

SECTION 5
REINFORCING STEEL, STRUCTURAL STEEL AND MISCELLANEOUS METAL

- 5.01 Scope: The work covered by this Section of Specifications consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all reinforcing steel, structural steel, miscellaneous metal and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this contract.
- 5.02 Drawings: The Contractor shall furnish to the Engineer for review bending and placing details for steel bar reinforcing which shall show bar size, spacing, bending and tagging identification and drawings covering structural steel work showing details of fabrication and erection of structural steel in accordance with the General Requirements of these Specifications. No manufacturer or fabrication shall commence until such drawings have been reviewed. The Contractor shall submit to the Engineer for review the detailed location of construction joints not shown on the Drawings but required for the execution of the work prior to the detailing of any reinforcing steel.
- 5.03 Reinforcing Steel: Bar reinforcement and wire mesh reinforcement shall be furnished by domestic steel mills and shall conform to the applicable ASTM specifications and ACI Building Code, as amended to date, and in accordance with the following:
- A. Bar Reinforcement: Materials, fabrication and placement of steel bar reinforcement shall be in accordance with the following:
1. Materials: Bar reinforcement shall be deformed bars and conform to the requirements of ASTM A- 615 Grade 60. The steel for bars shall be made by the open hearth, basic oxygen or electric furnace process, and the bars shall be rolled from billets or ingots of properly identified heats. The steel shall be made and the bars rolled in the United States. The use of cold twisted bars will not be permitted.
 2. Fabrication: Steel bar reinforcement shall be cold bent to shapes indicated on the Drawings. Bending shall be done in the shop before shipment unless otherwise specified. Bending details for steel bar reinforcement shall conform to the requirements of the ACI Building Code (ACI-318) unless otherwise indicated on the Drawings or specified. Steel bar reinforcement shall be bent, bundled and tagged in accordance with details furnished by the fabricator.
 - a. Splices: Steel bar reinforcement shall be furnished full length unless otherwise indicated on the Drawings. Splices, where permitted, shall be well distributed or located at points of low tensile stress. Splices and dowels, except when used in cantilever wall or slab construction, shall lap not be less than 30 times the diameter of the bar. Splices and dowels used in cantilever wall or slab construction shall lap 40 diameters. Splices in horizontal reinforcement shall be staggered. The minimum clear distance between spliced bars, except when bar clamps are specified, shall

be 1½ bar diameters. In no case shall the minimum clear distance between spliced bars be less than 1" or less than 1½ times the maximum size of coarse aggregate.

- 1) Design is based upon "non-contact" type vertical splices lapped and specified above as required under the applicable sections of the ACI code. Tied "contact" lapped splices will be allowed for ease in establishing the basic framework for the vertical rebar mats. However, no more than 20% of the required vertical lap splices may be "contact" type splices. All other lap splices shall conform to the minimum and maximum clear distance requirements as specified above and in the applicable sections of the ACI code.
 - b. Hooks: Hooks of 180° shall have a radius of bend on the axis of the bar of not less than 3 bar diameters plus an extension of 4 bar diameters at the free end. Hooks of 90° shall have a radius of bend on the axis of the bar of not less than 4 bar diameters plus an extension of 12 bar diameters at the free end.
 - c. Openings: Openings 12" and larger through concrete walls and slabs shall have a minimum of 8 extra diagonal bars in each face of the wall or slab of the same size as the largest bar in the wall or slab. The length of extra diagonal bars at openings shall be as shown on the Drawings or diameter of opening plus 24 bar diameters each end of bar.
 - d. Minimum Reinforcing: Minor concrete walls, slabs and other Class "A" concrete sections, where no reinforcement is shown on the Drawings, shall have a minimum area of steel bar reinforcing equal to 0.0025 times the cross-sectional area of the concrete work.
3. Placing: Steel bar reinforcement shall be placed in the locations shown on the Drawings and held securely in place during the placing of concrete. The pushing of short bars into new concrete work will not be permitted. Bar reinforcing in walls shall be spaced the proper distance from the face of the wall by the use of approved precast concrete mortar blocks. Precast mortar blocks used for bar reinforcement spacing shall have a minimum compressive strength equal to the concrete being placed. Bar reinforcing in slabs or beams shall be spaced the proper distance from the bottom of the slab or beams by use of precast concrete mortar blocks, steel chairs with plastic coated legs or plastic tips, or stainless steel chairs. Vertical stirrups shall always pass around main tension members and be securely attached thereto. Bar spacing, covering, minimum clearance, bond and anchorage shall conform to the requirements of the ACI Building Code (ACI-318), except as otherwise indicated on the Drawings or specified.
4. Fastening, Reinforcing and Placing Concrete: Steel bar reinforcing, when properly placed, shall be securely wired together at intersections with 18

gauge black annealed wire. Prior to the placing of concrete, all mortar and other foreign matter which may reduce or destroy bond shall be removed from the reinforcement. No concrete shall be deposited until the placement of the reinforcing has been reviewed by the Engineer or his representative.

