitudinal steel from the lower layers by heavy upper-beam bolsters, placed directly over low supports.

Begin the spacing of beam bolsters at not more than 2 feet from the end of the beams or caps and space the additionally required bolsters at not more than 4 feet.

Use concrete blocks, having dimensions not greater than 2 inches by 2 inches by specified clearance, fastened to the steel by the cast-in wires, for spacing the upper main longitudinal steel below the top bars. Maintain the side clearance by concrete blocks, having dimensions not greater than 2 inches by 2 inches by required clearance, fastened to the reinforcing steel by the cast-in wires.

415-5.9.2 Tolerances: Place the main longitudinal steel so as to provide a bottom and top clearance within 1/4 inch of the Plan vertical dimensions for all layers. Space the steel 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 steel 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 steel 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 prestress beam construction, the Contractor may support the top mat of steel 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 steel in each layer with a double-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 steel in position during the placing of concrete, tie additional intersections as necessary to hold the reinforcing steel 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 steel and for bottom-mat steel, 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 steel 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 steel 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 steel 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 by the cast-in wires.

4. Truss Bars: Support truss bars as specified in 415-5.10.1(3).

415-5.11.2 Tolerances: Use tolerances in placing the steel in box culvert slabs as specified for deck slabs in 415-5.10.2. Use tolerances for placing steel in walls as specified in 415-5.8.2.

415-5.11.3 Tying: Tie steel in box culverts as specified for deck slabs in 415-5.10.3.

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 steel 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 steel bar supports exhibit unsatisfactory performance, breakage, or permanent deformation during rebar 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 steel.

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 steel.

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.

Provide 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, Table II.

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 premolded 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.

415-5.13.3 Plastic Bar Supports and Spacers: Use non-stackable plastic bar supports and spacers. Bar supports shall be able to meet the concentrated load requirements of 415-5.13.1 within a working temperature range of 20 to 150°F. Spacers shall be able to provide sufficient strength to support reinforcing steel in the required position without deformation and relaxation under job conditions. For drilled shafts, use wheel spacers with a smooth perimeter surface.

Provide 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.

Provide the Engineer with 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 Method of Measurement.

415-7.1 General: The quantity to be paid for will be the plan quantity, in pounds, of reinforcing steel incorporated into the completed work and accepted, subject to any changes

approved by the Engineer. The quantity will not include the reinforcing steel in any item of work for which the basis of payment 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 in pipe endwalls. No deduction will be made from reinforcing steel 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.

415-7.2 Unit Weights of Bars: The unit weights used will be CRSI Standard Reinforcing Steel Bar Weights.

415-7.3 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 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 weight 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.