500 STRUCTURES

ITEM 509 - REINFORCING STEEL

509.01 Description. This item shall consist of furnishing and placing in concrete, reinforcing steel of the quality, type, size and quantity designated, including steel dowels.

509.02 Materials. Reinforcing steel shall be deformed bars conforming to Sections 709.01, 709.03, or 709.05. Spiral reinforcement shall conform to Section 709.01 or 709.08. Bar mats and wire fabric shall conform to Sections 709.09, 709.10 and 709.12. Epoxy coated reinforcing steel shall conform to Section 709.00.

The bar size number is specified on the plans in the bar mark column. The first digit where three digits are used, and the first two digits where four are used, indicates the bar size number. For example, P601 or P0601 indicates a Number 6 bar.

Sufficient additional reinforcing steel shall be provided for sampling. Random samples shall be replaced in the structures with additional steel, spliced in accordance with Section 509.08.

509.03 Care of Materials. All reinforcing steel when received on the worksite, prior to its use shall be stacked off the ground and shall be kept free from dirt, oil, grease, or avoidable rust. When placed in the concrete, it shall be clean and free from loose rust.

509.04 Method of Placing Material. Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete. Bars in the superstructure shall be tied at all intersections except where spacing is less than 1 foot (0.3 m) in each direction, in which case alternate intersections shall be tied. At the Contractor's option, a portion not to exceed 25 percent of the upper longitudinal bars in a

bridge deck may be placed beneath the upper transverse bars for support of the top mat. In no case shall reinforcing steel be driven or forced into the concrete after it has taken its initial set.

Welding on reinforcing is prohibited except as permitted by Sections 709.10 and 709.12. Fabrication of reinforcing bar cages for prestressed beams is permitted when done in a manner satisfactory to the Engineer.

The clearance between the reinforcing steel and the surface of the concrete shall not be less than:

(a) 2 1/2 inches (64 mm) at the top surfaces of sidewalks.

(b) 3 inches (76 mm) at the face of footings placed against rock or earth rather than forms.

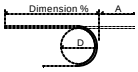
(c) 1 inch (25 mm) at the bottom surface of a cast-in-place deck slab.

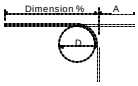
(d) 2 inches (51 mm) all other surfaces.

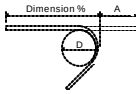
The clearance between the reinforcing steel and the top surfaces of cast-in-place concrete deck slabs shall be 2 1/4 to 2 1/2 inches (57 to 64 mm).

509.05 Bending. Reinforcing steel shall be carefully shaped to the pertinent dimensions shown on the plans and in the Standard Bends table. Reinforcing steel showing transverse cracks shall not be used.

STANDARD BENDS



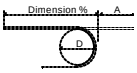


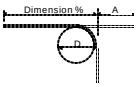


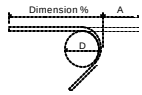
Bar Size	Nominal Dimensions: Diameter in	Area in^2	Weight lb/ft	180E Bend: D in	180E Bend: A in	90E Bend: D in	90E Bend: A in	135E Bend: D in	135E Bend: A in
3	0.375	0.11	0.376	2 1/4	5	2 1/4	5	1 1/2	4
4	0.500	0.20	0.668	3	6	3	7	2	4 1/2
5	0.625	0.31	1.043	3 3/4	7	3 3/4	8 1/2	2 1/2	5 1/2
6	0.750	0.44	1.502	$4^1/_2$	8	4 1/2	10		
7	0.875	0.60	2.044	5 1/4	10	5 1/4	12		
8	1.000	0.79	2.670	6	11	6	$13^1/_2$		
9	1.128	1.00	3.400	9 1/2	15	9 1/2	15 1/2		
10	1.270	1.27	4.303	10 3/4	17	10 3/4	18		
11	1.410	1.56	5.313	12	19	12	20		
14	1.693	2.25	7.65	18 1/4	27	18 1/4	25		
18	2.257	4.00	13.60	24	36	24	33		

Tolerances: For diameter of bends, "D", the tolerance may be plus or minus the diameter of the bar. Standard fabricating tolerances shall be in accordance with the *CRSI Manual of Standard Practice*. No weight allowances will be made for tolerances.

