

502.32	Structural Concrete Culvert End wall	Cubic Meter [Cubic Yard]
502.33	Structural Concrete Culvert End wall	Lump Sum
502.40	Structural Concrete Box Culvert	Cubic Meter [Cubic Yard]
502.41	Structural Concrete Superstructure Slab	Cubic Meter [Cubic Yard]
502.42	Structural Concrete Roadway and Sidewalk Slab on Steel Bridges	Cubic Meter [Cubic Yard]
502.43	Structural Concrete Superstructure T-beam Type	Cubic Meter [Cubic Yard]
502.44	Structural Concrete Wearing Surface on Bridges	Cubic Meter [Cubic Yard]
502.45	Structural Concrete Approach Slab	Cubic Meter [Cubic Yard]
502.46	Structural Concrete Culvert Connection	Cubic Meter [Cubic Yard]
502.48	Low Permeability Concrete Structural Concrete	Cubic Meter [Cubic Yard]
502.49	Curbs and Sidewalks Concrete Fill	Lump Sum Cubic Meter
502.56		[Cubic Yard]

SECTION 503 - REINFORCING STEEL

503.01 Description This work shall consist of furnishing and placing reinforcement, either plain or epoxy-coated, in accordance with these specifications and in conformance with the Plans, Supplemental Specifications and Special Provisions.

503.02 Materials Materials shall meet the requirements of the following Sections of Division 700 - Materials:

Reinforcing Steel	709.01
Welded Steel Wire Fabric	709.02

503.03 Schedule of Material When the Department does not furnish reinforcing steel schedules, the Contractor shall submit order lists, bending diagrams and bar layout drawings to the Resident for approval. The reinforcing steel shall not be ordered until these lists and drawings are approved. Approval shall not relieve the Contractor of full responsibility for the satisfactory completion of this item. When the Department allows the use of precast concrete deck panels, or any other significant changes that effect the quantity of reinforcing steel, the Contractor shall be responsible for revising the reinforcing steel schedule; the revised schedule shall be submitted to the Resident for approval.

503.04 Protection of Material Reinforcement, either plain or epoxy-coated, shall be stored on skids or other supports a minimum of 300 mm [12 in] above the ground surface and protected at all times from damage and surface contamination. The storage supports shall be constructed of wood, or other material that will not damage the surface of the reinforcement or epoxy coating. Bundles of bars shall be stored on supports in a single layer. Each bundle shall be placed on the supports out of contact with adjacent bundles.

If it is expected that epoxy-coated bars will be required to be stored outdoors for a period in excess of three months, then they shall be protected from ultraviolet radiation.

503.05 Fabrication Bending of reinforcing bars and tolerances for bending of reinforcing bars shall be in conformance with the latest edition of the "Manual of Standard Practice of the Concrete Reinforcing Steel Institute" and the "Detailing Manual of the American Concrete Institute". Unless otherwise specifically authorized, bars shall be bent cold.

503.051 Epoxy Coating Reinforcing steel, specified on the design drawings to be epoxy coated, shall meet the requirements of AASHTO M284/M284M (ASTM A775/A775M), Epoxy-Coated Reinforcing Steel Bars, and the following requirements:

- a. The Contractor shall furnish a written certification that at the point of application of the coating and at the reinforcing bar shop the coating, the coated bars, and the handling and packaging of the coated bars, meet all the requirements specified in Section 5.2.1 and Section 15.1 of AASHTO M284/M284M (ASTM A775/A775M), and Section 503.053 of these specifications.
- b. Patching material as specified in Section 5.4 of AASHTO M284/M284M (ASTM A775/A775M), shall be supplied for both shop and field patching of the coated reinforcing steel. The patching material shall be supplied as required, but at not less than the following rates:

#10 to #16 [#3 to #5] bars: 1 L/4800 m [1 qt/15000 ft] of bar, or fraction thereof

#19 to #29 [#6 to #9] bars: 1 L/2550 m [1 qt/8000 ft] of bar, or fraction thereof

#32 [#10] and up: 1 L/1900 m [1 qt/6000 ft] of bar, or fraction thereof

- c. All testing shall be as specified in AASHTO M284/M284M (ASTM A775/A775M), except that the frequency of testing for adhesion of the coating shall be two bars of each size out of all bars coated with each individual batch or lot of

epoxy resin, or two bars of each size out of all bars coated in an eight hour period, whichever is greater.

d. If a reinforcing bar fabrication shop uses previously stockpiled bars to supply the requirements of this contract, the fabrication shop shall furnish copies of all certificates required to be furnished by the coating applicator under a., above. The certificates furnished shall be directly traceable to the actual bars used through batch numbers, order numbers or similar information. If such certification is not available, the Department reserves the right to perform the tests specified under AASHTO M284/M284M (ASTM A775/A775M), at the expense of the fabrication shop. For bars supplied from stock, the fabrication shop shall supply all patching material specified under b., above.

e. The Contractor shall notify the Resident at least 1 week prior to the start of the coating application, so that the Resident or their designated representative may be present at the beginning of the application of the epoxy coating.