B. Wire Mesh Reinforcement: Wire mesh reinforcement, when shown on the Drawings or specified to be required in the work to be done, shall be furnished and placed in accordance with the following:

1. Materials: Wire mesh reinforcement shall conform to the requirements of ASTM A-185 and unless otherwise indicated in the Drawings shall be 4" by 4" mesh of 6-gauge wire.
2. Placement: Wire mesh reinforcement shall be secured in position by spacer bars and chairs. Spacer bars shall be lapped not less than 5". Precast concrete mortar blocks may be used in lieu of metal chairs in slabs on ground. Mesh shall be checked for position during placing of concrete and any displacement corrected. Mesh shall overlap 1" at edges unless otherwise indicated on the Drawings and shall be securely tied at ends and overlap.

C. Reinforcement – Storage and Protection: Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports, and shall be protected as far as is practicable from mechanical injury and surface deterioration. When placed in the work, it shall be free from rust, dirt, scale, paint, oil or other foreign matter which may reduce or destroy bond.

5.04 Iron Castings: The Contractor shall furnish all miscellaneous iron castings, including catch basins, manhole frames and covers, steps, floor drains, bolt inserts, brackets, supports and such other iron castings as are shown on the Drawing in accordance with the applicable ASTM Specifications, as amended to date. All materials furnished shall be installed in a good workmanlike manner.

- A. Castings: Castings, unless otherwise specified, shall be of gray-iron conforming to ASTM A-48. Manhole and step castings shall be the Owner's standard unless otherwise specified.
- B. Malleable Castings: Malleable castings shall conform to ASTM A-47.
- C. Quality: All castings shall be tough, close-grained and smooth and free from blow holes, blisters, shrinkage stains, cracks, cold shots and like defects. No plugging of defective castings will be permitted.
- D. Workmanship: All castings shall be made accurately to dimensions shown on the Drawings or ordered and shall be planned or ground where necessary whether marked or not to secure perfectly flat bearing surfaces. Allowance shall be in the patterns, so the specified thickness of metal will not be reduced.
- E. Weights: No castings, the weight of which is less than the theoretical weight based on required dimensions by more than 5%, will be accepted.

- F. Cleaning and Painting: All castings shall be thoroughly cleaned and painted before rusting begins. All castings except those to be embedded in concrete shall be cleaned and given a priming coat of paint in the shop. Castings, which will be exposed in buildings, shall be painted in accordance with the painting section of these Specifications. Castings which are to be installed outdoors, such as manhole frames, covers and steps, shall be given one coat of an asphaltic or bituminous paint which results in a smooth and tough well-bonded coating.
- 5.05 Nosings for Concrete Treads: Nosings of all concrete steps, interior and exterior, shall be 3" in width and shall be Wooster Type 101 Alumogrit or American Abrasive Metal Company Style A or equal abrasive safety treads, securely anchored to concrete.
- 5.06 Stainless Steel: Unless otherwise specified, all fabricated work indicated on the Drawings and/or specified to be stainless steel shall be Type 316, in accordance with ASTM A-276 as amended to date.
- 5.07 Bolts, Nuts and Screws: Steel bolts and nuts for jointing miscellaneous steel shall conform to ASTM A-325 or A-490 and shall be American National Standard dimensions. Anchor bolts, in general, shall be placed in forms prior to placing concrete. When expansion bolts must be used, they shall be Rawl, National, or equal. Anchor bolts and expansion bolts shall be Type 302, 304, or 316 stainless steel. Steel and aluminum weir plates, aluminum railing, miscellaneous aluminum, galvanized steel and stainless steel jointing shall be fastened with Type 302 or 304 stainless steel bolts, nuts, and screws as required.
- 5.08 Aluminum: Aluminum shall be of the following alloys:
- Sheet or plate: 6061-T6
 - Structural or rolled shapes: 6061-T6
 - Extruded shapes: 6061-T6
 - Tubing or pipe: 6061-T6 or 6063-T6
 - Nuts and bolts: 2024-T4 with #205 aluminum finish
- A. Aluminum Grating and Treads: All grating, except otherwise shown, shall be equal to Borden Aluminum Plank "Standard," or Liskey extruded aluminum grating, "Duro-Grip," with rectangular punch. The grating shall be of the depth shown and shall be of aluminum alloy 6061-T6 or 6063-T6. Weld end plates to all bearing bars and band all cutouts. Exposed welds and welding beads on the exposed top surface of the grating and/or end plates and bands will not be acceptable. Samples, which represent the finished product, shall be submitted to the Engineer for review in accordance with the General Requirements section of these Specifications. Seat angles in concrete shall be ¼" thick aluminum angles of a size which will properly accommodate the depth of the grating bars. Stair treads shown as being of aluminum shall be of the same aluminum alloys as the grating. The types shall be as shown or approved equivalent. Field paint all aluminum surfaces which will be in contact with concrete or carbon steel with suitable asphaltic paint.

- B. Aluminum Pipe Railing: All rails and posts shall be fabricated size 1½" Schedule 40 aluminum pipe of 6061-T6 or 6063-T6 alloy. Railing may be shop fabricated with continuous welded joints and mill finish or may be assembled from approved factory fabricated one-piece extrusion machined fittings and pipe with 305 stainless steel blind rivets and self-tapping screws all with 7 mil anodized finish. Welding shall be by inert gas shielded arc method with all welds ground smooth.
- C. Aluminum Gates and Frames: Aluminum gates and frames shall be built of structural or extruded shapes as shown on the Drawings and shall be given an anodizing finish.
- 5.09 Welding/Inspection and Testing: Welders working on job shall meet the following qualifications.
- A. Experience of Welders and Welding Operators: Shop and field welders and welding operators shall be qualified by an independent laboratory using test procedures covered in AWS D1.1 and shall have been employed as a welder / welding operator using the positions for which they are qualified during the previous 90 days. The Contractor shall provide the Engineer and laboratory inspector with the (a) names of welders and/or welding operators to be employed in the shop and field, (b) certification of the position, (c) date of the last qualification test and (d) the name of the qualifying laboratory.
1. All welders employed in the field on the erection of the steel work shall be qualified for the most difficult welding position during field erection.
 2. The Contractor shall require any welder to retake the test, when in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Recertification of the welder shall be made to the Engineer only after the welder had taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.
 3. All section of welds found defective shall be chipped or cut out to base metal and rewelded before proceeding with the work.
 4. Costs of all qualifications, tests and retests shall be borne by the Contractor.
- B. Joint Qualification: All joints shall comply with AWS D1.1.
- C. Inspection and Testing: Inspection and testing shall be as follows:
1. Inspections and Tests: Inspection and tests shall be performed by an independent laboratory complying with ASTM E-329. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.
 2. Shop Inspections: Shop inspections and tests shall include fit-up, preparation of surfaces and welding.
 3. Field Inspections: Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.

4. Reports: Reports of shop and field inspections and testing shall be made by the laboratory on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Inspector, Contractor, Fabricator and Erector.

5.10 Structural Steel:

A. Shop Drawings and Erection Procedures:

1. The Contractor shall prepare and submit shop and erection plans covering all structural steel and related items in accordance with the General Requirements section of these Specifications. All dimensions for checking of structural steel details shall be shown on the drawings.
2. The Contractor shall be responsible for the confirmation of all steel details to the typical and special details shown on the drawings and for all details, notes and schedules appearing on the drawings. The Contractor shall be responsible for giving information for the fabrication and erection of the structural steel. Related items shall be shown on the erection or shop drawings. Drawings shall include all shop and erection details including cuts, copes, connections, hole, bolts and welds. For bolted, the type, size and length of bolts including washers shall be shown. All welds, both shop and field, shall be indicated by standard welding symbols as noted by AWS D1.1. Drawings shall show the size, length and type of each weld.
3. The Contractor shall prepare and submit two copies of a detailed erection procedure with the shop and erection drawings. The procedure shall include the sequence of erection with temporary staying and bracing. No copies of such procedure will be returned.