STANDARD BENDS







Bar Size	Nominal Dimensions: Diameter mm	Area mm^2	Weight kg/m	180E Bend: D mm	180E Bend: A mm	90E Bend: D mm	90E Bend: A mm	135E Bend: D mm	135E Bend: A mm
#10M	9.5	71	0.560	60	130	60	130	40	105
#13M	12.7	129	0.994	75	155	75	180	50	115
#16M	15.9	199	1.552	95	180	95	215	65	140
#19M	19.1	284	2.235	115	205	115	255		
#22M	22.2	387	3.042	135	255	135	305		
#25M	25.4	510	3.973	150	280	150	345		
#29M	28.7	645	5.060	240	380	240	395		
#32M	32.3	819	6.404	275	430	275	455		
#36M	35.8	1006	7.907	305	485	305	510		
#43M	43.0	1452	11.38	465	685	465	635		

Tolerances: For diameter of bends, "D", the tolerance may be plus or minus the diameter of the bar. Standard fabricating tolerances shall be in accordance with the *CRSI Manual of Standard Practice*. No weight allowances will be made for tolerances.

509.06 Shop Assembled Units. The use of unit frames or shop assembled reinforcement where practicable, is recommended.

509.07 Approval of Placing. Reinforcing steel shall be in place and approved by the Engineer before any concrete is placed.

509.08 Splicing. Splices of reinforcement shall be made only as specified or determined by the Engineer.

Spiral reinforcement shall be spliced by lapping 1 1/2 turns. A material sample of spirals up to 30 inches (0.8 m) long, if taken from an end of the spiral need not be replaced.

Number 14 and 18 bars shall be spliced with approved mechanical connectors.

Mechanical connectors shall be capable of developing 125 percent of the yield strength of the bars connected.

Bars used to replace random samples shall be lapped as follows:

LAP LENGTH

BAR SIZE	UNCOATED	EPOXY COATED
4	1'-10" (559 mm)	2'-3" (686 mm)
5	2'-4" (711 mm)	2'-9" (838 mm)
6	2'-9" (838 mm)	3'-4" (1016 mm)
7	3'-2" (915 mm)	3'-9" (1143 mm)
8	3'-8" (1117mm)	4'-5" (1346 mm)
9	4'-7" (1397 mm)	5'-7" (1702 mm)
10	5'-10" (1778 mm)	7'-2" (2184 mm)
11	7'-3" (2210 mm)	8'-9" (2667 mm)

509.09 Supports. Precast mortar blocks or metal supports, of adequate strength, of the proper depth and in sufficient number shall be used for supporting the bars in slabs, beams or girders. The supports for reinforcing steel shall not be spaced more than 4 feet (1.2 m) transversely or longitudinally. Where metal supports are used, the portion at or near the surface of the concrete shall be stainless steel, galvanized steel, or epoxy coated or plastic coated steel and shall be of such shape that they will be easily enveloped by the concrete.

If mortar blocks are used they shall be made from the same materials and of the same proportions of sand and cement as that of the concrete in which they are to be used. They shall

be cast and properly cured for at least seven days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to the reinforcing steel.

509.10 Epoxy Coated Reinforcing Steel. Plastic coated or epoxy coated bar supports and tie wires shall be employed to protect the coating form physical damage during placement and to prevent electrical coupling between mats.

Bars shall be carefully handled and installed so that patching at the job site will be kept to a minimum. Damage as defined by 709.00 shall be repaired in accordance with that item.

Where repair is required, the damaged areas shall be cleaned, repaired, and adequate cure time allowed before placing concrete. The installation shall be considered approved when patching has been done as outlined above.

509.11 Method of Measurement. The number of pounds of reinforcing steel shall be the actual number of pounds (kilograms) of the various sizes incorporated in the concrete as shown on the plans, completed and accepted. The number of pounds (kilograms) shall be determined from the number, length and weight of the bars as shown on the steel list of the plans, based on the weight per linear foot (meter) shown in the table, with deductions for bars not used and additions for extra bars used as directed by the Engineer. Supports, mechanical connectors, and tie wires shall not be included in the calculated weights but shall be incidental in the price bid.

509.12 Basis of Payment. Payment shall be made at the contract price for:

Item	Unit	Description
509	Pound (Kilogram)	Reinforcing Steel
509	Pound (Kilogram)	Epoxy Coated Reinforcing Steel