503.052 Patching of Epoxy Coating Patching required at the point of application of the epoxy coating shall be done in conformance with the requirements of AASHTO M284/M284M (ASTM A775/A775M).

At the reinforcing steel fabrication shop and at the job site, all nicks, cuts, scratches, cracks, abrasions, sheared ends etc., visible to the naked eye, shall be repaired using patching material supplied as specified under Section 503.051 b. To the greatest extent possible, repairs to each day's production at the fabrication shop and each day's placement at the job site shall be done before the end of each working day. If damaged areas do become rusted or contaminated with foreign matter, then these areas shall be cleaned by sandblasting, or an equally effective method, such that all visible rust and/or foreign matter is removed prior to patching.

503.053 Packaging and Handling of Epoxy-Coated Bars All handling of epoxy-coated reinforcing bars by mechanical means shall be done by equipment having padded contact areas, or by the use of nylon webbing slings. The use of chains or wire rope slings shall not be allowed, even when used with padding. All bundles of coated bars shall be lifted with a strong back, spreader bar, multiple supports or a platform bridge to prevent bar-to-bar abrasion from sags in the bundles. Support points during lifting or transporting of bundled epoxy-coated bars shall be spaced at a maximum of 4.5 m [15 ft].

Bundled bars shall be strapped together with non-metallic or padded straps in a manner to prevent bar-to-bar abrasion due to relative movement between bars.

Bars loaded for transport shall be loaded and strapped down in a manner that will prevent damage from motion and

vibration, to the greatest extent possible. Bundles of bent bars shall be transported strapped to wooden platforms or shall be crated. All individual bundles and layers of bundles shall be separated, and supported by dunnage.

Individual bars shall be handled in a manner that prevents damage to the coating due to abrasion or impact, and at no time shall any bar be moved by dragging over any surface, including other reinforcing bars. Sufficient personnel shall be assigned to assure that there is complied with the above.

503.06 Placing and Fastening All steel reinforcement shall be accurately placed in the positions shown on the plans and shall be firmly held there during the placing and setting of the concrete. Immediately before placing concrete, steel reinforcement shall be free from all foreign material, which could decrease the bond between the steel and concrete. Such foreign material shall include, but not be limited to, dirt, loose mill scale, excessive rust, paint, oil, bitumen and dried concrete mortar.

Bars shall be fastened together at all intersections except where spacing is less than 300 mm [1 ft] in either direction, in which case, fastening at alternate intersections of each bar with other bars will be permitted providing this will hold all the bars securely in position. This fastening may be tightly twisted wire or by tack welding when permitted by the Resident. All tack welding shall be done in accordance with Section 504, Structural Steel. No tack welding for fastening or supporting reinforcing steel in areas of high tensile stresses will be permitted. Welding on epoxy-coated reinforcing steel will not be permitted under any condition.

In general, no welding will be permitted on the main reinforcing steel of superstructure slabs.

Proper distances from the forms shall be maintained by means of stays, blocks, ties, hangers or other approved means. Blocks used for this purpose shall be precast portland cement mortar blocks of approved shape and dimensions. Chairs may be used for this purpose and, when used, must be plastic, plastic coated, epoxy coated or plastic tipped. Layers of bars may be separated by precast portland cement mortar blocks or other approved devices. The use of pebbles, pieces of broken stone or brick, metal pipe or wooden blocks shall not be permitted. The placing of reinforcement as concrete placement progresses, without definite and secure means of holding the steel in its correct position, shall not be permitted except in the case of welded steel wire fabric or bar mats.

Epoxy-coated reinforcing bars supported on formwork shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable materials. Wire bar supports shall be coated with dielectric material for a minimum

distance of 50 mm [2 in] from the point of contact with the reinforcing bars. Reinforcing bars used as support bars shall be epoxy-coated. In walls, spreader bars shall be epoxy-coated.

Tie wire for epoxy-coated reinforcing steel shall be soft annealed wire that has been nylon, epoxy or plastic coated.

Field bending or cutting of epoxy-coated reinforcing bars will not be allowed, unless otherwise indicated on the plans or permitted by the Resident. When field bending or cutting is allowed, all damaged coating areas shall be repaired in accordance with the patching requirements.

Bars in bridge seats shall be placed so as to clear anchor bolts.

