SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Free-standing railings at steps.

D. Balcony railings and guardrails.

E. Roof Railings:

1. Remove existing parapet wall/metal railings including chain link fence and sleeves. Removal of existing railing shall be performed as per lead abatement protocols in Division 2.
2. Remove existing reinforced concrete curb/beam as shown on drawing. Provide scaffold with working platform and enclosures during demolishing and reconstruction of railing and concrete curb/beam. Protect people and properties from falling debris.
3. Remove existing spandrel waterproofing and caulking. Removal of spandrel waterproofing and caulking shall be done as per asbestos abatement protocols per Division 2.
4. Remove roofing including roof cant and base flashing as shown on drawing. Removal of base flashing shall be done according to asbestos abatement protocols in Division 2.
5. Provide temporary flashing as shown on drawings at all exposed edges of existing roofing membrane. Install the flashing hot mopped in such a manner as to preclude any possibility of water infiltration into the existing roofing system and/or the spaces below the place of work.
6. Build concrete curb/beam as shown on Drawings and as specified. Spandrel waterproofing shall be installed as shown on the drawings.
7. New roof railings; including all rails, posts, and sleeves along perimeter of roof of all buildings as shown on drawings.
8. Steel base plate for stub.
9. Light steel framing, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on drawings or as required to complete each item of work of this Section, not included as part of work of other trades.
10. Galvanizing and separation of dissimilar metals for work of this Section.
11. Cutting, fitting, drilling and tapping work of this Section to accommodate work of other Sections and of concrete, masonry or other materials as required for attaching and installing work of this Section.
12. Provide temporary protections to all work areas at roof and surrounding existing roofing from water infiltration and other damage as a result of work of this section.
13. Contractor shall work on a roof of a building only after entry on to the roof is prohibited to residents or general public by installing sturdy enclosure around roof bulkhead as directed by Authority's Representative. The enclosure shall be built in such a way that it does not damage the roofing and bulkheads, and is not passable by residents or general public. The enclosure shall be maintained until the contract work is completed. Contractor shall be responsible for controlled access and protection from the open roof during entire new railing installation.
14. Contractor shall provide temporary but sturdy barrier at edge of roof where existing sections of parapet wall/railing are removed as directed by Authority's Representative until permanent roof railing under this Contract is installed. The barrier shall be built in such a way that it does not damage the existing roofing and roof deck and is not passable by residents or general public.

1.02 GENERAL REQUIREMENTS

A. All work shall conform to the latest industry practices and standards as applicable. Install all materials as per manufacturer's instructions.

B. All repair work shall be performed by competent workers trained and experienced in the particular type of work.

C. Roof Railings - Do not work on more than two (2) buildings at a time.

D. Deviations from the plans and specifications shall not be made without the written approval from Authority's Representative and architect and/or engineer of NYCHA.

E.

1.03 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.

C. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this section.

D. Section 05 51 00 - Metal Stairs: Attachment plates for handrails specified in this section.

E. Section 06 20 00 - Finish Carpentry: Wood handrail.

F. Section 08 80 00 - Glazing: Glass baluster infill.

G. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

H. Section 09 91 13 - Exterior Painting: Paint finish.

I. Section 09 91 23 - Interior Painting: Paint finish.

J. Section 10 14 00 - Signage: Photoluminescent markings.

1.04 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.

C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

E. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

J. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011.

K. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

L. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

M. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.

N. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010.

O. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications; 2013.

P. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.

Q. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

R. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.

S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

T. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

U. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.05 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication. Do not delay job progress. Allow for trimming and fitting when taking field measurements before fabrication that might delay work.

B. Shop Assembly: 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 re-assembly and coordinated installation.

C. Reference Standards: The work is subject to requirements of applicable portions of the following standards:
   1. "Manual of Steel Construction", American Institute of Steel Construction.
   2. AWS D1-1 "Structural Welding Code", American Welding Society.
   3. SSPC SP-3 "Surface Preparation Specification No. 3, Power Tool Cleaning", Steel Structures Painting Council.
   4. SSPC PA-1 "Painting Application Specification", Steel Structures Painting Council.
   5. "Handbook on Bolt, Nut and Rivet Standards", Industrial Fasteners Institute.

D. Sample railing installation and testing:
   1. Construct a railing sample with/without concrete curb, (Roof Railings) comprises all railing components, for Authority's Representative visual examination, for quality control, and performance of required testing.
   2. Install the sample in strict accordance with approved shop drawing(s). The length of sample railing shall be as directed by Authority's Representative.
   3. Authority's Representative will review technical aspects; surface preparation, and workmanship.
   4. Do not alter, move, or destroy approved sample until Work is completed and approved by Authority's Representative.
   5. Approved sample will be standard for judging workmanship on remainder of Project.
   6. Obtain Authority's Representative's written approval for sample installed

1.06 SUBMITTALS

A. General:
   1. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   2. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

3. Samples: Submit two, ____ inch long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.

B. Roof Railings:
1. Manufacturer's Literature: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.
2. Shop Drawings:
a. Shop drawing showing locations of new posts along entire perimeter with required dimension.
b. Shop drawings for the fabrication and erection of all assemblies of miscellaneous ironwork. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1-0" scale. Show anchorage and accessory items.
c. Shop drawings must be approved by NYCHA prior to any fabrication or installation.
d. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld, weld and tack weld are not acceptable.
3.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Handrails and Railings:
1. Alumi-Guard; ____; ____: www.alumi-guard.com/sle, or approved equal.
2. C.R. Laurence Co., Inc; CRL Welded Post Railing Systems (WRS): www.crl-arch.com. or approved equal.
3. Kee Safety, Inc; Kee Klamp (steel): www.keesafety.com. or approved equal.
4. KaneSterling; ____: www.sterlingdula.com. or approved equal.
5. The Wagner Companies; ____: www.wagnercompanies.com. or approvbed equal.
6. _____.
7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Non-Weld Pipe Fittings:
1. Kee Safety, Inc; Kee Klamp (steel): www.keesafety.com. or approved equal.
2. _____.
3. _____.
4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Metal Rail Infill:
1. The Western Group; Woven Wire: www.architecturalwire.com. or approved equal.
2. _____.
3. _____.
4. Substitutions: See Section 01 60 00 - Product Requirements.

D. Photoluminescent Handrail Strips:
1. Safe-T-Nose, LLC; _____: www.safetnose.com. or approved equal.
2. _____.
3. _____.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
   2. Top Rails and Wall Rails: Wood rails, specified in Section 06 20 00.
   3. Intermediate Rails: 1-1/2 inches diameter, round.
   4. Intermediate Rails: 1-1/4 by 1 inch rectangular.
   5. Posts: 1-1/2 inches diameter, round.
   6. Posts: 1-1/2 inches square.
   7. Balusters: 1/2 inch square solid bar.
   8. Infill: _____.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
   2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
   3. For anchorage to stud walls, provide backing plates, for bolting anchors.
   4. Posts: Provide adjustable flanged brackets.

G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

H. Photoluminescent Handrail Strips: Manufacturer's standard clear anodized aluminum extrusion with embedded photoluminescent strip, complies with UL 1994 and ASTM E2072.
   1. Attachment: Provide manufacturer approved field applied adhesive, factory applied adhesive, and mechanical fasteners.
   2. Products:
      a. _____.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ALUMINUM MATERIALS

A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

B. Aluminum Tube: Minimum wall thickness of 0.127 inch; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

C. Solid Bars and Flats: ASTM B211 (ASTM B211M).

D. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

E. Welding Fittings: No exposed fasteners; cast aluminum.

F. Straight Splice Connectors: Concealed spigot; cast aluminum.

G. Exposed Fasteners: No exposed bolts or screws.

H. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

2.04 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.

C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

E. Exposed Fasteners: No exposed bolts or screws.

F. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

G. Straight Splice Connectors: Steel concealed spigots.

2.05 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Install continuous plastic handrail cover. Heat weld joints and trim smooth.

2.06 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

C. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

D. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.

E. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 Integrally colored anodic coating not less than 0.4 mils thick.

F. Class II Color Anodized Finish: AAMA 611 AA-M12C22A34 Electrolytically deposited colored anodic coating not less than 0.4 mils thick.

G. Pigmented Organic Coating System: AAMA 2603 polyester or acrylic baked enamel finish.

H. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system.

I. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.

J. Color: To be selected by Architect from manufacturer's standard line.

K. Color: As shown on drawings.

L. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 ROOF RAILINGS

A. Materials:
   1. Metals

a. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
b. Stainless Steel Sheet: ASTM A666
c. Steel Plates, Shapes and Bars: ASTM A36.
d. Steel Tubing: Cold formed, ASTM A500; or hot rolled, ASTM A501.
e. Railing assemblies including rails, posts and stubs shall be hot-galvanized pre-galvanized in the shop in accordance with ASTM A-123, A-143, A-153, A-384 and A-385.
f. Steel Pipe: ASTM A53, type and grade selected by fabricator and required for design loading, galvanized. Standard weight, Schedule 40, unless indicated. All steel pipe to be primed and painted, as per section 09 91 00, unless otherwise noted.
g. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

2. Grout: Setting compound for posts shall be non-shrink cementitious grout such as Masterflow 713 Grout by BASF, or equivalent.
3. Fasteners
   a. General: Provide zinc-coated fasteners for exterior use. Select fasteners for the type, grade and class required. All fasteners shall be tamper-proof type when exposed.
   b. Bolts and Nuts: Regular hexagon head type, ASTM A307, Grade A.
   c. Machine Screws: Cadmium plated steel, ASME B18.6.3.
   d. Plain Washers: Round, carbon steel, ASME B18.22.1, galvanized.
4. Anchors for post base plate
   a. General: As indicated on drawing, provide stainless steel anchors. Anchors shall be AISI Type 316 stainless steel provided with s. s. nuts and washers of matching alloy group. Avoid contact of s. s. anchors with galvanically dissimilar metals.
   b. Stainless steel bolts: Regular hexagon head type, ASTM F593.
   c. Stainless steel nuts: ASTM F594.
5. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.
6. Galvanize Repair Coating: For touching up galvanized surfaces, provide Z.R.C. Cold Galvanizing Compound by Z.R.C. Chemical Products Co. or approved equal.

B. Prime Painting (if indicated in the Contract):
1. Scope: All ferrous metal shall be cleaned and shop painted with one coat of specified ferrous metal primer using Series 88 Azeron Primer made by Tnemec or approved equal.
2. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning: for cleaning of ferrous metals which are to receive shop prime coat.
3. Application
   a. Apply shop prime coat immediately after cleaning metal and within 12 hours of Hot-Dip galvanizing by process of primergalv in the shop. Apply paint in dry weather and under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.
   b. Paint surfaces which will be concealed after shop assembly shall be painted prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinner, adulterants or admixtures shall be only as stated in said instructions.
   c. Paint shall uniformly and completely cover metal surfaces, 2.0 mils minimum dry film thickness. Finished coat of railing assembly shall be gray color matching color of railing at buildings #1 thru #4. No work shall be shipped until the shop prime coat has dried.
4. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

5. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

C. Galvanizing:
   1. Scope: All ferrous metal exposed to the weather, or indicated on drawings or specified to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication.
   2. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.
   3. Application: Hot-dip galvanizing shall be applied in accordance with:
      a. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. ASTM A153: Galvanized Coating on Iron and Steel Hardware - Table 1.
      c. ASTM A446: Galvanized Coating on Steel Sheets.
      d. Minimum weight of galvanized coating shall be two (2) oz. per sq. ft. of surface.
   4. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.
   5. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.
   6. To minimize surface imperfections, material to be galvanized shall be dipped in a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.
   7. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.
   8. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. If not, the piece shall be rejected and replaced to the acceptance of the Authority's Representative

D. Protective Coatings:
   1. Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one coat of specified bituminous paint, which shall be in addition to the specified shop prime paint. Mask off those surfaces not required to receive protective coating.
   2. Provide additional separation between dissimilar metals as noted on the drawings or as required by Authority's Representative.

E. Wormanship:
   1. General
      a. Metal railing work shall be fabricated by an experienced fabricator or manufacturer and installed by experienced workers.
      b. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings and specifications, approved shop drawings, and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected.
      c. All work shall be accurately and neatly fabricated, assembled and erected.
   2. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop, in largest practical sizes to minimize fieldwork. It is the responsibility of the Contractor to assure him/herself that the shop-fabricated metal railing items will properly fit the field condition. In the event that shop-fabricated items do not fit the field condition, the item shall be returned to the shop for correction.
   3. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.
   4. Holes: Drill or cleanly punch holes; do not burn.

5. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Authority's Representative.
    a. Welding
        1) Shall be in accordance with "Standard Code for Welding in Building Construction" of the American Welding Society, and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.
        2) Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
        3) All welds on or behind surfaces which will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.
    b. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.
6. Operating Mechanism: Operating devices (i.e. pivots, hinges, etc.) and hardware used in connection with this work shall be fabricated, assembled, installed and adjusted after installation to operate smoothly, freely, noiselessly and without excessive friction.
7. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items specified under this Section of the Specifications to be built into concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.
8. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.
9. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.
10. Exposed Work
    a. In addition to requirements specified herein and shown on drawings, all surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, butts, and other defects which mar appearance of finished work.
    b. Metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.
    c. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

F. Metal Railing Items:
1. Furnish and install roof railings along the perimeter of the building roof as per the Drawings and as specified below.
2. Fabricate items to sizes, shapes and dimensions required.
3. All rails, posts and sleeves shall be Hot-Dip Galvanized steel conforming to ASTM A-123.
4. The clear space between concrete curb/slab top and bottom rail, between consecutive subsidiary posts, and between subsidiary post and adjoining main post shall not be more than 4". The height of the railing shall be shown on drawing.

5. All joints shall be fully shop welded 1/8” fillet and smooth. The exposed cross sections of cut pipes and the weld locations of the assembled railing shall be fully coated with zincrich paint.
6. The posts shall be spaced at maximum 5’-0” on centers. The spacing between the end post and adjoining post on each side in both segment shall be equal and not more than 3’-0”. All end post shall start from the roof corners. Locate all posts in one straight line in each segment.
7. Expansion sleeves shall be 3-1/2” long and outside diameter of sleeves shall be such as to fit tightly inside the rails. All the railing panels shall be connected to each other with expansion sleeves at top and bottom rails.

G. Miscellaneous Steel Framing:
1. Steel framing, bracing, supports, framing, clip angles, shelf angles, plates, etc., shall be of such shapes and sizes as indicated on the drawings and details or as required to suit the condition and shall be provided with all necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and all other connecting and adjoining work.
2. All steel framing steel shall be furnished and erected in accordance with the applicable requirements of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings: by the American Institute of Steel Construction and as specified herein.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSPECTION

A. Examine the areas and conditions where railing is to be installed and notify the Authority’s Representative of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.03 ERECTION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of metal railing fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors for items which are to be built into concrete, masonry, or similar construction.

C. Fitting Connections: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

E. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

F. Field Touch-Up of Galvanized Surfaces: Touch-up shop applied galvanized coatings damaged during handling and installation. Use galvanizing repair coating specified herein for galvanized surfaces.

3.04 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.05 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.06 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.07 SCHEDULE

A. Stairs A and B: Flat steel bar railing system, plastic handrail cover, primed finish.

B. Stair C: Aluminum pipe railings, high performance organic finish.

END OF SECTION