

DIVISION 5

METALS



SECTION 05500**MISCELLANEOUS METALS AND FASTENERS****PART 1 - GENERAL****1.01 WORK INCLUDED**

Provide all labor, materials, equipment and services necessary for fabrication and erection of structural steel and aluminum and for fabrication and installation of miscellaneous non-ferrous metals as shown on the Drawings and not specifically included under other sections of these Specifications.

1.02 RELATED WORK

- A. Section 05120 - Structural Steel.
- B. Section 09900 - Field Painting.

1.03 REFERENCES

All work under this section shall be governed by:

- A. Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings - American Institute of Steel Construction, 1978, including addenda.
- B. Aluminum Construction Manual, Section 1, Specifications for Aluminum Structures The Aluminum Association 1982.
- C. All welding shall conform to the latest code of the American Welding Society.
- D. ASTM A-276.
- E. ASTM A-325.
- F. ASTM F-593, 594.
- G. Federal Specification FF-S-325.
- H. ASTM A-48.
- I. Federal Specification TT-V-51F.
- J. ANSI B94.12.
- K. ASTM A-123, A-153, A-384, A-385, A-563 and A-780.
- L. SSPC SP-1, SP-2, SP-3, SP-7.

1.04 SUBMITTALS

A. Shop drawings, giving complete information necessary for fabrication, layout and installation of metal work shall be submitted to the Engineer for review prior to fabrication.

B. Preparation of shop drawings for fabricated metal items shall be coordinated by the Contractor with the manufacturers of various equipment in order to comply with details, locations, openings, and arrangements required by the manufacturers.

C. Field measurements shall be made to verify all dimensions in the field which may affect installation of work before shop drawings are made and/or fabrication is performed.

PART 2 - PRODUCTS

2.01 STEEL

A. Structural steel shall conform to the requirements of ASTM A-36. Structural tubing, where used, shall conform to the requirements of ASTM A-500, Grade B, and the ends of the tubing shall be properly sealed to protect the internal surfaces. Steel anchor bolts shall be ASTM A-36 hot-rolled threaded rod or bar stock

B. Structural steel members as required shall conform to Section 05120 "Structural Steel".

C. Base and bearing plates shall be provided where necessary to provide maximum bearing value of not more than 200 psi on solid concrete masonry units nor more than 750 psi on concrete, and shall be grouted in place.

2.02 STAINLESS STEEL

Stainless steel shapes shall be AISI Type 304 or 316 in accordance with ASTM A-276. Miscellaneous bar stock products such as pipe straps shall be 400 Series stainless steel. Anchor bolts, nuts and washers shall be AISI Series 300 stainless steel.

2.03 ALUMINUM

All structural and miscellaneous aluminum shall be Alloy 6061 (Alloy 6063 for extrusions), Temper T6, unless otherwise noted, indicated or accepted by the Engineer. Where welding is necessary in fabrication, it shall be done in conformance with Section 7 "Welded Construction" of Specifications for Aluminum Structures, referenced hereinbefore.

2.04 FASTENERS

A. Bolts, Nuts and Washers:

1. Structural bolts shall be high strength ASTM A-325, Type 1, galvanized and galvanized ASTM A-325 hardened flat washers and galvanized ASTM A-325 hex nuts. Galvanized bolts, nuts and washers shall be centrifugally spun after galvanizing. Nuts shall have threads tapped oversize after galvanizing. All stainless steel bolts, nuts and washers shall be AISI Type 300 Series stainless steel in accordance with ASTM F-593, with ASTM F-594 nuts. All bolts shall have hexagonal heads.

2. Anchors and Bolts, including nuts and washers, shall be provided where necessary for securing the work in place. Sizes, types and spacings of anchors and bolts not indicated or specified otherwise shall be as necessary for their purposes. Anchor bolts and anchors for the erection of structural steel shall be galvanized. Anchored bolts, nuts, and washers for all other uses including, but not limited to, underwater use and for the installation of equipment, piping, pumps and motors shall be stainless steel type 304.

B. Expansion Anchors: All expansion anchors shall be stainless steel wedge type meeting the requirements of Fed. Spec. FF-S-325, Group II, Type 4, Class 1, and shall be Phillips Red Head, Hilti, or equal. The entire anchor (bolt, expansion clip, nut and washer) shall be AISI Type 300 Series stainless steel.

2.05 CASTINGS

All miscellaneous iron castings shall be of best quality materials, free from flaws and unsightly defects. Gray cast iron shall be ASTM A-48 Class 35 (35,000 psi tensile strength). Furnish and install in the locations indicated casting of the type and size shown on the Drawings.

2.06 CARPENTER'S IRON WORK

Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

Provide miscellaneous steel framing and supports as required to complete the work. Fabricate miscellaneous units to the sizes, shapes, and profiles shown, or if not shown, of the required dimensions to receive adjacent grating, plates, louvers, vents, grilles, screens or other work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the work.

2.08 MISCELLANEOUS STEEL TRIM

Provide shapes and sizes as required for the profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

PART 3 - EXECUTION

3.01 ANCHORAGE ITEMS

The Contractor shall furnish all bolts, nuts, shims, pins, screws, straps, nails and other anchors which may be required by the Drawings or job conditions to secure all items permanently in place, whether or not specifically called for or shown on the Drawings.

3.02 FABRICATION AND INSTALLATION OF METAL WORK

15029/7.19.2016
FASTENERS

MISCELLANEOUS METALS AND

A. General: All metal items shall be accurately fabricated and erected with exposed joints close fitting. All joints shall be of such character and so assembled that they will be as strong and rigid as adjoining sections. Joints shall be located where least conspicuous. Items shall have smooth finished surfaces except where otherwise shown or specified.

B. Built-In Items: Members or parts to be built in with masonry or concrete shall be in a form affording a suitable anchorage or shall be provided with approved anchors, expansion shields or other approved means of securing members.

C. Dissimilar Metals: Ferrous and non-ferrous metals shall be insulated at all contacts with felt washers, strips or sheets, bitumastic paints, or other acceptable means. All aluminum surfaces in contact with concrete shall be coated with two (2) coats of Fed. Spec. TT-V-51F Asphalt Varnish or equal.

D. Connections:

1. All required anchors, couplings, bolts, and nuts required to support miscellaneous metal work shall be furnished and installed as required.
2. Weights of connections and accessories shall be adequate to safely sustain and withstand stresses and strains to which they will be normally subjected.
3. Connections shall be bolted except where welding is called for in the Drawings. Bolts shall be 3/4-inch diameter unless noted or required otherwise.

E. Expansion Anchors:

1. Expansion anchors shall be installed in holes drilled into concrete with carbide tipped drill bits conforming to ANSI B94.12-1977, using a rotary impact hammer for 1/2" and larger anchors, or a hammer drill for 1/4" and 3/8" anchors. Hole depth shall equal or exceed the anchor manufacturer's minimum recommended embedment. Should hole depth equal anchor manufacturer's minimum recommended embedment, hole shall be cleaned out by air pressure. The minimum hole depth table, following, serves only as a general guide; anchor manufacturer's recommendations shall govern. Contractor shall assure hole is perpendicular and conforms in size to anchor manufacturer's recommendations.
2. Washer and nut shall be assembled on anchor so that the top of the nut is flush with the top of the anchor. Then the anchor shall be driven into the hole through the work until the washer bears against the work. The anchor shall be expanded in accordance with the manufacturer's recommendations. Edge and end distances, and spacing of anchors, defined in the table hereinafter, shall be complied with.

3.03 WELDING

Welding procedures, welders and welding operators, both for shop and field welding, shall be qualified and certified in accordance with the requirements of AWS D1.1 "Welding in Building Construction" of the American Welding Society. Manufacturer's and fabricator's shop drawings shall clearly show complete information, and Contractor shall perform all field welding in conformance with this information, regarding location, type, size and length of all welds, all in accordance with AWS A2.0 "Standard Welding Symbols" of the American Welding Society. Special conditions shall be fully explained by notes and details

15029/7.19.2016
FASTENERS

MISCELLANEOUS METALS AND

3.04 HOT DIP GALVANIZING

A. All fabrication, galvanizing and repair shall comply with ASTM standards as they apply in accordance with the publication "ASTM Standards for Materials Hot Dip Galvanized After Fabrication, 198111 issued by American Hot Dip Galvanizers Association, Inc. In particular, the following specific standards shall apply to work under this contract: ASTM A-123, A-153, A-384, A-385, A-563 and A-780.

B. Items to be galvanized shall be fabricated in accordance with ASTM A-385-80

C. Galvanizing for fabricated steel items shall conform to ASTM A-123-78 and shall be done after fabrication. Steel assemblies shall be subject to safeguarding from warpage and distortion during galvanizing per ASTM A-384-76.

D. Galvanizing for structural steel-fasteners and hardware shall conform to ASTM A-153-80. Galvanized bolts, nuts and washers shall be centrifugally spun after galvanizing. Nuts shall have threads tapped oversize, after galvanizing, in accordance with ASTM A-563-80.

E. Upon field erection, any damage measuring more than 1/10 inch wide shall be repaired with a zinc-based solder or zinc rich paint in accordance with ASTM A-780-80. Marred, damaged, or uncoated areas 4 square inches and less shall be patched with a zinc based solder to a thickness of 5 mils; areas greater than 4 square inches shall be patched with an organic zinc rich paint to a dry film thickness of 9 mils. The paint shall have a minimum of 94% zinc dust in the dry film, Devcon Z, LPS Instant Cold Galvanized, or equal. The Resident Project Representative shall determine the extent of damage which would require recoating.

F. Items subject to distortion during transit, such as thin, curved members, etc., shall be stacked on edge and/or blocked to prevent radius change or other distortion while in transit to and from the galvanizing plant.

3.05 PAINTING

A. All steel items furnished under this section which are to be painted shall be shop coated with a universal primer, Koppers Pug Primer, Tnemec 77 Chem-Prime, Degraco #91453 Phenolic Primer, or equal. Refer to Section 09870 for finish painting.

B. Painting for items in contact with potable water supplies shall comply with all applicable AWWA Standards and the "State Health" regulations of the State of the Owner. Refer to Section 09870.

3.06 EXPANSION BOLT TABLE

SIZE, IN.	MINIMUM HOLE DEPTH, INCHES		RECOMMENDED TORQUE (STONE AGGREGATE CONCRETE) FT.-LBS.
	FLOOR/WALL (UNCLEANED HOLE)	CEILING (OR CLEANED HOLE)	
1/4			10 max.
3/8			25 - 35
1/2			45 - 65
5/8	Anchor Length Less Work Thickness Plus	Anchor Length Less Work Thickness.	80 - 90
3/4	Two Anchor Diameters.		125 - 175
7/8			200 - 250
1			250 - 300
1-1/4			400 - 500

Recommended spacing, edge distance, and end distance for Wedge Type anchors are given in the following table:

ANCHOR SIZE, INCHES	1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
Spacing Distance, 4-3/8-1/4-7-3/4 Inches	1-3/4	2-1/2	2-5/8	3-1/2	4-3/8	5-1/4	7	8-3/4
Edges & End 3-1/4-1/4-5 Distances, Inches Parallel or Away from Edge	1-1/2	1-3/4	2	2-1/2	3	3-1/2	4-1/4	5
Load Toward Edge 4-1/2-1/4-6-1/4	2	2-3/8	2-3/4	3-1/2	4	4-1/2	5-1/2	6-1/4

- END OF SECTION -

SECTION 05520**METAL FABRICATIONS****PART 1 - GENERAL****1.01 SCOPE OF WORK**

Furnish all labor, materials, and equipment required to construct and install metal fabrications as shown on the Drawings and specified herein. Included in this section are handrails, grating, nuts, and anchors.

1.02 RELATED WORK NOT INCLUDED

Concrete work is included in Division 3.

1.03 QUALITY ASSURANCE

A. All fabricated materials shall be of the highest quality, free of structural, handling, and workmanship defects.

B. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. All work under this section shall be governed by:

1. Specifications for the design, fabrication and erection of structural steel for building - American Institute of Steel Construction, 1978, including addenda.
2. Aluminum Construction Manual, Section 1, Specifications for Aluminum Structures - the Aluminum Association 1982.
3. All welding shall conform to the latest code of the American Welding Society.

D. Aluminum work shall be fabricated in a shop where the quality of work is in accordance with the highest standards for work of this type. All work shall be executed by mechanics skilled in the fabrication of aluminum, and shall be true to detail with sharp, clean profiles, fitted with proper joints and intersections and with finishes as specified.

E. All miscellaneous metal work shall be formed to shape and size with sharp lines and angles. Shearing and punching shall leave clean true lines and surfaces.

1.04 SUBMITTALS

A. Shop Drawings

1. The CONTRACTOR shall submit to the ENGINEER in accordance with Division 1, Section 01300 detailed shop drawings of all materials to be fabricated, and shall receive the ENGINEER's certification of review before fabrication. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor bolt installation by others. Include any requirements for surface preparation, paint products, or grout.
2. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties and other information needed for structural analysis. This shall not relieve the CONTRACTOR of responsibility for all errors, omissions, and deviations of his shop drawings from the Drawings and Specifications and from requirements of final results called for in the Drawings and Specifications.
3. The general design and dimensions of the miscellaneous metal work are indicated on the drawings, but the Contractor shall be responsible for the correctness of the details and dimensions of the finished articles. He shall verify conditions at the job before fabrication and coordinate the work with that of all other trades to prevent interference.

B. Samples: The CONTRACTOR shall submit 2 sets of representative samples of materials and finished products as may be requested by the ENGINEER, or as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel

1. Steel plates and structural steel shapes shall conform to ASTM Standard Specification for Structural Steel, Designation A36-77a.
2. Sheet steel shall be cold rolled or hot rolled carbon sheet steel conforming to ASTM Standard Specification for Steel, Carbon, Cold Rolled Sheet, Commercial Quality, Designation A36-72 or ASTM Standard Specification for Steel, Carbon (0.15 maximum, percent), Hot Rolled Sheet and Strip, Commercial Quality, Designation A569-72, as appropriate.
3. Steel fabrication shall be done in conformity with the "AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," Eighth Edition dated December, 1980, latest revisions and supplements.
4. Structural tubing, where used, shall conform to the requirements of ASTM A-500, Grade B, and the ends of the tubing shall be properly sealed to protect the internal surfaces. Steel anchor bolts shall be ASTM A-36 hot rolled threaded rod or bar stock. Structural steel members as required shall conform to Section 05120 "Structural Steel".
5. Base and bearing plates shall be provided where necessary to provide maximum bearing value of not more than 200 psi on solid concrete masonry units nor more than 750 psi on concrete and shall be grouted in place.

6. Prime and paint in accordance with Division 9, unless otherwise required or permitted.
7. Unless otherwise noted on the Drawings or in the Specifications, galvanizing shall be by hotdip process in accordance with ASTM A 525-81, Coating Designation G90 (previous Coating Class Commercial 1.25 oz. per sq. ft.).
8. Damaged zinc coating shall be repaired according to Federal Specification DOD-21035A (Galvanizing Repair Spec.) and ASTM A 780-80 as follows:
 - a. Remove foreign matter from both damaged and contiguous undamaged area by wire brushing and cleaning with metal conditioner recommended by cold galvanizing coating manufacturer.
 - b. Apply 2 coats of cold galvanizing coating to damaged area, ensuring an overlap of the surrounding undamaged galvanizing for continuity of galvanic protection. Cold galvanizing coating shall be Z.R.C. Chemical Products Co., "Z.R.C. Cold Galvanizing" or Galvicon Corp., "Cold Galvanizing," or equal.
9. Steel pipe shall conform to ASTM Standard Specifications for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless Designation A53-79.

B. Aluminum:

1. Aluminum work shall be fabricated of plates, rolled or extruded shapes, sheets or castings conforming (unless otherwise permitted or indicated) to the following alloy and temper designations of the Aluminum Association:
 - a. Structural rolled or extruded shapes 6601-T6.
 - b. Extruded shapes 6063-T6.
 - c. Castings 214.
 - d. Sheets 3003-F.
 - e. Bolts and nuts 2024-T4.
 - f. Aluminum railings 6063-T6.
2. The Contractor shall furnish the Engineer/Architect with mill certificates and a signed statement from the fabricator that all aluminum work furnished is of the proper alloys, as specified above.
3. All structural and miscellaneous aluminum shall be Alloy 6061 (Alloy 6063 for extrusions), Temper T6, unless otherwise noted, indicated or accepted by the Architect/Engineer.
4. Aluminum fabrication shall be in accordance with ASCE the Aluminum Association "Specifications for Aluminum Structures", latest revision. Welding shall be done by the argon-shielded tungsten-arch method or the automatic or semi-automatic argon-shielded consumable-electrode method, or equal. Welding rods and electrodes shall be in strict accordance with above specifications.

5. Where anodic coating is required and type is not specified or shown on the Drawings, coating shall be Class I, A44 integral color, to be selected by Architect. Anodic coatings shall conform to the following requirements:
 - a. Class I Anodized Coatings:
 - (1) The finish shall meet quality requirements of AAMA 611-89.
 - (2) The coating shall be continuous, uniform in appearance and free from powdery areas.
 - (3) Class I coating minimum of 0.7 mil thickness.
 - (4) Remove any factory applied protection films immediately after installation.
 - (5) Provide 20-year warranty.
 - b. Clear Anodic Coatings (Where Indicated): The exposed surfaces of aluminum shall be cleaned of all fabricating oils and foreign matter, given a medium caustic etch pretreatment and shall receive the following clear anodized finish.

No. 2: A minimum coating thickness of 0.0008 inch (0.0018 mm) and a minimum coating weight of 27.0 mg per square inch (215R1).

2.02 HANDRAILS

A. General

1. All handrail components and systems shall meet applicable federal and state regulations.
2. All handrails shall be the standard aluminum pipe handrail, unless otherwise noted on the Drawings.
3. Shop drawing submittals shall include verification that all components including base flanges, side mounting assemblies and anchor bolts can meet required strength capacities. Anchorages shall be identical to those shown on the Drawings or equal.
4. A vertical post sample with fittings and base connection shall be submitted for review and acceptance prior to preparation and submission of the shop drawings.

B. Standard Aluminum Pipe Handrail

1. Pipe for rails and posts shall be of 6063-T6 extruded aluminum with smooth standard mill finish. Scratches and discolorations uncommon to standard mill finish and sharp edges and rough surfaces shall be removed by rubbing with stainless steel wool lubricated with neutral soap solution.
2. Joints shall be welded and/or slip-on fitting type.

3. Welded joints shall be ground smooth, buffed and rubbed to a finish similar to the pipe.
4. Slip-on fittings shall be cast of magnesium aluminum alloy meeting Aluminum Association requirements for Alloy B-535.2 and furnished with stainless steel set screws. Fittings shall be "SpeedRail" and "NuRail" as manufactured by Hollaender Manufacturing Company, Cincinnati, Ohio, or equal.

C. Performance

1. Handrail system design, construction and installation shall meet or exceed all applicable Federal and State regulations. Handrail anchors, posts, rail and fabric shall be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail, with a minimum of deflection.
2. The manufacturer shall submit to the ENGINEER certified test data verifying the strength of his handrail system.

2.03 NUTS AND BOLTS

A. Unless otherwise shown on the Drawings or required in other parts of these Specifications, all nuts and bolts shall be in accordance with ASTM A 307-83a, Grade A and shall be electrogalvanized according to ASTM B 633-79a.

B. All nuts, bolts, washers and accessories in contact with water, in any moist atmosphere or damp area such as occurs above water, or embedded in concrete exposed to the weather, shall be Type 302 or 304 stainless steel. Stainless steel nuts, bolts, and washers shall be used to fasten aluminum to all materials including aluminum.

C. Other bolts, screws and washers shall be as follows:

1. Lag Bolts: Square head type, FS FF-B-561.
2. Machine Screws: Cadmium plated steel, FS FS-S-92.
3. Wood Screws: Flat head carbon steel, FS FF-S-111.
4. Plain Washers: Round, carbon steel, FS FF-W-92.
5. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.
6. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and type as required.
7. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.03 ALUMINUM GRATINGS

A. Gratings shall be the dimensions and at the locations as shown on the Drawings and as required to meet deflection specifications below and of aluminum Alloy 6063-T5, 6063-T6, or 6061-T6, or equal. Gratings shall be designed for an allowable uniformly distributed load of 200 lbs. per square foot and a concentrated load of 400 lbs. per foot of width with less than 0.25 inch deflection.

B. The metal grating, if applicable, shall be IKG Borden, or equal, aluminum swage locked grating. Grating shall be constructed with bearing bars placed edgewise and joined by straight cross bars. Bearing bars to be I-Bar configuration. The size and spacing of bars shall be determined based on the design loadings above and the span of the grating. The bearing bar shall be punched to receive the cross bar. Notching, slotting or cutting the top of the top or bottom flanges of the bearing bars to receive cross bars will not be permitted. Cross bars shall be secured to the main bearing bars by a swaging process to prevent turning, twisting or coming loose. Ends of cross bars to be trimmed flush with outside face of bearing bars. Trimming will be made in such a manner as to prevent destruction of swaged lock on bearing bar. Top surface of bearing bars shall have slip-resistant surface. Gratings shall be secured in place by at least four (4) stainless steel, removable-type hold down clips per panel.

C. If applicable gratings in concrete shall have aluminum angle frames with mitered corners and with welded joints ground smooth where exposed. The frames shall have welded anchors and shall be set in the concrete as it is placed.

2.04 ALUMINUM LADDERS

A. Aluminum ladders shall be furnished and installed at the locations shown on the Contract Drawings.

B. The ladders shall be constructed with side rails of 2-1/2" by 1/2" flat bar and brackets of 3" by 1/2" flat bar with rungs of 1" diameter bars, shouldered, driven through the side rails and peened. Maximum bracket support spacing shall be 5' - 0" on centers. The brackets shall be welded to the side rails. Rung spacing shall be 12" on centers. In general, the ladders shall extend to within 6" of the access opening. Ladders shall be constructed of 6061-T6 aluminum. Wedge type expansion anchors shall be used to attach aluminum ladders to walls as indicated on Contract Drawings.

2.05 ALUMINUM STAIRS

A. The aluminum stairs shall have structural aluminum channel stringers and supports, aluminum stair treads and platforms and sheet aluminum risers as indicated on the drawings and in the details.

B. The treads shall be formed from 1-3/4" thick aluminum tread and the risers shall be formed from .080" thick sheet aluminum. The treads shall be supported by and attached to 1-1/2" by 1-1/2" by 3/16" aluminum carrier angles bolted to the stringers. The treads shall be the widths indicated. The risers shall be bolted to the treads.

C. All platforms shall be fabricated of aluminum grating and shall be supported on the edges by structural aluminum angles and at the midspans by structural aluminum tees.

D. The treads and platforms shall have an acceptable nonskin pattern surface. Treads shall have a nosing.

E. The Contractor shall provide all structural aluminum angle hangers, struts, rod hangers, closure plates and brackets indicated or necessary to complete the stairs as indicated. The stair treads and grating shall be by the same manufacturer.

2.06 GUARD CHAINS

Removable guard chains at openings in aluminum pipe railings shall be fabricated from wrought, non-welded aluminum chain having 12 links per foot. The chains shall be secured to aluminum eyes bolted or welded to the pipe stanchion at one end of the opening. The free ends of the chains shall be provided with hooks formed from 1/4" diameter solid aluminum rod for attaching to similar eyes in the pipe stanchion at the opposite end of the opening.

2.07 GUARDRAIL SYSTEMS

A. Description: This section covers material requirements for corrugated sheet steel beams and accessories for guardrail, terminal sections, guardrail posts, offset blocks, end treatments and timber guard posts.

B. Beams and Accessories: Conform to AASHTO 180. Hardware for Type I, II or III beams may be either hot-dip galvanized, electrogalvanized, or mechanically galvanized. Galvanize according to AASHTO M 232. The Engineer will reject beams with zinc oxide (white rust) in amounts deemed objectionable. Furnish Type II beams of either Class A, 2.67 mm thick or Class B, 3.43 mm thick as specified in the Contract.

C. Terminal Sections: Conform to AASHTO M 180 and the details shown on the drawings. Galvanize sections after fabrication. Furnish Type 2 sections of either Class A, 2.67 mm thick or Class B, 3.43 mm thick as specified in the Contract.

D. Guardrail Posts: Provide either steel or timber and use the same type through the project.

1. Steel Guardrail Posts: Fabricate from steel conforming to AASHTO M 183 for the wide flange shapes and ASTM A 570 for C shapes except ensure that C shape posts have mechanical properties equal to those required by AASHTO M 183. Punch or drill holes for connector bolts before galvanizing. Galvanize all posts according to AASHTO M 111.
2. Materials for End Treatments: Conform to paragraph 2.07.B above for common components and, except where otherwise provided, ensure they are of the same class and type as required for the guardrail to which they are attached. Galvanize all non-corrosion-resistant metals used in end treatments according to AASHTO M 111 or AASHTO M 232 as applicable.

2.08 CONCRETE ANCHORS

A. Sizes and spacings or numbers of anchors shall be shown on the Drawings and materials shall comply with exposure requirements listed under Nuts and Bolts above. All anchors used for securing moving or vibrating equipment (pumps, motors, gears, sluice gates, conveyors, etc.), shall be of the cast-in-place type.

B. The size and number of anchors shall be approved by the equipment manufacturer.

C. Unless specifically noted otherwise on the Drawings or Specifications, concrete anchors for other applications shall be chemical grout-type anchors equal to Hilti "HVA Adhesive Anchor," or Ramset "Chemset Chemical Anchors." Installation shall be in strict accordance with the manufacturer's recommendations which shall be available on the job site.

2.09 MISCELLANEOUS FRAMING AND SUPPORTS

Provide miscellaneous steel framing and supports as required to complete the work. Fabricate miscellaneous units to the sizes, shapes, and profiles shown or if not shown, of the required dimensions to receive adjacent grating plates, louvers, vents, grilles, screens or other work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the work.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall be responsible for all errors, omissions, and deviations of the shop drawings from the Drawings and Specifications. Any errors or omissions shall be brought to the attention of the ENGINEER whose interpretation and instructions shall be received before proceeding with the fabrication of that portion of the work.

B. Similarly, manufacturers' printed installation instructions shall be strictly followed and any conflicts with the shop drawings and/or Contract Drawings shall be directed to the ENGINEER for resolution before proceeding with installation.

C. All base plates, inserts and anchorages shown embedded in concrete shall be accurately located and secured before placing concrete as per a manufacturer supplied template. All structural members and components shall be accurately leveled, plumbed and secured at locations shown on the Drawings.

D. Painting: Cleaning and painting of all fabricated materials shall be in strict accordance with Division 9, of these Specifications.

E. Steel

1. All fabrication and erection shall be done in conformity with the "AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," Eighth Edition dated December, 1980, latest revision.
2. Refer to Article 2.01.A of this Specification Section for repair of galvanized surfaces.

F. Aluminum

1. The contact surfaces of aluminum with steel, dissimilar materials, and/or masonry shall be protected from corrosion by a thick coating of coal tar, Koppers Bitumastic No. 50, or equal.
2. Aluminum surfaces embedded in concrete shall be protected from corrosion by a tightly adherent coating of 2 applications of zinc chromate primer.
3. Areas where the paint has been damaged by abrasion or other cause shall be cleaned and repainted as directed so that the aluminum will have a complete protective paint film when brought into contact with the material against which it is being protected. Before application of coating, the surface shall be cleaned of all dirt, heavy deposits of grease or oil, and other foreign substances and shall be immersed in or swabbed with an acceptable solvent. Next the surfaces shall be rinsed with clear water and thoroughly dried.
4. Where a shop coating of methacrylate lacquer has been specified on aluminum work to protect the surface from stain, the protective coating of lacquer worn off during handling or erection shall be replaced in the field by a new coating of lacquer of the same type.
5. During construction care shall be taken to prevent damage to the aluminum work from splashing or the accumulation of paint, concrete, mortar, or other similar materials.

3.02 FABRICATION AND INSTALLATION OF METAL WORK

A. General: All metal items shall be accurately fabricated and erected with exposed joints close fitting. All joints shall be of such character and so assembled that they will be as strong and rigid as adjoining sections. Joints shall be located where least conspicuous. Items shall have smooth finished surfaces except where otherwise shown or specified.

B. Built-In Items: Members or parts to be built in with masonry or concrete shall be in a form affording a suitable anchorage or shall be provided with approved anchors, expansion shields or other approved means of securing members.

C. Dissimilar Metals: Ferrous and non-ferrous metals shall be insulated at all contacts with felt washers, strips or sheets, bitumastic paints, or other acceptable means.

D. Connections:

1. All required anchors, couplings, bolts, and nut required to support miscellaneous metal work shall be furnished and installed as required.
2. Weights of connections and accessories shall be adequate to safely sustain and withstand stresses and strains to which they will be normally subjected.
3. Connections shall be bolted except where welding is called for in the Drawings. Bolts shall be 3/4" diameter unless noted or required otherwise.

E. Expansion Anchors:

1. Expansion anchors shall be installed in holes drilled into concrete with carbide tipped drill bits conforming to ANSI B94.12-1977, using a rotary impact hammer for 1/2" and larger anchors, or a hammer drill for 1/4" and 3/8" inch Hole depth shall equal or exceed the anchor manufacturer's minimum recommended embedment. Should hole depth equal anchor manufacturer's minimum recommended embedment, hole shall be cleaned out by air pressure. The minimum hole depth table following serves only as a general guide, anchor manufacturer's recommendations shall govern. Contractor shall assure hole is perpendicular and conforms in size to anchor manufacturer's recommendation.
2. Washer and nut shall be assembled on anchor so that the top of the nut is flush with the top of the anchor. Then the anchor shall be driven into the hole through the work until the washer bears against the work. The anchor shall be expanded in accordance with the manufacturer's recommendations. Edge and end distances and spacing of anchor table hereinafter, shall be complied with.

3.03 WELDING

Welding procedures, welders and welding operators, both for shop and field welding, shall be qualified and certified in accordance with the requirements of AWS D1.1 "Welding in Building Construction" of the American Welding Society. Manufacturer's and fabricator's shop drawings shall clearly show complete information and Contractor shall perform all field welding in conformance with this information regarding location, type, size and length of all welds, all in accordance with AWS A2.0 "Standard Welding Symbols" of the American Welding Society. Special conditions shall be fully explained by notes and details.

3.04 HOT-DIP GALVANIZING

A. All fabrication, galvanizing and repair shall comply with ASTM Standards as they apply in accordance with the publication "ASTM Standards for Materials Hot-Dip Galvanized after Fabrication, 1981" issued by American Hot-Dip Galvanizers Association, Inc. In particular, the following specific standards shall apply to work under this contract: ASTM A-123, A-153, A-384, A-385, A-563 and A-780.

B. Items to be galvanized shall be fabricated in accordance with ASTM A-385-80.

C. Galvanizing for fabricated steel items shall conform to ASTM A-123-78 and shall be done after fabrication. Steel assemblies shall be subject to safe guarding from warpage and distortion during galvanizing per ASTM A-384-76.

D. Galvanizing for structural steel fasteners and hardware shall conform to ASTM A-153-80. Galvanized bolts, nuts and washers shall be centrifugally spun after galvanizing. Nuts shall have threads tapped oversize, after galvanizing, in accordance with ASTM A-563-80.

E. Upon field erection, any damage measuring more than 1/10" wide shall be repaired with a zinc based solder or zinc rich paint in accordance with ASTM A-780-80. Marred, damaged, or uncoated areas 4 square inches and less shall be patched with a zinc based solder to a thickness of 5 mils; areas greater than 4 square inches shall be patched with an organic zinc rich paint to a dry film thickness of 9 mils. The paint shall have a minimum of 94% zinc dust in the dry film, Devcon Z, LPS Instant Cold Galvanized, or equal. The resident project representative shall determine the extent of damage which would require recoating.

F. Items subject to distortion during transit, shall be stacked on edge and/or blocked to prevent radius change or other distortion while in transit to and from the galvanizing plant.

3.05 MISCELLANEOUS METAL FABRICATIONS

A. Rough Hardware:

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Miscellaneous Steel Trim:

1. Provide shapes and sizes for profiles shown. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
2. Galvanize miscellaneous steel trim where indicated.

3.06 HANDRAILS

A. General

1. Refer to Article 2.02 this Section for types of handrails.
2. Shop drawings and handrail manufacturer's printed instructions shall be closely followed during handrail installation. Posts shall be installed plumb and rails parallel.
3. Required anchorages shall be strictly followed.

B. Workmanship

1. All rail and post cuts shall be square and accurate for minimum joint gap, clean and straight, and free of burrs and nicks.
2. In exterior and high humidity interior fabricated fitting installations, provision shall be made to drain entrapped water from inside the railing system to prevent electrolysis and/or damage from freezing. Manufacturer's printed instructions shall be strictly followed.
3. Welds and damaged areas shall be finished and coated according to Article 2 .02, this Section.
4. Where required, holes shall be drilled and countersunk the correct size for proper fit of all components.
5. In aluminum handrail systems where protection is applied for prevention of electrolysis from dissimilar materials, visibility of protective material shall be minimized.
6. Handrail system surfaces shall be protected from physical damage and discoloration during storage, assembly and installation. Manufacturer's coverings to protect anodized finishes shall be left intact until damage from construction operations no longer exists.

C. Rigidity

1. Posts shall be continuous from mounting surface to top rail.
2. Top and bottom rails shall be unspliced lengths between posts except as covered under expansion joints.
3. Railing manufacturer's instructions shall be strictly followed regarding torquing and tightening of fittings, and type and materials of fasteners.
4. Only stainless steel fasteners shall be used in aluminum installations, unless otherwise noted.

D. Expansion Joints

1. To prevent excessive stresses and misalignment in standard aluminum handrail systems, expansion joints and gaps shall be provided in top and bottom rails. Joints shall be located within 8 inches of posts and supports and the top and bottom rail joints shall be in vertical alignment. In fence-type handrail systems, top rail couplings shall be furnished with galvanized expansion compression spring as required in Part 2, this Section.
2. Where sleeve-type expansion joints are used, fasten only one side of sleeve to rail and allow other side of sleeve to slide on adjacent rail in standard aluminum handrail systems.
3. Gaps shall be provided according to the table below which is based on coefficients of expansion of 0.000013 inch/ °F for aluminum and 0.0000065 inch/°F for steel; a

temperature difference of 120 °F less the minimum listed temperature; and an expansion joints spacing of 24'-0" on centers for aluminum and 40'-00" on centers for steel. Where it is known that other temperature differentials and/or expansion joint spacings will be experienced, gap dimensions can be determined by: gap in inches = (coefficient of expansion) x (temperature difference from maximum to minimum) x (distance in inches between expansion joints).

EXPANSION JOINTS GAP TABLE

Temperature (°F) at Time of Installation	<u>Gap Dimension Required at Each Expansion Joint</u>	
	Aluminum Railing with Expansion Joints on 24'0" Centers	Steel Railing with Expansion Joints on 40'0" Centers
20 to 0	1/2"	7/16"
0 to 20	7/16"	3/8"
20 to 35	3/8"	5/16"
35 to 50	5/16"	1/4"
50 to 70	1/4"	1/4"
70 to 90	3/16"	3/16"
90 to 120	1/8"	1/8"

3.07 NUTS AND BOLTS

A. Bolts embedded in concrete shall be secured with templates at the time of pouring concrete. Bolts shall be suitably protected from damage throughout the construction period.

B. Damaged galvanized surfaces on nuts and bolts shall be repaired according to Article 2.04, this Section.

3.08 CONCRETE ANCHORS

Concrete anchors shall be installed strictly in accordance with manufacturer's printed instructions which shall be available on the job site.

- END OF SECTION -