When specified on the contract plans, reinforcing steel shall be anchored into drilled holes.

The anchoring material shall be one of the products listed on the Maine Department of Transportation's list of Prequalified Type 3 Anchoring Materials. Installation shall be in accordance with the manufacturer's published recommendations.

At each anchor location, existing reinforcing will be located to avoid drilling through existing bars. Where interferences are found to exist, location adjustments will be determined by the Resident.

Minimum embedment lengths of reinforcing bars shall comply with the manufacturer's published recommendations for the anchoring material selected. These embedment lengths shall be verified by the Resident before installation of the reinforcing bars. The reinforcing steel lengths indicated on the Plans may be reduced, at the Contractor's option, to the determined minimum embedment lengths.

Reinforcement shall be inspected and approved by the Resident before any concrete is placed.

503.07 Splicing Reinforcing bars shall be spliced in accordance with the requirements of this section, and in the locations shown on the plans. No modifications of, or additions to, the splice arrangements shown on the plans shall be made without the Resident's prior approval. Any additional splices authorized shall be staggered as much as possible. All splices shall be made in a manner that will ensure that not less than 75% of the clear concrete cover and not less than 75% of the minimum clear distance to other bars will be maintained, as compared to the cover and clear distance requirements for the unspliced bar.

Lapped splices shall be made by placing the bars in contact and wiring them together. Splice laps shall be made in accordance with the following table, unless otherwise noted on the plans:

METRIC UNITS

Minimum Lap Splice Length (millimeters) ¹									
Bar Type	Bar Size								
	#10	#13	#16	#19	#22	#25	#29	#32	#36
Plain	350	450	550	650	825	1075	1350	1725	2100
Epoxy Coated	530	675	825	975	1250	1625	2025	2600	3150

US CUSTOMARY UNITS

Minimum Lap Splice Length (inches) ¹									
Bar Type	Bar Size								
	#3	#4	#5	#6	#7	#8	#9	#10	#11
Plain	14	18	22	26	33	43	54	68	83
Epoxy Coated	21	27	33	39	50	64	80	103	124

¹ Lap Splice lengths are based on the following parameters: Minimum center-to-center spacing between bars of 150 mm [6 in]; nominal yield strength of the reinforcing steel of 420 MPa [60 ksi]; minimum 28-day compressive strength of concrete of 30 MPa [4350 psi]. When any of the preceding parameters is altered, appropriate minimum lap splice lengths will be determined by the Resident. When lap splices are placed horizontally in an element where the concrete depth below the splice will be 300 mm [12 in], or more, the indicated lap splice lengths shall be multiplied by a factor of 1.4.

Mechanical couplers may be used for splicing reinforcing bars, provided they are approved by the Resident and conform to the following requirements:

a. Tension Couplers Couplers shall be able to develop 1.25 times the theoretical yield strength of the spliced bar in tension. Bolted and wedge-lock type couplers will not be allowed.

b. Compression Couplers Couplers shall be capable of maintaining the spliced bars in alignment prior to and during

concrete placement. For reinforcing bars designed to act in compression, the individual bar ends shall be within $1\frac{1}{2}^\circ$ of being "square" to the final 300 mm [12 in] of the bar. Additionally, abutting bar ends shall be in contact, and the angle of the gap between abutting bar ends shall be 3° , or less.

c. Mechanical Couplers Any mechanical couplers using a threaded splicer and dowel in combination, requiring a lapped splice with the reinforcing bars, shall have a minimum lap splice length as required by this Section.

Welded splices may be made by the "Thermit" process or, with the approval of the Resident, by the shielded metal arc welding process or the self-shielded flux-core arc welding process. The latter two processes shall be used in strict conformance with the requirements of the latest edition of AWS D1.4 "Structural Welding Code - Welding Reinforcing Steel" and any applicable provisions of Section 504, Structural Steel. The Contractor shall submit complete details of their proposed method of making welded splices for the Resident's approval.

503.08 Lapping Sections of welded steel wire fabric shall securely fasten to adjoining sections and overlap. All laps shall be in accordance with Wire Reinforcement Institute Manual of Standard Practice.

Bar mats shall be spliced as required for the individual bars.

503.09 Substitution Substitution of different size bars shall not be permitted except with the written authorization of the Resident.

503.10 Method of Measurement Reinforcing steel, both plain and epoxy-coated, shall be measured by the computed number of kilograms [pounds] of steel reinforcement authorized. Welded steel wire fabric shall be measured by the computed number of kilograms [pounds] of fabric authorized. Splices made using mechanical devices or by welding, as shown on the plans or required by the specifications, will be measured as the number of splices of each kind satisfactorily made and accepted.