B. Applicable Specifications and Codes: The following specifications and codes form a part of this section of these Specifications:

1. American Institute of Steel Construction Publications, Manual of Steel Construction, Eighth Edition
 - a. *Code of Standard Practice for Steel Buildings and Bridges*
 - b. *Specification for the design, Fabrication and Erection of Structural Steel for Buildings with commentary*
2. American Society for Testing and Materials: As amended to date.
 - a. *A 36, Specifications for Structural Steel*
 - b. *A 572, Specifications for High-Strength Low Alloy Columbium-Vanadium Steels for Structural Quality*
 - c. *A 325, Specifications for High-Strength Steel Bolts for Structural Steel Joints. Including Suitable Nuts and Bolts and Washers*
 - d. *A 490, Specifications for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints*

- e. *E 329, Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction*
3. American Welding Society, AWS: Shall be D1.1 as amended to date, Structural Welding Code
 4. Specifications for Structural Joints: Using ASTM A 325 or A 490 bolts
 5. Fabrication and Erection of Structural Steel for Buildings: Unless otherwise indicated on the drawings or in the Specifications for the design, the publication, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction, hereafter designated AISC, shall govern structural steel work. Welding shall be in accordance with American Welding Society Standard Code D1.1.
- C. Substitutions of Sections: Substitutions of sections and / or modifications of details and the reasons for such substitutions or modifications shall be submitted with the shop drawings for approval. Approved substitutions, modifications, and/or changes in related portions of the work shall be coordinated by the Contractor and shall be accomplished at no additional cost to the Owner.
- D. Responsibility for Errors: The Contractor shall be responsible for all errors of detailing, fabrication and for the correct fitting of the structural members. The Contractor shall make all measurements in the field to verify or supplement dimensions shown on the Drawings and shall assume responsibility for fitting new work to existing work.
- E. Templates: Templates with instructions for the setting of anchors, anchor bolts and bearing plates shall be furnished by the Fabricator to the job. The Contractor shall ascertain that the items are set during the progress of the work.
- F. Qualifications:
1. Experience of Fabricator: Fabrication shop and erector shall have fabricated and erected projects of similar size and complexity for at least ten years.
 2. Experience of Welders and Welding Operators: Welders and welding operators, shop and field, shall be qualified by an independent laboratory using test procedures covered in AWS D1.1, and shall have been employed as a welder / welding operator using the positions for which they are qualified during the previous 90 days. The Contractor shall provide the Engineer and laboratory inspector with the (a) names of welders and/or welding operators to be employed in the shop and field, (b) certification of the position, (c) date of the last qualification test and (d) the name of the qualifying laboratory.
 - a. All welders employed in the shop on the fabrication of the steel work shall be qualified for the most difficult welding position during shop fabrication.

- b. All welders employed in the field on the erection of the steel work shall be qualified for the most difficult welding position during field erection.
- c. The Contractor shall require any welder to retake the test, when in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Recertification of the welder shall be made to the Engineer only after the welder had taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.
- d. Should any 2 radiographic or ultrasonic tests or coupons cut from the work of any welder show strengths or undertests less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be removed from the work.
- e. When coupons are removed from any part of a structure:
 - 1) The members cut shall be repaired at no additional cost to the Owner in a neat and workmanlike manner.
 - 2) Joints will be of a type to develop the full strength of the members.
- f. Joints will be cut with peening to relieve residual stress.
- g. All sections of welds found defective shall be chipped or cut out to base metal and re-welded before proceeding with the work.
- h. Costs of all qualifications, tests and retests shall be borne by the Contractor.

3. Joint Qualification: All joints shall comply with AWS D1.1.

G. Inspection and Testing:

- 1. Inspections and Tests: Inspections and tests shall be performed by an independent laboratory complying with ASTM E-329. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.
- 2. Shop Inspection: Shop inspections and tests shall include fit-up, preparation of surfaces and welding.
- 3. Field Inspections: Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.
- 4. Reports of Inspections: Reports of shop and field inspections and testing shall be made by the laboratory on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Resident Engineer, Inspector, Contractor, Fabricator and Erector.

- H. Materials: Materials shall be of domestic manufacture, within trade tolerances, new, undamaged and without splices. Structural material, plain or fabricated, shall be stored above the ground upon platforms, skids or supports. Materials shall be kept free of dirt, grease and foreign matter and shall be protected from corrosion.
1. Structural Steel:
 - a. Structural steel shall comply with ASTM A-36 unless indicated otherwise on the Drawings.
 - b. The Contractor shall furnish two copies of all mill reports covering the chemical and physical properties of the steel used.
 2. Bolts, Nuts and Washers:
 - a. All bolts, nuts and washers shall comply with ASTM A-325 or A-490.
 - b. ASTM A-325 and A-490 bolts shall be used for connections as indicated on the Drawings.
 3. Welding Electrodes and Flux:
 - a. Electrodes and flux used for submerged arc welding shall be of the same manufacture. The flux shall be free of the contamination of dirt, mill scale and foreign material. Fused flux used in welding shall not be reused. Bare electrodes and flux used in combination shall conform to the requirements of AWS D1.1.
 - b. Electrodes for manual shielded metal-arc welding shall conform to AWS D1.1.
 4. Grout: Non-shrink grout beneath base and bearing plates shall be Embecco by the Master Builders Company, Five Star Grout by U.S. Grout Corp., or equal.
- I. Welding Equipment: Welding equipment shall be capable of providing the welding required by the Drawings and/or Specifications and in compliance with the requirements of joint qualification in AWS D1.1.
- J. Fabrication:
1. Structural Material: Structural material shall be fabricated and assembled in the shop. Assembled pieces shall be taken apart for the removal of burrs, and shavings produced by the reaming operation. Parts not connected in the shop shall be secured by bolts to prevent damage in shipment and handling.
 2. Connections: Connections shall be as shown on the Drawings. Connections not indicated shall be made to conform with the AISC Specification. One-sided or other types of eccentric connections will not be permitted. Surfaces of joints for welded and bolted connections shall be clean bright metal. Fit up of the parts shall be inspected and approved by the laboratory inspector prior to making final connection.

- a. Holes shall be cut, drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling or reaming operation shall be removed. Holes for bolts shall be $\frac{1}{16}$ " larger than the diameter of the bolt except as noted on the drawing.
 - b. Welded connections will be permitted only where indicated on the Drawings. Welded construction shall conform to the AISC and AWS Specifications.
 - c. Bolted connections using ASTM A-325 or A-490 bolts shall conform to the Specifications for Structural Joints using ASTM A-325 or A-490 bolts. Indicator washers shall be used to show that bolts are properly tightened. Both threads shall be excluded from the shear planes of the contact surfaces between the connected parts. Load indicator washers shall be Cornet Load Indicator by Cooper + Turner, Inc. or equal.
3. Milled Surfaces: Milled surfaces shall comply to the AISC Specification and the Drawings.
 4. Allowance: Allowance shall be made for draw in all tension bracing.

K. Erection:

1. Splices: Splices and field connections shall be made as shown or noted on the Drawings. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the assembly and fitting of parts shall be reported immediately to the Engineer for directions as to the method of correction. Corrections shall be made at no additional cost to the Owner.
2. Leveling Plates: Leveling plates shall not be used under base plates.
3. Anchor Bolts: Anchor bolts and anchors shall be located and built into connecting work. Bolts and anchors shall be preset by the use of templates to locate the anchors and anchor bolts.
4. Column Bases: Column bases and bearing plates may be attached or loose as approved on the shop drawings. Plates shall be supported and aligned on steel wedges or shim. After the supported members have been plumbed and positioned and the anchor nuts tightened, the entire bearing area under the plate shall be dry-packed solidly with non-shrink grout. Wedges and shims shall be cut off flush with the edge of the column base and bearing plates, and shall be left in place.
5. After Assembly: After assembly, the various members forming parts of a completed frame or structure shall be aligned and adjusted before being fastened. Tolerance shall conform to AISC. Fastening of splices of compression members shall be done after the abutting surfaces have been

brought completely into contact. Bearing surfaces and surfaces that will be in permanent contact shall be cleaned before the members are assembled. As erection progresses, the work shall be fastened to take care of all dead load, wind and erection stresses. Splices will be permitted only where indicated on the Drawings. Erection bolts used in welded construction shall be tightened and left in place. Welding for redrilling will not be permitted.

6. Driftpins: Driftpins may be used only to bring together the several parts and shall not be used in such manner as to distort or damage the metal.
7. Gas Cutting Torch: The use of a gas cutting torch in the field for correcting fabrication errors is prohibited unless the Engineer has specifically approved such procedure for each case individually in writing.

L. Painting:

1. Cleaning: All steel work shall be cleaned of loose mill scale, loose rust, accessible weld slag or flux deposit, dirt and foreign matter. Oil and grease deposits shall be removed by solvent. No paint shall be applied when steel temperature is below the dew point of the atmosphere.
2. After Cleaning: After cleaning and connections are approved by the laboratory inspector, all steel work except surfaces to be fireproofed, or surfaces to be welded shall be given a shop coat of primer. The primer shall be applied at a rate to provide a minimum dry film of 2.0 mils. The primer shall be applied without holidays or paint runs.
3. After Erection: After erection all field connections shall be cleaned. All connections, including welds and bolts, and all abraded surfaces on the shop primer shall be painted to give one complete coat of primer. Paint for field touch-up shall be the same paint used for the shop coat.

5.11 Payment: No separate payment will be made for the work of this Section. The cost of the work, and all costs incidental thereto, shall be included in the amount bid in the Proposal for every item to which the work pertains.