Weights will be computed in accordance with the following:

For bars, both plain and epoxy-coated, weights will be computed in accordance with the following table:

METRIC UNITS

Kilograms per Meter									
Bar Size	#10	#13	#16	#19	#22	#25	#29	#32	#36
Weight	0.560	0.994	1.552	2.235	3.042	3.973	5.060	6.404	7.907

US CUSTOMARY UNITS

Pounds per Foot									
Bar Size	#3	#4	#5	#6	#7	#8	#9	#10	#11
Weight	0.376	0.668	1.043	1.502	2.044	2.67	3.4	4.303	5.313

For welded steel wire fabric, weights will be computed in accordance with the following table:

METRIC UNITS

Size in mm	152 by 152	76 by 152	102 by 102	152 by 152
Gauge	W1.4 by W1.4	W1.4 by W1.4	W1.4 by W1.4	W2.9 by W2.9
Weight (Kg/m ²)	1.02	1.46	1.51	2.05

US CUSTOMARY UNITS

Size in inches	6 by 6	3 by 6	4 by 4	6 by 6
Gauge	W1.4 by W1.4	W1.4 by W1.4	W1.4 by W1.4	W2.9 by W2.9
Weight (lbs/100 ft ²)	21	30	31	42

For other sizes of fabric, the commercially recognized weights will be used.

No addition to, or deduction from, the theoretical weight per meter [foot] of the uncoated bars will be made because of additional requirements for blast cleaning and epoxy coating of the bars.

Lapped splices and splices made using mechanical devices or by welding, that are authorized at the Contractor's request, will not be measured for payment.

503.11 Basis of Payment The accepted quantity of reinforcing steel will be paid for at the contract unit price per kilogram

[pound] for each item involved, completed, and accepted.

The accepted quantity of epoxy-coated reinforcing steel will be paid for at the contract unit price per kilogram [pound] for each item involved, completed and accepted, and all additional expenses that may be incurred by the Contractor or their suppliers as a result of the requirements in these specifications will be considered incidental to, and included in, the contract unit price per kilogram [pound].

Payment for work associated with revisions to the reinforcing steel schedule, required when the Department allows the use of precast concrete deck panels, or any other significant changes that effect the quantity of reinforcing steel, shall be considered incidental to related contract items.

The accepted quantity of welded steel wire fabric will be paid for at the contract unit price per kilogram [pound], in place, completed and accepted.

The accepted quantity of mechanical and/or welded splices will be paid for at the contract unit price each, completed and accepted, for each type specified.

Payment will not be made for any materials used to hold reinforcement in place or for extra weight due to substitutions and splices made for the Contractor's convenience.

When reinforcing steel is specified to be anchored into drilled holes, no additional payment will be made for drilling and anchoring reinforcing steel or cutting of reinforcing steel to embedment lengths.

Payment for additional material samples, as required for testing by the Department, shall be considered incidental to related contract items.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
503.12 Reinforcing Steel, Fabricated and Delivered	Kilogram [Pound]
503.13 Reinforcing Steel, Placing	Kilogram [Pound]

503.14	Epoxy-Coated Reinforcing Steel, Fabricated and Delivered	Kilogram [Pound]
503.15	Epoxy-Coated Reinforcing Steel, Placing	Kilogram [Pound]
503.16	Welded Steel Wire Fabric, Complete in place	Kilogram [Pound]
503.17	Mechanical/Welded Splice	Each

SECTION 504 - STRUCTURAL STEEL

504.01 Description This work shall consist of detailing, fabricating and erecting structural steel bridges, ancillary bridge products and other steel structures.

504.02 Materials Materials shall meet the requirements of the following Sections of Division 700-Materials:

Structural Steel	713.01
Heavy-Hex Structural Bolts, Washers, Nuts and DTI's	713.02
Pre-formed Pads	713.03
Bronze or Copper-Alloy Bearing and Expansion Plates	713.04
Cold-Finished Carbon Steel Shafting	713.05
Castings	713.06

Note: The Department maintains a list of pre approved welding consumables that may be used without furnishing Certificates of Conformance from the electrode/consumable manufacturer.

504.03 Drawings The Contractor shall prepare shop detail, erection and other necessary working drawings in accordance with Section 105.7 - Working Drawings. Weld and nondestructive examination symbols shall be shown on the shop drawings. Welding Procedure Specifications (WPSs) shall be considered part of the shop drawing submittal. The drawings will be reviewed and approved in accordance with the applicable requirements of Section 105.7 and the AASHTO/NSBA Shop Detail Drawing Review/Approval Guidelines, G1.1.

504.04 Facility Requirements Steel shall be fabricated in a facility holding a current AISC or MDOT shop certification as follows: